The New Evidence Scholarship: Analyzing the Process of Proof

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THE NEW EVIDENCE SCHOLARSHIP: ANALYZING THE PROCESS OF PROOF†

RICHARD LEMPERT*

I. EVIDENCE SCHOLARSHIP: FROM RULES TO PROOF

When I began teaching evidence seventeen years ago, the field was moribund. The great systematizers of the common law—Wigmore, Maguire, McCormick, Morgan and their ilk—had come and, if they had not all already gone, their work was largely finished. Not only was most of what passed for evidence scholarship barely worth the reading—the same, after all, could be said of many fields of law at most times—but disregarding student work, few scholars were writing regularly on evidentiary matters.

This situation changed with the proposal and adoption of the Federal Rules of Evidence. New talent was attracted to the field of evidence and lead articles on evidence proliferated in the law reviews. Too often, however, these articles followed the model "What's Wrong with the Twenty-Ninth Exception to the Hearsay Rule and How the Addition of Three Words Can Correct the Problem." They were seldom interesting and if they had potential utility it was rarely realized, for the federal rules remain today largely as they were when enacted.2 The work was, in short, a timid kind of deconstructionism with no overarching critical theory to give it life. But the interest in evidence inspired by the federal rules, even if rarely revealed in memorable work on that topic, was all to the good. Genuinely talented people have become excited about exploring evidentiary issues.

Today I think we are seeing the fruits of this burgeoning of interest and the talent it has attracted. Evidence is being transformed from a field concerned with the articulation of rules to a field concerned with the process of proof. Wigmore's other great work is being rediscovered,3 and disciplines outside

† © 1986 by Richard Lempert.
* Professor of Law & Sociology, University of Michigan Law School. J.D. 1968 University of Michigan Law School; Ph.D. 1971 University of Michigan. I am grateful to the following people for reading and commenting on a draft version of this paper: Stephen Burbank, Stephen Fienberg, David Kaye, Donald Regan, David Schum, Peter Tillers and Judith Thomson. The usual disclaimers of mentor responsibility apply; in some instances with more than the usual degree of force.
1 This title not only suggests the focus of the type of scholarship I am thinking about but also typifies it in length and lack of grace.
2 Some of this work may have influenced state codifications or judicial constructions of ambiguous language. Such an impact—if it occurred—is a genuine contribution that I do not denigrate. It reminds us that scholarship may be valuable without being interesting.
3 J. WIGMORE, THE SCIENCE OF JUDICIAL PROOF AS GIVEN BY LOGIC, PSYCHOL-
the law, like mathematics, psychology and philosophy, are being plumbed
for the guidance they can give.\textsuperscript{4}

This symposium is a testimony to this third wave (in my teaching lifetime)
of evidence scholarship; indeed, nowhere is the concern for proof more
central than in that body of scholarship which seeks to build on or criticize
mathematical models as modes of proof or as a means of understanding trial
processes. What I propose to do in this paper is, first, discuss briefly the
ends to which this body of work is directed. Then, I shall develop some
themes, stimulated by a portion of Professor Allen's paper and by the larger
literature, including other papers prepared for this symposium, of which it is
a part. Finally, since this paper originated in an invitation to comment on
Professor Allen's contribution to the symposium, I shall examine closely
Professor Allen's suggestion that rather than rethink our mathematics we
should reconceptualize trials.

II. THE USE OF MODELS

The literature that relates theories of probability to theories of proof is
largely a debate between those who advocate some role for Bayesian modes
of inference in understanding or applying the law and those who criticize or
reject this position.\textsuperscript{5} The language of the debate is often mathematics or
essentially mathematical metaphors, but in this case the abstraction of
numbers does not preclude considerable passion. The passion suggests that
something important is at stake. In fact, there are a variety of stakes, and

\textsuperscript{4} I realize that broad-brush painting of the kind I have done thus far calls out for
detailed support by citation in the law review tradition. However, as an invited
commentator in a symposium, I think the essayist tradition which does not demand
detailed footnoting of what most people know is not out of place and has much to
commend it. Citation to the works of the great common law critics and synthesizers is
unnecessary for anyone who knows anything about evidence, and I would not cite
authors of "Twenty-Ninth Exception" type articles in any event, for there is no
virtue in embarrassing people or in creating unnecessary enemies. I shall discuss a
major body of "process and proof" type work in what follows. Among the work I
could cite under this head let me simply note the work on presumptions by Ronald
Allen, see, e.g., Allen, Structuring Jury Decisionmaking in Criminal Cases: A
Unified Constitutional Approach to Evidentiary Devices, 94 Harv. L. Rev. 321
(1980), and Charles Nesson, see, e.g., Nesson, Reasonable Doubt and Permissive
Inferences: The Value of Complexity, 92 Harv. L. Rev. 1187 (1979), to emphasize
that transforming the focus of evidence scholarship from rules to proof does not
exclude familiar modes of doctrinal legal scholarship.

\textsuperscript{5} Frequentists—the Bayesians' usual antagonists in discussions of the utility of the
Bayesian approach to statistics—are generally non-participants in the discussion. But
see Cohen, Confidence in Probability: Burdens of Persuasion in a World of Imperfect
what is in issue has important implications for the conflicting positions. Too often, however, the stakes are not sorted out, and our ability to assess the relative merits of Bayesian and other approaches to the problem of proof suffers as a result. Thus, our first step is to ask why a particular conceptualization of the proof process is being used or advocated. As Professors Schum\(^6\) and Tillers\(^7\) have suggested in the papers they prepared for this symposium, some conceptualizations will be better suited for certain purposes than others.

A. A Prescription for Action

The article which triggered widespread interest in the applicability of Bayesian reasoning to trial processes—and arguably still accounts for residual passion—was the comment of Finklestein and Fairley on People v. Collins,\(^8\) in which they argued that the real problem in that case lay not in the prosecutor's attempt to use statistical reasoning but in his failure to offer the jury statistical information in the form best suited to its decision-making task—i.e., Bayes's Theorem.\(^9\) Professor Laurence Tribe, in his justly cele-

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\(^8\) 68 Cal. 2d 319, 438 P.2d 33, 66 Cal. Rptr. 497 (1968) (en banc).

\(^9\) Finkelstein & Fairley, A Bayesian Approach to Identification Evidence, 83 HARV. L. REV. 489 (1970). This was not the first article in the legal literature to suggest the applicability of Bayes's Theorem to trial proof. See Cullison, Probability Analysis of Judicial Fact-Finding: A Preliminary Outline of the Subjective Approach, 1 TOL. L. REV. 538 (1969); Kaplan, Decision Theory and the Factfinding Process, 20 STAN. L. REV. 1065 (1968). See also Ball, Moment of Truth: Probability Theory and Standards of Proof, 14 VAND. L. REV. 807 (1961). However, these earlier discussions did not benefit from either the interest in probability theory engendered by People v. Collins or from making claims so bold and questionable as to arouse the interest of an antagonist as formidable as Laurence Tribe.

There is another more autobiographical sense in which the Finklestein and Fairley article together with Tribe's response helped generate some of the debate that followed. In the winter of 1972 I taught a seminar on problems in trials and proof to five students at the Yale Law School. We spent several weeks on the Bayesian debate, teaching ourselves Bayes's Theorem largely from the footnotes to the two articles. One conclusion we reached was that while Tribe had won the debate on the advisability of instructing jurors in Bayes's Theorem, the theorem had substantial potential as a model of legal standards and processes of proof. Half the members of that seminar—if I may consider myself a member—went on to publish articles reflecting this belief. Daniel Kornstein authored an article entitled A Bayesian Model of Harmless Error, 5 J. LEGAL STUD. 121 (1976), and I wrote Modeling Relevance, 75 MICH. L. REV. 1021 (1977). By far the most important member of this group was David Kaye, whose numerous contributions figure prominently in discussions of Bayes’s Theorem, statistics, and trial processes, as can be seen from the many citations to his work in this symposium issue.
brated article *Trial by Mathematics*, took issue with Finklestein and Fairley on both counts.

Among legal academics it is generally agreed that Tribe won this particular debate. As Professor Allen writes in his contribution to this symposium, "It is becoming increasingly obvious, for example, that Bayesian approaches can best be used heuristically as guides to rational thought and not as specific blueprints for forensic decisionmaking." This conclusion, is however, premature. Statistical evidence has figured in litigation for more than a century, and in recent years has become increasingly common and complex. For example, a recent LEXIS search of statistical terms done for the National Research Council reports:

A search of published opinions in federal courts with a computer-based legal information retrieval system reveals the dramatic growth since 1960 in cases involving some form of statistical evidence. Between January 1960 and September 1979 the terms 'statistic(s)' or 'statistical' appeared in about 3,000 or 4% of 83,769 reported District Court opinions. In the Courts of Appeals, the same terms appeared in 1,671 reported opinions.

These uses include not only statistical descriptions of samples and populations, but also uses of the kind Finklestein and Fairley proposed—as identification evidence. With both sorts of uses problems arise because juries are presented with frequentist statistics in situations where Bayesian approaches may be more appropriate to the task at hand.

I shall not dwell on this issue except to make one point. Many participants

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12 It is, I should note, a view I once shared. See Lempert, supra note 9, at 1021.
16 Examples include efforts to identify the accused as the criminal through blood traces or hair samples. (The statistical basis of hair sample identifications is, I should note, suspect. See id. at 79-82.) Other kinds of identification evidence like fingerprints also depend on statistical inferences but the reliability of these tests is thought to be so high that their statistical base may be neglected.
17 Lempert, *Statistics in the Courtroom: Building on Rubinfeld*, 85 Colum. L. Rev. 1098 (1985); see supra note 15 and accompanying text.
in this symposium paint with a broad brush in rejecting any place for Bayesian models in trial processes. Often their arguments, or portions of their arguments, read as if statistical evidence has no place at all in trials. Those who criticize Bayesian models of the legal process and the suggested application of Bayesian approaches at trial must confront the reality that statistical evidence is offered in trials every day.

I do not mean to argue that this reality cannot be accommodated by critics of Bayesian models or proposed applications. It is not difficult to imagine a place for statistical evidence in a theory that focuses, as do most non-Bayesian theories of rational proof, on the relative weight of conflicting evidence, the plausible generalizations that trial evidence allows, or the coherence of evidence with some larger plausible story. More difficult challenges for those who reject the Bayesian perspective are to explain why, if statistical evidence is presented at trials, frequentist approaches should be preferred to Bayesian ones, and to reevaluate arguments used to reject Bayesian approaches to proof where they do not accommodate the reality of the regular use of statistical evidence. Thus, arguments from the intuition that the law will not allow verdicts to rest on naked statistical evidence must accommodate or condemn a world in which the only admissible evidence of discrimination is embodied in a statistical model, or where the only admissible evidence linking the defendant to a crime is a hair match. If the answer is, as it appears implicitly to be in the case of fingerprint evidence, that the statistical probabilities are sufficiently high as to be unproblematic, an explanation is required of why one level of irreducible and undeniable uncertainty is tolerable and another is not.

B. Normative Models

A second use that may be made of Bayes’s Theorem and of competing probabilistic schemes is as a normative model. This use is not completely

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19 Even this may not be essential for those who reject Bayesian models of the proof process. Some role for a Bayesian presentation of evidence may be nested within a more encompassing non-Bayesian theory.

20 Ordinarily the latter type of evidence will not be naked because some of the evidence that led, for example, to the decision to take a hair sample from the suspect will be admissible. But such statistical evidence may be naked when the evidence that leads to the suspect’s arrest is not admissible or when, as in the case of fingerprints, “trace” evidence, the weight of which can only be evaluated statistically, is all that allows the suspect to be identified. Moreover, even where the statistical evidence is not naked, it may so far outweigh all other evidence in the case that it is clearly both crucial and dispositive. Where this is clear, one must confront the fact that the trier is relying on statistical evidence despite the irreducible and undeniable uncertainty that such evidence entails, thus posing the core problem of naked statistical evidence.
distinct from the first use I have discussed, as those who advocate instructing factfinders on Bayes’s Theorem do so on the assumption that Bayesian reasoning is normatively appropriate for legal factfinding. Attacks on Bayes’s Theorem as a normative model may be similarly motivated by the perception of a link between the status of Bayes’s Theorem as a normative model for trial factfinding and the appropriateness of furnishing jurors with the information needed to reason in a Bayesian fashion. In part to preclude any movement in the latter direction, critics of “trials by mathematics” deny the possibility that Bayes’s Theorem may be a normative model of how trial factfinders should proceed.

The practical consequence of promoting Bayesian approaches at trials does not, however, follow from accepting Bayes’s Theorem as a normative model for adjudicative factfinding. First, there may be competing norms. Bayes’s Theorem may model only part of the reaction we expect jurors to have to information, and emphasizing the Bayesian part may have adverse consequences for other values. The right of juries to nullify, for example, suggests that jury factfinding is valued for reasons that extend beyond the rational weighing of evidence. Encouraging jurors to be more Bayesian may cause them to emphasize the rational, evidence-weighing aspect of their task to the detriment of other aspects we wish to preserve. Going further and providing jurors with aids to Bayesian information processing (imagine jurors of the future punching into a computer their prior probabilities and likelihood ratios after each item of evidence) or even failing to provide jurors with more than statistical evidence may symbolically—and intolerably—denigrate messages we wish to convey about trials or human judgment.21

A second reason why Bayesian normativity does not necessarily suggest the desirability of changing current modes of proof is that it may be impossible to provide jurors with the information they need to process information in a Bayesian rational fashion. In particular, we may not be able to inform jurors adequately concerning those prior probabilities that provide the basis for assimilating new information, or about the degree of dependency among various items of evidence. The move usually made by Bayesian advocates to deal with this problem—to allow subjective estimates of these hard (perhaps impossible) to quantify values—is not necessarily sound, for obvious “second-best” problems are raised. Strictly Bayesian decisions with inaccurate priors or mistaken estimates of evidentiary dependency may lead to worse decisions, by the criteria of full-information Bayesian rationality, than the decisions jurors would reach through ordinary unsystematic and non-mathematical processes.22


22 In this connection it is important to note that a juror’s information processing is not in an important sense fully personalistic. Thus, in deciding how to instruct the jury we do not function, for example, as decision theorists trying to aid a client with
A different second-best problem arises if, as is clearly the case, people are not natural Bayesian decisionmakers. While a factfinder's entire decision-making process might be more rational in the sense of yielding, on the average, more accurate verdicts if the entire case could be presented an investment decision. The theorist can tell the client that if he estimates probabilities in a particular way, a certain decision is a wise one. Since the client is deciding for himself, it is appropriate for him to live with his estimates; he can hardly be heard to complain that he would have done better had he followed an apparently less rational way of combining information because his probability estimates were not accurate. Given what he believed at the time, his action was the best thing for him to do. A juror, however, is deciding for someone else and society must live with the juror's errors. Thus the juror's probability estimates may be subjective but they are not personal in the sense that the resulting decision is the best thing for him to do. The law is not interested in what is most satisfying or wisest for the juror, but only in accurate verdicts, leavened perhaps by other value considerations. While it may be appropriate to hold individuals deciding for themselves to the perverse consequences that sometimes attend second-best solutions, the law in deciding whether a particular kind of reasoning should be promoted cannot escape the need to evaluate fully the consequences of introducing an irreducibly subjective element.

A committed Bayesian subjectivist might argue that there is no such thing as an objective probability or that objective probabilities exist only in those limited circumstances where a known mechanism randomly generates outcomes from a larger set. It is clear, however, that for some purposes some probability estimates are better than others. A person who bets on outcomes of tosses of a fair coin will, for example, lose money if he gives odds based on the prior expectation that the coin has a $2/3$ chance of coming up heads. Indeed, I would argue that working from a "realistic" prior, whether held initially or derived retrospectively by induction, is in law and most other settings an important ingredient of rational thought. For example, a juror who believes at the outset of litigation that the odds are 100:1 that a tort plaintiff injured himself through his own negligence would not be deciding the subsequent case rationally within the meaning of the law even if he used a perfectly Bayesian approach to evaluate all further items of evidence. The factfinder would from the law's standpoint be similarly irrational if in applying Bayes's Theorem the evidentiary value accorded the information entering the likelihood ratio were untenable. Rationality in law, I am arguing, involves a "sensible" view of the weight to be accorded information and not just the process of combining subjectively weighted evidence according to a scheme that meets the criteria of some normative model—like Bayes's Theorem—of rational decisionmaking. When I speak of a "realistic" view of a prior probability or a "sensible" view of the weight to be accorded information, I mean a view which, if information is rationally combined, will lead to a verdict that given the evidence presented is likely (i.e., is a good bet) to describe the situation the factfinder is charged with reconstructing.

statistically with accurate probabilities amenable to Bayesian manipulation, it does not necessarily follow that verdicts on the average will be more accurate if only portions of cases are so presented. Professor Tribe, in his critique of trials by mathematics, advanced one important reason why this is so when he suggested that numerical information might dwarf "softer" data. To this observation one might add that Bayesian ways of presenting information might have a greater impact than the ways that information is presented for softer information processing. In each case, of course, the softer data or the data better suited for softer processing may be more informative (diagnostic) than the information that exists or can be presented in a more systematic and quantitative form.

The argument about the "hard" dwarfing the "soft" might apply even if legal factfinders were natural Bayesian reasoners, for they might attend to information based on its compatibility with their natural mode of reasoning. If factfinders aren't natural Bayesian reasoners further problems can arise when attempts are made to encourage them to think about all or part of a case in Bayesian terms. Factfinders might be confused in ways they would not be if they received no advice about how to combine evidence, or they might give the quantitative evidence too little rather than too much weight because the Bayesian decision-making style was unfamiliar or felt onerous. The net result might be less accurate verdicts than the system would produce if all evidence were qualitative and no word of Bayes's Theorem were breathed.

For these reasons at least, the debate about whether Bayes's Theorem is an accurate normative model for all or part of the trial process has no necessary implications for the way we choose to conduct trials. But these potential problems do not mean that it is a mistake to instruct juries or judges about Bayesian reasoning or to introduce more quantitative methods at trials. It is an empirical question whether the problems I discuss above are so serious that, even if Bayes's Theorem is an appropriate normative model for all or part of the trial process, no attempt should be made to make legal factfinders better Bayesian reasoners. Let us assume, however, that the problems I point to preclude practical applications of the Bayesian perspective at trial. Of what use, then, is Bayes's Theorem and why does the normativity of the Bayesian approach matter? I will suggest two reasons.

First, Bayes's Theorem may be useful as a heuristic device. This is the use I made of it in my article Modeling Relevance. While I am clearly the

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24 Tribe, supra note 10.

25 By the same token, Bayes's Theorem may be an inappropriate normative model for trials but it may be appropriate to instruct jurors in Bayesian approaches to information processing. The case may be particularly strong where the issue is not whether jurors are going to be given statistical evidence, but how that evidence is to be presented. See supra notes 13-20.

26 Lempert, supra note 9.
wrong person to offer unbiased testimony, I use Bayes’s Theorem every year when I teach relevance in my evidence course, and it works. Students have a better understanding of issues relating to relevance than they had before I used this approach, and the class develops a common vocabulary with which to discuss relevance-related problems throughout the course. I also continue to defend the propositions that the basic rules of relevance, Federal Rules of Evidence 401 and 402, are captured, as a normative matter, by Bayes’s Theorem, and that the question whether probative value is outweighed by such Rule 403 considerations as prejudice and waste of time may be illuminated in a Bayesian framework.

This use of Bayes’s Theorem treats the law’s rules and procedures as normative and attempts to model them. One might also argue that rationality of the type represented by Bayes’s Theorem should characterize legal factfinding and that if the law’s norms do not conform to the requisites of Bayesian models of rationality they should be changed so that they do. This is in essence the move that Professor Allen makes when he argues that we should respond to the law’s shortcomings vis-à-vis normative models of rationality by changing the way we think about trials. The boldness of this move is self-evident, and Professor Allen’s attempt to ground the suggestion is equally original. He argues that the trial format as it currently exists in civil cases is incompatible not only with Bayesian conceptions of rational

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27 It is important in this connection to note that the classroom model includes not only Bayes’s Theorem but also a utility matrix (called a “regret matrix”) which allows basic value choices and concepts like prejudice to be captured.
28 FED. R. EVID. 401. Definition of “relevant evidence”: “Relevant evidence” means 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.
FED. R. EVID. 402. Relevant evidence generally admissible; Irrelevant evidence inadmissible.
All relevant evidence is admissible, except as otherwise provided by the Constitution of the United States, by Act of Congress, by these rules, or by other rules prescribed by the Supreme Court pursuant to statutory authority. Evidence which is not relevant is not admissible.
29 In his paper prepared for the symposium Professor Shafer gently criticizes my earlier work and suggests that even heuristically Bayes’s Theorem is inadequate because it ignores the fact that evidence may be relevant on different issues. Shafer, The Construction of Probability Arguments, 66 B.U.L. REV. 799, 815 (1986). I don’t disagree with Professor Shafer’s point but I think his criticism of my use of a Bayesian model misunderstands the legal process. While the point is not articulated except when controversies arise, evidence is always offered on specific issues, and relevance is judged with respect to the issue on which it is offered. Thus, the model applies with respect to specific issues even if the evidence might have been admissible had the proponent argued for admissibility based on its tendency to prove some other point.
decisionmaking but with Baconian and other conceptions of rationality as well. Assuming this incompatibility exists, as I shall for purposes of this paper, it poses starkly the questions of whether and when legal norms should conform to norms defined in other systems. Even if the legal system has a norm of formally rational factfinding at its core, it is not clear that this is or should be the master norm in civil or criminal cases. I shall express my doubts on these and other scores as I comment on Professor Allen's specific suggestions in the last portion of this paper.

C. Descriptive Models

A third use that may be made of Bayesian or other models of reasoning is descriptive. One might argue, for example, that Bayes's Theorem reflects the way people actually process information. Much of the writing antagonistic to the Bayesian model appears to attack it on descriptive grounds. Indeed, some of the non-lawyers who have offered non-Bayesian models of rational reasoning appear to have been attracted to the law because they saw in legal rules and practices good evidence that the prescriptions of Bayes's Theorem are inconsistent with one form of apparently rational decisionmaking.

The effort to discredit Bayes's Theorem on descriptive grounds is somewhat puzzling, for we know that Bayes's Theorem does not successfully model the decisionmaking of people who think that they are reasoning rationally or that they are expected to do so. A body of research reveals that people are at best inconsistent in their reasoning when judged by the standard of Bayes's Theorem; they have particular difficulty in appreciating the extremes that cumulated probabilities can reach, and in some respects and on some issues they do not reason in a Bayesian fashion at all.

I believe that the explanation for the puzzling attack on what we know to be a descriptively inadequate model lies in a confusion between the "is and the ought" like that which Professor Tillers notes in the paper he prepared for this symposium. First, it appears that the critics of Bayes's Theorem seek to demonstrate its normative inadequacy by showing that it does not adequately model human decisionmaking. Second, those who have offered

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30 L. COHEN, supra note 18; see generally Shafer, supra note 29.
31 See supra note 23. Note, however, that the failure of Bayes's Theorem to consistently model actual behavior does not mean that it has no descriptive utility. It might still capture central tendencies in the way people reason about some or most issues. By analogy, the economic model of human behavior fails to capture much that is important about human decisionmaking; but at the aggregate level and even for certain purposes at the micro level it may offer an adequate or even a good model of the way people will react when confronted with particular incentives. Similarly, Bayes's Theorem may in some situations predict well particular or average effects that certain types of information are likely to have on human decisionmaking.
32 Tillers, supra note 7, at 933.
Alternatives to Bayesian rationality seek to support the descriptive adequacy of their schemes by showing that they conform to modes of reasoning which the law appears to prescribe.

Ordinarily one cannot derive an "is" from an "ought," so the first argument appears suspect. However, when the issue is not the abstract issue of what is right but rather whether the legal system should demand a certain kind of reasoning, a good argument can be made that the "is" - "ought" distinction should be dissolved. If people cannot in fact reason consistently in a Bayesian fashion or if the practical problems with Bayesian interventions at trials are too severe, it may be that normative demands for Bayesian type rationality are unsuitable for the law in that they provide no realistic standard to guide decisions. But even if this position is rational, it is by no means self-evidently correct. It is possible that the best way to achieve the law's goal of rational decisionmaking is to impose Bayesian rationality rules.

I use the term Bayesian rational to refer to a set of rules, a system, or a process that is "rational" in several respects. First, if evidence is to be combined with some inferential end in view, the process by which it is combined follows the postulates of Bayes's Theorem. Second, prior probabilities are taken seriously not just as is implied by the preceding criterion but also in that in the absence of additional evidence, the prior probability is treated as a posterior probability. Third, posterior probabilities are taken seriously in that they are regarded as the decisionmaker's best estimate of the probability that a state of affairs exists given the evidence—including base rate evidence—relating to the likely existence of that state of affairs. Fourth, the process, system, or rules value accurate outcomes where accuracy is defined as correctly evaluating a true state of affairs. This last requirement does not mean that it is Bayesian irrational to place different values on different possible decisions thus leading to decisions which presume states of affairs that are less likely than their alternatives. Nor does it mean that the system cannot regard values other than accuracy as important or even dispositive. Bayesian rationality does, however, mean that value issues must be confronted directly and cannot be ducked by fudging the likelihood that a state of affairs will be mischaracterized. For example, it is not Bayesian irrational to have a system which mandates acquittals when there is an .80 chance that the defendant committed the crime charged even if the acquittal is taken to mean that the defendant did not commit that crime. It would be irrational even if there are good value reasons to acquit to combine evidence which justifies a posterior probability of guilt of .80 so as to arrive at a posterior probability below .50 or to assume that an acquittal must reflect such a probability. Finally, what is Bayesian rational depends on the decision-making process's intended outcome. A Bayesian rational decision at the system level may not require factfinding in the individual case which follows Bayes's Theorem. For example, assuming factfinders could process case-specific information in a Bayesian fashion, it might be Bayesian rational not to allow this. First, other values might suffer from instructing factfinders to apply Bayes's Theorem. Second, factfinders might systematically err in evaluating the evidence that is manipulated according to Bayes's Theorem and this error might be such that fewer long run errors are made by requiring factfinders to reason in some other way than that required by Bayes's Theorem. These kinds of decisions are
of evidence and procedure on trials even if the law’s factfinders are not completely or even largely Bayesian in the way they approach the evidence presented to them.

Since the reverse is also possible, in that the law may choose to follow rules of evidence and procedure that are inconsistent with Bayesian requirements even if factfinders largely follow a Bayesian logic, the law’s rules and procedures as norms, to the extent they are inconsistent with Bayesian approaches, are not necessarily informative about the descriptive adequacy of competing models of rational decisionmaking. Reference to legal issues may be a helpful source of speculation, and even of thought experiments, but it cannot resolve the key issues. Empirical experimentation of the kind engaged in by Professors Schum and Martin\(^3\)\(^4\) is needed.

### III. Subjective Probabilities and Objective Paradoxes

In my view the key issues raised by Bayesian models of trial decisionmaking are normative. We might ask whether Bayes’s Theorem is consistent with the law’s expectations of the fact-finding process, and we might ask whether the fact-finding process should conform with the requisites of Bayesian rationality. Some would argue that inconsistencies between Bayesian approaches and the norms of legal decisionmaking are as obvious as the inconsistency between the prescriptions of Bayes’s Theorem and the way that people actually process information. Except with respect to the normative characteristics of Federal Rules 401 and 402,\(^3\)\(^5\) I am agnostic on the issue of whether Bayes’s Theorem adequately captures the law’s expectations about how trials should proceed. I do, however, think that some of the arguments that are used to suggest the inapplicability of Bayes’s Theorem as a model of actual trial processes are not as convincing as those who advance them and many of those who resist them apparently assume.

Two such arguments take the form of paradoxes. They juxtapose the apparent requirements of a Bayesian approach with the results we see in law, and argue from the apparent inconsistency between them that Bayes’s Theorem is an inadequate model of the law’s decision-making expectations. A third argument is that a Bayesian approach to trials does not take account of the weight of evidence and so suggests results—such as finding for plaintiffs in civil cases whenever the ultimate Bayesian probability is above \(^{34}\) Schum & Martin, *supra* note 23.

\(^{35}\) Lempert, *supra* note 9.
.50, even though the evidence in support of the plaintiff is in some sense unconvincing—that are inconsistent with the results that are and should be reached at trials. Professor Allen relies on two "paradoxes," the conjunction paradox and the gatecrasher's paradox, in arguing that the Bayesian model is inconsistent with the rules that currently govern trials, and he notes the argument regarding the weight of the evidence as well. The latter argument is emphasized by Professors Brilmayer,36 Cohen37 and Shafer38 in the papers they prepared for this symposium.

One reason why paradoxes arise when results apparently mandated by Bayes's Theorem are compared with the result that seems intuitively right for a legal trial is that the paradoxes are based on the manipulation of objective probabilities while factfinding is based on subjective probabilities. While it is true, as Professor Savage39 and others have shown, that subjective probabilities may be manipulated according to the same probability calculus as objective ones, and that this manipulation will give consistent, rational (in a sense) results, we should not lose sight of the subjective nature of probability estimates in evaluating the Bayesian rationality of the legal system.

A. The Conjunction Paradox

Consider first the conjunction paradox. It is well known that in a Pascalian system the probability of two independent events, A and B, equals the probability of A times the probability of B.40 Professor Allen points out one apparent implication of this fact. If there are two independent elements that the plaintiff must prove to make a case, each representing a state of affairs the existence of which has no implications for the existence of the other and each of which exists with a probability of .75, their conjoint probability is .56, and the plaintiff should recover in a civil suit since the preponderance of the evidence standard is thought to mandate a verdict for the plaintiff whenever his case as a whole is more likely than not (i.e., has a greater than

38 See generally Shafer, supra note 29.
40 This is one manifestation of the product rule. If there are two events A and B, P(A & B) = P(A) x P(B|A); if P(B) = P(B) then events A and B (elements of a case in the following discussion) are independent. Note that unless P(B|A) = 1, P(A & B) will always be less than both P(A) and P(B). The non-independence of events does not vitiate the product rule. It simply means that P(A & B) is larger than it would be if P(A) and P(B) were independent. But, as I suggest below, the implications of this fact for the challenge posed by the conjunction paradox are by no means trivial.
.50 chance) to be true. On the other hand, if there is a third element to the plaintiff’s case that is similarly independent of the other two and with the same probability of existence, the probability that the plaintiff, who must prove the simultaneous existence of all three elements, has met his burden in all respects is .42, and the defendant should prevail. Yet the law apparently requires the plaintiff to prove each element of his case by only slightly more than a .50 probability which, given the preponderance standard, appears inconsistent with the requisites of Bayesian rationality and likely to lead to a plethora of wrongful plaintiff’s verdicts. Not only does this recovery rule suggest that the law does not respect Bayesian decision-making processes, but the law seems to many to be right in this view, and it is difficult to spot the plethora of wrongful plaintiff’s verdicts which a Bayesian approach would avoid. Thus, the law does not and should not respect the Bayesian version of wisdom. Decisions that are incorrect from the perspective of Bayes’s Theorem are correct as a matter of both jurisprudence and justice.

There are a number of defenses that one who believes the law is Bayesian rational (or at least is not proved Bayesian irrational by this example) may make. Most defenses avoid the problem, but are no less likely to be correct on this account. One might, for example, argue that the probabilities favoring the existence of the different elements of a plaintiff’s case are generally highly dependent, and that successful plaintiffs generally prove the separate elements of their cases by far more than a mere preponderance of the evidence. If these empirical assumptions are tenable, then in most cases in which plaintiffs recover the conjoint probability of the necessary elements is likely to above .50 as well.41

A second and more intriguing defense is that the law may be Bayesian rational without mandating a fact-finding process that combines elements in conformity with Bayes’s Theorem or its underlying axioms.42 If one were

41 I am aware that the empirical assumptions that support this conclusion, like the assumption of perfect or substantial independence made by those who advance the conjunction paradox, have not been systematically tested. One obvious source of dependency in the evidence the factfinder receives is that evidence bearing on different elements may come from the same witness. Thus the credibility accorded to testimony supporting one element of a case is likely to be similar to the credibility accorded to testimony supporting another element of a case. This means that even if the elements of a case are conceptually independent the proof of these elements and the factfinder’s subjective probabilities of their existence need not be. In short, the case in which a conjoint subjective probability favoring the plaintiff is .50 or less when the subjective probabilities relating to the elements of the plaintiff’s case each exceed .50 may be empirically rare despite the mathematical plausibility of this situation.

42 One might also argue that the conjunction paradox has nothing to do with the Bayesian rationality of trials. The argument is that Bayes’s Theorem prescribes a way of combining evidence. Once the legally separate elements of a case have been evaluated, there is no more evidence left to be combined. The factfinder has, for
designing a legal system and attempting to maximize the number of correct verdicts in civil cases, the Bayesian rational strategy would not necessarily be to insist that factfinders assess the conjoint probabilities of separate elements in a Bayesian fashion and render a verdict only when the conjoint probability was in excess of .50. This decision rule is optimal only if the estimates of the probabilities of the various elements are objectively correct. But factfinders are limited to subjective estimates, while the law’s goal is objective truth.

A Bayesian rational design for legal decisionmaking should take the subjectivity of factfinders into account. To deal only with the marginal case, we are interested in the contrast between the probability that a plaintiff actually deserves to recover, given that the factfinder believes that all elements necessary to the plaintiff’s case have a slightly better than .50 chance of being true, and the probability that the plaintiff does not deserve to recover in these circumstances. It may be that total errors are minimized by allowing rather than denying recovery in this situation. In other words, the imperfections of human information processing and the fact that jurors will not have all the information relevant to the issues they must decide may mean that a rule that allows a recovery on conjoint subjective probabilities of less than .50, as long as the existence of each element is thought to be more likely than not, is from a systemic point of view Bayesian rational. More than any other easily applied rule, it may accurately separate those cases in

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example, already evaluated the evidence bearing on issue A and reached a conclusion about its probable existence, and the same is true of issues B, C, etc. The implications of this series of findings is a legal question that Bayes’s Theorem does not and cannot address. There is, on the other hand, no conjunction paradox with respect to evidence that tends to prove a legally required element since factfinders are expected to follow the conjunction rule in evaluating the evidence that bears on each legally separate element.

While I find this argument intriguing, I do not rest the case against the challenge of the conjunction paradox on it. The law’s goal is, presumably, to allow recovery when it is more likely than not that the plaintiff deserves to recover and to deny recovery when this is not the case. Recovery is deserved at law—I assume—when the conjunction of all the elements that the plaintiff must prove to establish his case is more likely than not to exist. While Bayes’s Theorem cannot be applied to evaluate this conjunction since it is not a conjunction of evidence, a basic rule of the probability calculus and one of the axioms on which Bayes’s Theorem rests is that P(A & B) = P(A) x P(B|A) or, where P(B|A) = P(B), i.e., in the case of independent events, P(A & B) = P(A) x P(B). Treating the elements of the case as events (e.g., the defendant was negligent, or the plaintiff suffered an injury) I believe that the challenge of the conjunction paradox is a fair one, for in a Bayesian rational system as I use the term, the product rule must be applied where the probability of a conjunction of events is in issue unless some other value or a Bayesian evaluation from a more encompassing perspective precludes it.
which plaintiffs objectively deserve to recover from those cases in which they do not.  

B. The Gatecrasher Paradox

The paradox of the gatecrashers presents a different problem. Here 499 people have paid admission to a rodeo, but 1000 have attended; the other 501 people sneaked in without paying. Our intuition is that if the rodeo owner sued all the attendees and introduced no evidence other than the preceding statistic he could not recover from anyone, although in each case the probability that the defendant was a gatecrasher was above .50. Assuming that the preponderance of the evidence standard means a probability of liability above .50, this result seems inconsistent with the commands of Bayes's Theorem. Thus, this paradox also implies that Bayes's Theorem yields results that are inconsistent with the results that are and should be reached at trials.  

43 Whether this is the case is, of course, an empirical question. I am simply arguing that the Bayesian rationality of the trial process is not necessarily disproved by the conjunction paradox.  

44 One may argue, as Anne Martin did at the symposium that gave rise to this issue, that the gatecrasher's paradox has no implications for the appropriateness of Bayesian models of the legal system because Bayes's Theorem commands no result inconsistent with our intuition but instead suggests that our intuition, in the form of whatever prior hypothesis we held, should be followed. This is because under one reading of the problem there is no evidence to be combined. The argument is that the likelihood ratio, which is:

\[
\frac{P(E|H)}{P(E|\text{not-H})}
\]

where E is the evidence and H is some hypothesis of interest, in this case that the defendant crashed the gate, is 1. This is true if we regard the evidence as the fact that 501 people crashed the gate and 499 did not. This evidence is equally likely to be received whether or not the defendant crashed the gate and so does nothing to change our estimation of the likelihood that the defendant is a gatecrasher from the likelihood we estimated before receiving this information. There is nothing remarkable about this. If evidence that is fully evaluated in the prior is again presented to the decisionmaker, it will be redundant and will not change the judgment that has been tentatively reached. What makes the gatecrasher case special is that it appears from this argument that there is no information available to the factfinder except information that can be used to establish a prior. Thus Bayesian information processing cannot proceed. Even if I accepted this argument, however, I could not avoid the challenge posed by the gatecrasher paradox, for as I stated in note 33, supra, taking prior probabilities seriously is a requisite of what I call Bayesian rationality. In the "pure" gatecrasher hypothetical—that is a situation with no other evidence bearing on the defendant's guilt and no permissible spoliation inferences—the prior probability of the defendant's gatecrashing is .501 and a plaintiff's verdict seem appropriate. Moreover, viewing the evidence and prior probabilities in other plausible lights, there
Professor David Kaye, in a paper cited by Professor Allen, tries to deal
is evidence that may be manipulated in a Bayesian fashion which yields a posterior probability of .501 that the defendant crashed the gate.

Treating the base rate information as all that need be shown to make out the plaintiff’s case assumes that the defendant was at the rodeo and that the number of ticket buyers and gatecrashers is also given. Thus, there is no information apart from the base rate for a factfinder to assess. A different approach, which David Kaye and I took with some consultation, has the virtue of not assuming that the defendant was present at the rodeo, leaving this to be proved by the evidence, as would be the case at a trial. Professor Kaye’s argument proceeds along the following lines.

Let R be the event that the defendant was at the rodeo; \( N_T \) the number of ticket buyers (499); \( N_R \) the number of people at the rodeo (1000); and \( N \) the number in the relevant population to which ticket buyers and gatecrashers belong. The posterior odds are the likelihood ratio times the prior odds:

\[
\frac{P(T|R)}{P(T)} = \frac{P(R|T)P(T)}{P(R|T)P(T)}. \tag{1}
\]

First, consider the likelihood ratio \( P(R|T)/P(R|\neg T) \). If everyone who paid for a ticket went to the rodeo, then \( P(R|T) = 1 \). If everyone in the relevant population who did not pay for a ticket is equally likely to have gone to the rodeo, then \( P(R|\neg T) \), which is the probability that someone went to the rodeo given that he did not buy a ticket, is simply the number of people who went to the rodeo without buying a ticket, \( N_{R_T} = N_R - N_T = 501 \), divided by the number of people in the relevant population who did not buy tickets, \( N_T = N - N_T = N - 499 \). Thus,

\[
\frac{P(R|\neg T)}{P(R|T)} = \frac{N_{R_T}/N_T}{1} = \frac{501}{N - 499}. \tag{2}
\]

Next, continuing to treat everybody in the relevant population as initially identical, the prior odds are the proportion of non-ticket buyers in the relevant population, \( P(\neg T) = N_{\neg T}/N = (N - N_T)/N = (N - 499)/N \), divided by the proportion of ticket buyers, \( P(T) = N_T/N = 499/N \). Hence,

\[
\frac{P(\neg T)}{P(T)} = \frac{(N - 499)/N}{499} = \frac{N - 499}{499}. \tag{3}
\]

Substituting (2) and (3) into (1) gives the odds that a person who is shown to have been at the rodeo did not pay for a ticket:

\[
\frac{P(T|R)}{P(T)} = \frac{501}{N - 499} \times \frac{N - 499}{499} = \frac{501}{499}.
\]

My own attempt to grapple with the problem reaches the same result more simply by directly estimating the prior odds according to the formula (in which GC stands for being a gatecrasher and R for being at the rodeo):

\[
O(GC|R) = \frac{P(R|GC)}{P(R|\neg GC)} \times O(GC).
\]
with the paradox.\textsuperscript{45} He recognizes that subjective probabilities may vary from apparently objective ones, and argues that it may be appropriate to hold as a matter of law that the factfinder's subjective probability in the gatecrasher hypothetical must be less than .50, and that a verdict should be directed for the defendant. This rule, Kaye suggests, gives plaintiffs an incentive to offer more than background statistics. Indeed, it is arguably unreasonable in this case to allow a juror to reach a subjective probability of liability above .50 since the plaintiff's failure to offer more information, when the rule is that he must, itself counts as evidence against the plaintiff. Professor Allen argues that Kaye's incentive rationale avoids the hypothetical, and the claim that is even stronger with respect to the spoliation argument.

This solution has the virtue of emphasizing that the factfinder may begin with the assumption that the defendant is no more likely than anyone else in the relevant population (of size \(N\)) to have been a gatecrasher. Thus, the prior odds are consistent both with one tenable definition of the presumption of innocence (albeit a matter not in issue in the example since we are supposing a civil suit) as well as with the situation of a factfinder who starts a trial with no knowledge other than the fact that an actionable offense, or in the gatecrasher case some number of offenses, has occurred. The fact that the defendant was at the rodeo is evidence and the number of ticket buyers at the rodeo is information needed to evaluate the implications of that evidence. The only necessary assumptions are that all gatecrashers and ticket buyers attended—and may be shown to have attended—the rodeo, and that everyone in the relevant population has an apparently equal propensity to crash the gate. The prior odds, \(O(GC)\), are \(501:(N - 501)\), since knowing nothing but the number of gatecrashers the odds of the defendant's being a gatecrasher is the ratio of that number (501) to the number of people in the population who are not gatecrashers (\(N - 501\)). Alternatively

\[
O(GC) = \frac{P(GC)}{P(GC)} = \frac{501/N}{(N - 501)/N} = \frac{501}{N - 501}.
\]

Since it is certain that the defendant will be at the rodeo if he is a gatecrasher, and the probability that he will be at the rodeo if he is not a gatecrasher equals the number of ticket buyers (499) divided by the total population minus the number of gatecrashers, the formula for the posterior odds becomes:

\[
\frac{1/499}{(N - 501)} \times \frac{501}{(N - 501)} = \frac{501}{499}.
\]

If Professor Kaye's argument avoids the hypothetical, it at least suggests a good policy reason why the state should place the burden of acquiring more evidence on plaintiffs even in cases where it is impossible for plaintiffs to do so. The reason is that in the real world we will never be sure if the conditions of the hypothetical are met; much more often than not they won't be met, and more information will be available to the plaintiff. Thus, if we seek a rule which over the run of actual cases will minimize errors, a rule imposing a burden of producing more than background statistics on plaintiffs will do so. The fact that the law rejects the apparent commands of Bayesian rationality and the preponderance of the evidence standard in specific cases in order to minimize error in the long run does not mean that the law is, from a systemic standpoint, adopting a Bayesian irrational rule.46

Now let us put aside any policy reasons for directing a verdict against the plaintiffs and give a fully Bayesian argument that the plaintiff should not be able to get to the jury. The argument, following Professor Kaye,47 is an argument from spoliation. It is that the plaintiff’s failure to provide additional information is itself informative. Since the hypothetical provides that the plaintiff has offered evidence which on its face barely exceeds the more-probable-than-not threshold, any spoliation inference that should rationally be drawn against the plaintiff will entitle the defendant to a directed verdict.

Let us consider the objections that may be made against this position. The first is Professor Allen’s argument that it may be as easy for the defendant to offer non-statistical evidence as it is for the plaintiff to do so. Indeed, in the gatecrasher situation the defendants are likely to be in a better position than the plaintiff to offer non-statistical evidence since if tickets were issued some innocent defendants might have kept their ticket stubs and all defendants could testify under oath that they had in fact paid. But despite these possibilities, Professor Allen’s critique misses an important point. This point is that the law currently imposes a burden on plaintiffs—but not on defendants—to go forward with evidence. The question is whether at the close of the plaintiff’s case, at a time when the defendant has had no chance to present evidence, a reasonable jury could find that the plaintiff’s case is more probable than not. The fact that the plaintiff’s case might be strengthened when the defendant presents or fails to present a case does not at this time enter into the court’s decision. So long as this is the preexisting rule and plaintiffs have strong incentives to present accessible probative evidence, granting each defendant a directed verdict in the gatecrasher

46 Responding to Professor Kaye, Professor Allen also argues that if the plaintiff can produce more evidence so can the defendant. This does not follow, for the ability to produce more evidence is likely to be conditional on the existence of liability and on the issues the plaintiff chooses to raise. See the discussion in the text following note 67 infra.

47 Kaye, supra note 45. See also Lempert, supra note 9; Tribe, supra note 10.
situation will be consistent with a Bayesian evaluation of the probabilities whenever it appears that other evidence supporting the plaintiff’s claim would have been available had the claim been meritorious.

In the gatecrasher case, for example, if the plaintiff really thought that defendant A was a gatecrasher, why didn’t he call A to the stand, put him under oath, and ask him whether he had paid for his admission? Since the notion that one “vouches” for the credibility of his witnesses has been generally discarded and “hostile” witnesses can be impeached, there is little to be lost. One cannot assume that A would lie and, even if A had lied, cross-examination might have revealed A’s deception. A possible reason for plaintiff’s decision not to call A is that the plaintiff, perhaps based on A’s demeanor during a discovery deposition, had reason to believe that A was more likely than not telling the truth when he claimed he had payed. Thus the failure to call A may be informative, suggesting that it is more likely than not that A paid.48

There are at least two objections that might be made to this attempt to reconcile the gatecrasher paradox with Bayesian rationality. The first is Professor Allen’s claim, directed against Kaye, that it avoids the hypothetical; the second is that we would decide the same way if 80% of the attendees at the rodeo had crashed the gate. In the latter circumstance, despite the spoliation inference, a reasonable jury at the end of the plaintiff’s case might believe that it was more likely than not that a particular defendant had failed to pay. I shall deal with this latter objection first.

This possibility is embodied in another familiar problem case which is commonly regarded as inconsistent with the view that the law contemplates Bayesian rational factfinding. This case is usually expressed not in terms of gatecrashers but by reference to red and blue taxi cabs or blue and green buses, one of which has hit the plaintiff in a situation where both negligence and the impossibility of any more specific identification is clear. The argument proceeds on the assumption that a court would properly grant a directed verdict for the defendant in this situation. In my view the assumption is wrong, or if it is correct it is correct for a reason which suggests no necessary inconsistency between the application of a Bayesian model (in a world where the preponderance of the evidence standard is conceptualized as a greater than .50 probability that the defendant is liable) and the rules governing proof at trials.

First, consider the matter at the level of intuition. Assume we are confident that the plaintiff has actually been injured by a negligent bus driver, that the bus belongs to one of two companies, and that it is impossible

48 There is, I will admit, only the weakest of inferences to be drawn from the plaintiff’s failure to call A in the context of the gatecrasher hypothetical, but as the hypothetical is posed even a slight spoliation inference will change the balance of probabilities so that the plaintiff is no longer favored. In actual cases, or even in factually richer hypothetical cases, stronger inferences are likely to exist.
for the plaintiff to offer any evidence about which company's bus was responsible. Is there anything offensive about denying the defendant's motion for a directed verdict at the close of the plaintiff's case? I see no great cost in allowing such a case to survive a directed verdict and forcing the larger bus company to present evidence—e.g., testimony as to its bus schedules, testimony from its drivers that on the night in question they had injured no one—or risk liability. After all, statistical evidence is introduced in trials all the time. In a sex discrimination suit, for example, the plaintiff's case may rest on an equation which is not only acknowledged to be an imperfect representation of the defendant's employment policies but, if perfect, indicates some probability (e.g., one chance in twenty) that the data would be equally or more suggestive of discrimination although the defendant had done nothing illegal.  

One troublesome observation that some people have made in discussing the blue bus hypothetical is that if such suits are allowed to proceed the larger bus company will end up paying for all the bus accidents in town. Putting aside the question of whether this is more troublesome than generating a string of injured and deserving plaintiffs who never recover and the fact that in most future bus cases plaintiffs either will be unable to explain their lack of non-statistical evidence or defendants will be able to rebut the plaintiffs' claims, let me simply note that the objection if well taken does not threaten a Bayesian characterization of trial fact-finding norms. Bayes's Theorem as a normative model only tells us how information should be processed. It doesn't tell us when other values should outweigh a probabilistic judgment that favors the plaintiff. Thus, a decision to direct a verdict for defendants because it is unfair that the larger bus company always pays does not call into question the claim that the Bayesian approach captures the essential norms of trial factfinding any more than does the exclusion of privileged information, which prevents a fully informed assessment of all the facts.

Finally, it might be argued that the law of the blue bus hypothetical is inconsistent with my characterization of what a sensitive intuition suggests. The case most often cited on this point is Smith v. Rapid Transit Company.  

49 Consider also antitrust actions, where the damages sought rest on statistical estimates of the harm done. The jury is not required to limit the plaintiff's damage award to the lower bound of a 95% confidence interval around a damage estimate. If, for example, the jury settles on the point estimate of damages, there is a substantial chance that the plaintiff has received more than he deserved, but we are not troubled by this. If damages had to be set at the lower bound of the 95% interval, plaintiffs would ordinarily receive less than they deserved.  

50 317 Mass. 469, 58 N.E.2d 754 (1945). In Smith the Massachusetts Supreme Court held that a directed verdict was properly issued for the defendant when the only evidence suggesting that the defendant owned a bus allegedly responsible for the plaintiff's accident was that the defendant was the only bus company that had a franchise to operate a bus on the street where the accident occurred, and that the
Smith, however, is only one case, and it is not the hypothetical case of the colored buses. Few consciences would have been shocked had Smith been decided the other way. Smith did not involve naked statistical evidence. There was other evidence, relating to bus schedules and the like, suggesting that if Mrs. Smith's story about her injury and her inability to offer more detailed information was believed, then the bus company was indeed responsible for her accident. While these additional facts might argue against my position if the decision in Smith were clearly correct, I think they undercut the power of Smith to persuade. Certainly those who make the case against allowing verdicts based on naked statistical evidence do not claim to be able to extend their arguments to situations where there is additional information of the kind that existed in Smith. Indeed, in somewhat analogous situations such as those in Summers v. Tice\textsuperscript{51} and Sindell v. Abbott Laboratories\textsuperscript{52} courts have been praised for creative solutions allowing recoveries to plaintiffs who because of the nature of their injuries cannot prove the responsibility of particular defendants by a preponderance of the evidence.

This brings me to the charge that I, like Kaye, have ducked the hypothetical. I shall respond by confession and avoidance, but the avoidance shall precede the confession. The problem of the gatecrasher may be acknowledged and avoided by pointing to the uncertainty—given the subjectivity of factfinding—that will exist about whether the conditions of the gatecrasher hypothetical are met. These conditions are that the only evidence against the defendants is that they are members of a group, 50.1\% of whom owe the plaintiff money, and that the plaintiff cannot possibly bring any more specific evidence of violation against any of the defendants. These are stringent conditions and only the plaintiff will know fully—and then only if some effort is expended—if they pertain. If plaintiffs are allowed to get to the jury by showing that naked statistics are the only evidence available, they will have an incentive to falsely create the appearance that this is the case. In particular, they will seek to avoid the expense of ascertaining whether more particular evidence is available and the possibility that they will uncover evidence that exonerates innocent defendants who could not exonerate themselves at trial.\textsuperscript{53} The result is that a general rule directing verdicts for defendants in defendant company's bus schedule was perhaps consistent with the involvement of one of its buses in the accident. The court quoted from an earlier Massachusetts case: "[It is] not enough that mathematically the chances somewhat favor a proposition to be proved; for example, the fact that colored automobiles made in the current year outnumber black ones would not warrant a finding that an undescribed automobile of the current year is colored and not black . . . ." Sargent v. Massachusetts Accident Co., 307 Mass. 246, 250, 29 N.E.2d 825, 827 (1940).

\textsuperscript{51} 33 Cal. 2d 80, 199 P.2d 1 (1948).

\textsuperscript{52} 26 Cal. 3d 588, 607 P.2d 924, 163 Cal. Rptr. 132, cert. denied, 449 U.S. 912 (1980).

\textsuperscript{53} In the extreme case where the plaintiff in the gatecrasher situation could identify specifically all 501 gatecrashers, the 499 others who might, on a balance of prob-
gatecrasher situations is likely, over the run of cases, to lead to more accurate factfinding by the law’s preponderance of the evidence standard. A rule, in other words, works better than subjective case-by-case determinations. A decision rule which appears not to be Bayesian rational in a particular case is consistent with a Bayesian rational system.

But suppose we are not allowed to appeal either to Kaye’s value of providing plaintiffs with incentives to uncover specific information or to my value of achieving more correct decisions by the law’s more-probable-than-not criterion over the run of cases. Then we must confront the hypothetical head on. In these circumstances, where the plaintiff cannot present nonstatistical evidence and we cannot refer to other values, I think the intuitions that the plaintiff should not recover and that the law would not allow recovery are incorrect. They are incorrect because both our intuitions and the law’s apparent rules are based on situations actually encountered or on the contemplation of situations which implicitly contain other ingredients, such as the possibility of spoliation inferences. If we encountered pure naked statistical inference cases like the gatecrasher hypothetical with any frequency, both our intuitions and the law’s rules would change. Indeed, in cases like Sindell or in cases where statistical evidence is often the best if not the only mode of proof, both our intuitions and the law accept judgments that rest largely on the weight of impersonal, quantified probabilities which on their face make clear an irreducible probability of error.

If the pure gatecrasher case arose with any frequency, we would begin to feel sorry for starving rodeo operators (or we would strongly object to the hefty ticket prices that honest people were charged), and the law would accommodate itself to the situation. The simplest accommodation would be to allow the statistical evidence to place on defendants the burden of going forward, but this would only work if it were possible for defendants to present exonerative evidence. In the pure hypothetical, this possibility is ruled out. A second response would be to stick with the traditional rule to encourage rodeo operators to take steps to prevent gatecrashing. If this possibility is also ruled out, the hypothetical world in which gatecrasher cases continue to arise becomes increasingly distant from the world we live in. If we may nevertheless generalize from our legal world, we see, in the movement toward comparative negligence and, in cases like Sindell joint responsibility, the likelihood that strictly legal solutions, probably involving some form of proportionate recovery and liability, would arise. What is unlikely is that a rule directing verdicts against plaintiffs who can present

abilities, have been found responsible will have their cases dismissed. Indeed, once three defendants are specifically identified as gatecrashers, in each subsequent case the revised naked statistics (499 ticket buyers; 498 unidentified gatecrashers) mean that it is more probable than not that a given defendant purchased a ticket. Thus, if naked statistical evidence were sufficient to establish a prima facie case, the plaintiff in the gatecrasher hypothetical would have a strong incentive to suppress better, more particular evidence that might be available in a few cases.
only naked statistical evidence would endure. This seems right to us only because in this world our intuitions and the law have been conditioned by superficially similar cases from which careless generalization is easy.

Consider the following hypothetical case. 501 people pay to attend a rodeo. They pay their money and are allowed in but receive no ticket stubs. Then 499 people crash the gate. The incensed manager calls off the production before it begins and does not refund any money. A suit is brought by X to recover his admission fee. X can offer only the statistical evidence and—although it is difficult to imagine the situation—his failure to offer other evidence has no implication for the likelihood that he paid his way in. Will the rodeo manager be allowed to deny recovery to X and everyone like him?54 Why should the resolution of the gatecrasher's paradox turn in the pure case on the identity of the moving party? Should the law allow this situation to exist where no other values, like the stability of expectations, exist? I think not.55

C. The Weight of the Evidence

Finally, let me turn to the weight of the evidence. The most fundamental and interesting challenge to Bayesian models of legal decisionmaking is that they do not describe how factfinders process evidence and cannot in principle do so since factfinders respond to a sense of the weight of the evidence which is incommensurate with Bayesian probabilities. The argument is that this in principle disjunction between what Bayes's Theorem requires and how legal factfinding proceeds means that Bayes's Theorem is both descriptively and normatively an inadequate model of what the law expects of its factfinders since it leads to results which would not and should not be reached by the legal system. For example, situations may exist in which on the balance of probabilities it appears more likely than not that the defendant is liable to the plaintiff but the plaintiff's evidence is so slight that he will not and should not be allowed to recover. If so, Bayes's Theorem neither captures the law's norms nor, where it differs from the law's norms, makes a normative claim that we should respect.56

I do not wish to assert that there is no in principle distinction between Bayesian models and weight-of-the-evidence models of decisionmaking, for

54 With respect to the evidence available to the court, X's situation is like that of all those at the rodeo, paying customers and gatecrashers alike.

55 Of course, I acknowledge that the law has tie-breaking rules that typically disadvantage those challenging the status quo. I am arguing that our intuitions about the right result in the gatecrasher case do not turn on the need for such rules and that we better appreciate the questionable basis of the intuitions that many people express regarding the pure case when we ponder the reverse situation.

56 I am just discussing the weight of the evidence issue in respect to the law, but it is this issue which is at the heart of the broader debate about how we should think about evidence and the nature of rational reasoning. See, e.g., L. Cohen, supra note 18; G. Shafer, A Mathematical Theory of Evidence (1976).
coherent and inconsistent logical systems have been generated on the basis of these different perspectives. However, with respect to the law, I do not believe that a convincing case has been made that the Bayesian model yields results that are inconsistent with the results that arise when a court or jury evaluates the weight of the evidence in accordance with legal norms. The intuitive argument that it does generally rests on the proposition that one can imagine civil cases in which the probability that the defendant is liable appears from a Bayesian perspective to be above .50, but such scanty evidence has been offered in support of the plaintiff's case that a jury is properly not convinced that the defendant's liability has been shown by a preponderance of the evidence.

I question whether cases like this hypothetical in fact exist. I think the examples generally offered to support this proposition implicitly assume a Bayesian prior of 1:1, or something close to it, and then assume that whenever the likelihood ratio for the scanty evidence that is offered favors the plaintiff, applying Bayes's Theorem yields a posterior probability above .50. From this it is assumed that the plaintiff has, according to the Bayesian model, proved his case by a preponderance of the evidence although the case is unconvincing.

The mistake here is in implicitly or explicitly setting the Bayesian prior at 1:1. Although a civil jury should not favor one side over another, this is, in terms of my model of relevance, a matter captured by a regret matrix and not by Bayes's Theorem.57 Bayes's Theorem refers solely to the processing of information—that is, to an empirical process. The law's norms cannot set the Bayesian prior; the "ought" of not favoring either side cannot determine the "is."]8 What then is the proper prior? This is, of course, the sticking point in all attempts to apply a Bayesian approach to real world decision-making. Although any subjective estimate of the prior odds is often tolerable when we are discussing the in principle applicability of Bayes's Theorem as a normative model of legal reasoning, a similar looseness is not tolerable when we are concerned with the posterior probabilities at which a Bayesian factfinder should arrive.

57 Lempert, supra note 9, at 1032. In other words, no legal norm suggests that a factfinder should, before the parties present their cases, hold the tentative position that it is as likely as not that the plaintiff deserves to recover. Rather, the factfinder should throughout the litigation hold the belief that a mistaken decision for the plaintiff is as regrettable as a mistaken decision for the defendant.

58 The presumption of innocence may appear to do this, but I think it is largely concerned with an attitude the jurors should take in evaluating evidence rather than with specifying a prior probability to be revised in the light of the evidence in the case. It does, however, operate in a negative way with respect to the setting of priors, for it instructs jurors that certain information they have at the beginning of a case, such as the fact that the defendant has been arrested, should not enter into their prior probabilities. Moreover, the attitude captured by the presumption of innocence may be more consistent with some prior probabilities than with others.
I suggest that in all cases, civil and criminal, the prior probability of the matter in question be set at an odds of one to one less than the number of actors in the world. In other words, at the outset of the fact-finding process the defendant should be thought to be no more likely to be guilty or liable than he would be if responsibility were allocated by a lottery in which every actor in the world had the same chance of being selected. With absolutely no information, I see no other empirically justified starting point. To pursue the argument, imagine a Bayesian information processing machine that starts with this suggested prior. The Bayesian machine may of necessity receive evidence sequentially, but it evaluates information together. Thus, the first likelihood ratio it calculates is:

\[
\frac{P(A|H)}{P(A|\neg H)}
\]

where \(A\) is an item of evidence and \(H\) is an hypothesis—e.g., that the defendant acted negligently—at issue in the case. The second likelihood ratio the machine calculates is:

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59 An exception exists in cases like the gatecrasher case where we know that more than one person has engaged in an activity. Here the appropriate prior is the ratio of the number of actors known to have engaged in that activity to the number of actors in the world minus the number known to have engaged in the activity. (Actors need not be human beings, but may be other entities such as corporations.)

Legal factfinders, of course, face issues other than the identity issue I am discussing in the text. With respect to issues like motive, it is more difficult to specify an objective referent that, even if only in theory, may be used to indicate appropriate prior odds. Nevertheless, I think the same principle does apply; for example, in the case of motive, the prior odds can be set in principle at an estimate of one to the number of all possible other motives that might explain a behavior at issue. That is, except insofar as a behavior itself suggests that some motives are more likely than others, a factfinder without further evidence should not, before receiving other evidence, regard one motive as more likely to explain that behavior than other possible motives.

60 Some have suggested that 1:1 is the appropriate beginning odds for someone who is ignorant of a true state of affairs. I believe that Professor Shafer has shown the problems this can cause. G. SHAFER, supra note 56. With respect to my suggestion, I am not saying that this is the prior the factfinder should have before hearing the first item of evidence. Rather this is the prior the factfinder should proceed from as he or she begins to think about the case. Much that is learned or assumed before any evidence is given will properly affect the prior a factfinder holds when the first item of evidence is presented. For example, it is reasonable for a factfinder to assume that only those in some local population of which the defendant is a member could have engaged in the charged behavior (e.g., the population of people who could have been in a particular location at a particular time). This will dramatically reduce the prior and is a harmless leap so long as evidence of the defendant's ability to get to the location is presented at the trial and is not "double counted."
\[
\frac{P(A \& B|H)}{P(A \& B|\text{not-}H)}
\]

and so on until:
\[
\frac{P(A \& B \& \ldots \& N|H)}{P(A \& B \& \ldots \& N|\text{not-}H)}
\]
is calculated. This procedure allows the dependency of information to be taken fully into account, and it provides for the anomalous situation in which the direction in which evidence cuts is reversed upon the receipt of new evidence.\(^6\) If after receiving each item of evidence the Bayesian machine spewed out a tentative posterior probability, we would see that early evidence drastically reduced the odds against the hypothesis. For example, in an auto accident negligence suit where a hit-and-run defendant denied involvement in the accident, the evidence that the defendant drove a car would reduce the odds of the defendant’s responsibility from one to whatever number of people inhabit the world to one to whatever number of people drive cars. Evidence that the defendant usually drove in the vicinity of the accident would reduce the odds against the defendant’s involvement by a further substantial amount. Ultimately, however, to prove that it was more likely than not that the defendant was responsible, more specific evidence would be required. I will assert—and can only assert, for this example must be left at the level of thought experiment—that whenever the final probability spewed out by the Bayesian machine proceeding in this fashion exceeded .50 on all the evidence presented, including permissible spoliation inferences, the evidence would be sufficiently weighty for the law to allow the verdict to stand. If so, there is no \textit{in principle} distinction between decisions apparently justified by a Bayesian approach in a world where the preponderance of the evidence standard is conceptualized as a greater than .50 probability that the plaintiff’s claim is correct, and those decisions that the law’s norms require.\(^6\)

\(^6\) For example, evidence that the defendant in a murder case received a ticket for running a red light at a point from which it was difficult but not impossible to reach the scene of the crime by the time of the murder suggests the defendant is innocent, as it appears less likely than it would have without the evidence that the defendant was at the scene of the crime at the crucial time. However, if it is also revealed that the defendant had a full view of a police officer when he ran the red light, the evidence of the defendant’s location is more probative of guilt than innocence; it now appears that the defendant wanted to get ticketed, a desire consistent with seeking to establish an alibi in contemplation of committing the crime.

\(^6\) Note that with a Bayesian machine and objective information about probabilities the conjunction rule should apply where more than one element had to be proved to make out a case. That is, if the probability of each of three independent elements that the plaintiff had to prove to make his case was .75, the plaintiff would lose because there was less than a .50 chance that events had occurred in such a way that the
I think that the description of the Bayesian machine takes care of the suggestion that Bayesian conclusions are in principle different from and less in accord with the law’s norms about trial decisionmaking than the decisions reached by the non-Bayesian weighing of conflicting evidence. While the defense of Bayes’s Theorem might thus stop here, there is one final point I would like to make, a point which involves accepting the implicit premise that the appropriate Bayesian prior in a civil case is an odds ratio of 1:1. I do this not because I think the assumption is correct but because it helps illuminate another problem caused by deriving objective paradoxes from subjective probabilities.

The claim is basically that if Bayes’s Theorem is a model of trials the factfinder applying a preponderance of the evidence standard must always find for the plaintiff when the hypothesis the plaintiff seeks to establish has a better than .50 chance of being true, and must find for the defendant in all other instances. This argument, in Professor Allen’s terms, is the argument of negation. Bayesian probabilities on H and not-H must sum to one. Thus there appears no way to withhold judgment and ask for more information.

The validity of this argument depends on how the law’s standard is phrased. If the law commands factfinders to decide for the plaintiff whenever the posterior Bayesian probability exceeds .50 and for the defendant otherwise, the law is treating subjective probabilities or degrees of belief as objective ones and there is no third option. However, if the law recognizes the factfinder’s subjectivity and commands factfinders to find for the plaintiff when they are satisfied that the posterior probability is above .50 and for the defendant otherwise, factfinders have three options. They should find for the plaintiff when they are satisfied that there is more than a .50 chance that the plaintiff deserves to recover. They should find for the defendant when they see gaps or other flaws in the plaintiff’s case that makes them feel uneasy about giving the plaintiff the verdict even though, if forced to guess, they would think it more likely than not that the plaintiff should prevail.

If this third option seems unfamiliar in civil cases, it is not unfamiliar in the law. In criminal cases a “reasonable doubt” is commonly defined for jurors not in probabilistic terms but as the kind of doubt that would cause them to hesitate in a matter of great personal import. It is not irrational or inconsistent with the expectation that factfinders will reason in a Bayesian fashion to place on plaintiffs the burden of removing the factfinder’s uncertainty about whether a probability that apparently exceeds .50 actually does so.\textsuperscript{63} Fact-plaintiff deserved to recover. I believe that if the accuracy and objectivity of my hypothetical machine could be guaranteed, the law would allow the conjunction rule, for the law’s concern would be with the probability that the plaintiff was more likely than not entitled to recover on the case taken as a whole.

\textsuperscript{63} See also Cohen, supra note 5. I think that Professor Cohen’s concern with
finders are not Bayesian machines, and it may be that fact-finding accuracy will in the long run be enhanced rather than hindered by respecting difficult to identify sources of discomfort.64

Moreover, there is a common law tradition that jurors should not reach verdicts based largely on speculation. Speculation may yield a subjective probability or degree of belief in the plaintiff’s case that is above .50, but the probability estimate may be based on so little evidence that it is insufficient as a matter of law to justify a plaintiff’s verdict no matter how high it is. Thus, the law may expect factfinders to reason in a Bayesian fashion, but it must also recognize that this expectation will at best be imperfectly achieved. In the resulting second-best world, it may make sense, even if the only concern is accurate factfinding, not to require the rigid transformation of uncertain Bayesian posterior probabilities above .50 into plaintiffs’ verdicts. Legal factfinders, unlike our ideal Bayesian machine, may start with unduly high prior probabilities, or they may overvalue redundant evidence because it is difficult to appreciate the implications of dependency. Indeed, it may be that errors like these lead to difficult to articulate sources of unease with what on a conscious balance of the probabilities appears to be the appropriate final verdict.65

IV. RECONCEPTUALIZING TRIALS

If, as I have suggested in the preceding section, the paradoxes that Professor Allen and others draw on to show an inescapable disjunction between a Bayesian rational fact-finding process and the fact-finding process apparently prescribed by legal norms do not exist or do not suggest such a fundamental disjunction, it is unnecessary to proceed as Professor Allen

"weight of evidence" issues is well placed, but I do not mean to endorse all the arguments he makes for his position.

64 Note that if the source of discomfort is, as it may often be, a spoliation inference—e.g., if defendant were really liable why didn’t the plaintiff present evidence of X—the discomfort fits nicely into the Bayesian model and would, if the source were appreciated, lower the final probability judgment. As Arthur Conan Doyle showed us and as others have documented, see R. NISBETT & L. ROSS, supra note 23, people often do not appreciate the relevance of "negative" evidence. Nevertheless we may perhaps feel less confident of analyses because of dogs that never barked.

65 In addition, other values that have nothing to do with the style of information processing expected of legal factfinders may justify the "not persuaded" alternative. We might, for example, want to induce the parties, especially the plaintiff, to offer more or better quality evidence, or we might not want factfinders to leave trials dissatisfied with the verdicts they felt compelled to return. If these are our motives, the legal system’s choices do not prefer non-Bayesian to Bayesian modes of proof. They simply elevate other values above a conception of rational factfinding that, however defined, has no place for such values in it.
does to "reconceptualize" trials. Thus, on my own view of the situation there may be nothing more to say.\textsuperscript{66} However, since I have been invited to comment on Professor Allen's arguments and have hardly discharged this obligation to this point, I shall assume the disjunction Professor Allen articulates and focus on his suggested solution.

Before I turn to the specifics of Professor Allen's proposal I wish to emphasize the boldness of his scheme. It is bold in two ways. First, Professor Allen does not follow the lead of most critics of Bayesian rational models and argue that if real decisionmaking does not conform to our abstract models then the models should be changed. Rather he accepts the models, or at least the premises of rationality built into them, as normative and argues that if trials are not rational in the same way the models are, it is the rules of trial proof that should be changed. Second, although Professor Allen speaks about \textit{reconceptualizing} trials, he in fact argues for \textit{reformulating} trials. That is, he is not just suggesting a new way of conceiving of trials or thinking about them. Rather, he is prescribing a new set of legal rules. These rules have implications for the admissibility of evidence, the instructions given jurors, and the issuance of directed verdicts.

While I genuinely admire Professor Allen's boldness and creativity, I have considerable difficulty both with the specific suggestions he makes and the more general position that underlies them. Professor Allen's analysis begins with the observation that in civil cases the law should be indifferent between errors that favor plaintiffs and errors that favor defendants and should aim at minimizing the overall error rate in the long run. In other words, for Professor Allen the rules of proof should be neutral between the parties. This position is facially consistent with the preponderance of the evidence standard in civil cases, and so is firmly rooted in a legal norm. Professor Allen goes on to imply that rational decisionmaking, of a Pascalian or Baconian kind, will tend to bring about this state of affairs. Since he sees inconsistencies between the decisions likely to be reached using either of these two general approaches and the decisions that the current rules of trial practice are likely to yield, he argues that the rules of trial practice should be changed.

This approach, for all its originality, leaves important questions unanswered. The first is why we should define a rational system of proof for civil

\textsuperscript{66} The same is true if one finds the models offered by Professors Cohen, Shafer and others to be models of rational decisionmaking and accepts the claim that the processes such models describe are generally similar to those that characterize trials. Professor Allen, of course, attempts to show that such models give rise to some of the same paradoxes as the Bayesian model and so, as models of the trial process, they share many of the Bayesian model's alleged deficiencies. I have some difficulty with the arguments that Professor Allen advances to make this point, but since the proponents of these models are, unlike the Reverend Bayes, still active scholars, I shall leave to them the task of answering that portion of Professor Allen's argument that bears on their theories.
trials solely in terms of the minimization of equally weighted plaintiff and defense errors. To say that this decision respects the law's norm or definition of rationality as articulated in the civil burden of proof—the answer Professor Allen's discussion implies—will not do, for according to Professor Allen the pursuit of this norm requires changes in other norms of trial proof which on their face have as much claim to be respected as that implied by the civil burden. Moreover, it is clearly not irrational for a system of trial proof to pursue ends other than or in addition to the minimization of verdict errors, for trials serve values other than the dispensation of justice by the preponderance of the evidence standard.

Professor Allen acknowledges this point, but his argument at times comes perilously close to denying it. For example, the scheme he suggests relies more than the current system on effective pretrial discovery. This suggests the likelihood of increased disputing over discovery-related matters. The potential social costs of discovery disputes are obvious, and the legal system's rules might well recognize them. The situation is similar where values reflect concerns less easily measured. For example, Professor Allen writes:

The only justification for such rules is that some evidence cannot be understood, which includes being put to an inappropriate purpose such as unfairly prejudicing a party.

This assertion is not self-evidently valid. With respect to the admissibility of evidence, privileges provide a clear counter-example, for they exclude evidence for reasons other than those Professor Allen asserts. With respect to the sufficiency question, it is similarly possible for values other than rational factfinding to prevail. For example, we may not want to allow a case like that of the gatecrashers to rest on statistical proof because we regard this as intolerably dehumanizing. The defendant is being found liable not for who he is personally but for a category to which he belongs. Just as we would not allow a defendant in a job discrimination case to offer statistical evidence showing that on the average blacks or women perform less well than whites or men, so we may not wish to allow civil suits to proceed based solely on evidence that the defendant belongs to some broadly defined class more than half of whose members owe the plaintiff money. The symbolic nature of allocating responsibility on the basis of the statistical characteristics of members of a broadly defined class may be especially and properly disvalued by the law when stigma attaches to the finding of responsibility, as it does when a person has been shown to have acted carelessly or, even worse, to have sneaked into a rodeo without paying.

Finally, it is not clear what it means to be neutral between parties.

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67 See Allen, supra note 11, at 428 & n.66.
68 Id. at 428.
Professor Allen's proposal, for example, will largely foreclose directed verdicts for defendants at the close of plaintiff's cases, for the jury under his scheme will be charged not with weighing the general plausibility of the plaintiff's case, but with weighing the plausibility of the plaintiff's case against that of the case which the defendant offers. This allows plaintiffs to impose greater costs on defendants than they can under the current system, and may affect the propensity of plaintiffs to bring marginal or "strike" suits. Also, those cases that under the current system do not get to the jury will, by virtue of their weakness, almost always result in judgments for the defendant after the defense case is presented. Consequently, unnecessary costs, which are deadweight social losses, will be imposed on defendants.

A related question that Professor Allen leaves unanswered is why either a Pascalian or Baconian approach is an appropriate model of rationality for the trial system. I will not discuss this issue in detail, except to point out that a strength of Professor Allen's general argument becomes a weakness when the discussion switches to specific ways to reformulate trials. If Professor Allen is correct in his claim that both Pascalian and Baconian models do not fit the rules of proof that govern trials, trial processes appear irrational when judged by either of the predominant formal approaches to the question of human rationality. This perspective is original and is a strength of Professor Allen's argument, since it suggests that whatever our conception of rational decisionmaking, if that is our goal we should be troubled by the procedures that have emerged to govern trials.

This strength becomes a weakness, however, when specific reformulations of trial practices are suggested. Pascalian and Baconian approaches suggest different ways of evaluating the rationality of trial decisionmaking and of minimizing error by appropriate criteria of rationality. Having proposed a reformulation of trial procedures, Professor Allen must choose a model of rational decisionmaking against which his proposals can be judged. He does not. Even if Professor Allen's proposed revisions will eliminate certain features of trials that are paradoxical by reference to both Pascalian and Baconian models, it does not follow that the revised system will yield rational judgments by reference to the criteria of either.

In short, when I read in the introduction to Professor Allen's paper that he intended to offer a reconceptualization of trials, I thought he had in mind a project like that which Professor Nesson69 and Professor Tribe70 before him undertook. That is, I expected him to elaborate a model of the trial which attended to values other than rationality but—and this would have been the advance over Nesson and Tribe—had a clear place in it for rational information processing of a Baconian or a Pascalian kind. Instead, more than any other recent writer on this topic, Professor Allen is willing to let some formal model of rational decisionmaking dominate our views of how trials should

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69 Nesson, supra note 21.
70 Tribe, supra note 10.
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proceed. In his scheme the normativity of such models lies not in the extent to which they are consistent with the law's rules about how decisionmaking should proceed but in their postulated compliance with a barely argued first premise that the civil law elevates rational, neutral decisionmaking above all other values. But there is a circle here, for it is not at all clear how rational decisionmaking proceeds. In suggesting that Pascalian and Baconian models, at least where their implications overlap, set a standard of rationality by which the appropriateness of legal procedures may be judged, Professor Allen elevates formal mathematical norms above legal ones. I, for one, am troubled in a way that I am not by efforts to formally model the rationality that legal rules require.71

Turning from Professor Allen's idea of what it means to reconceptualize trials to his specific proposals for changes in how we should proceed, I find yet more that troubles me. I alluded to some of these matters when I discussed some values that Professor Allen's perspective ignores—for example, the social costs of discovery disputes and increased defense expenditures in cases that now end in directed verdicts at the close of the plaintiff's case. Some of my other problems with Professor Allen's approach are even more fundamental. For example, Professor Allen's suggestion that the trial factfinder compare the probability of a fully specified plaintiff's case with that of a fully specified defendant's case assumes that neither party has an advantage in developing the facts of what occurred, and that the party who can tell the most probable story deserves to win. This suggestion seems to me to be either a prescription for what now occurs, including the possibility of a negation defense, or a move likely to lead to substantial injustice.

Suppose a defendant moves for a directed verdict at the close of the plaintiff's case. He is asking the court to find that under no reasonable reading of the evidence could a jury conclude that the plaintiff's claim is more likely than not to be true. If the plaintiff's case is as weak as the defendant claims, what can be gained from requiring the defendant to present a more plausible story than that implicit in his motion for a directed verdict; i.e., the event had to have happened in some other way? Nothing, I would argue.

If Professor Allen's proposal means that defendants would be required to offer particularized counter-stories in such circumstances, costs would be incurred. One, to which I have alluded, is the cost of forcing a defendant to

71 The difference lies in the implications of disjunctions between legal rules and formal models. If the model is independently normative, inconsistent legal rules are "wrong" and should be changed. If the law is normative, inconsistencies between the law and a model reflect the model's inadequacy. If Professor Allen could show that the law embodies some formal model of rationality as its primary norm, requiring secondary procedural norms to conform to the model would not be problematic, for it would be requiring them to conform to some higher legal norm. Professor Allen may believe that this is the situation he is describing, but he has not established it convincingly.
mount an otherwise unnecessary defense. A second is the possibility that an unjust decision will result because the defendant does not know how to explain the phenomenon that the plaintiff seeks to hold him responsible for and so cannot tell a particularized counter-story.

Consider, for example, a malpractice action brought by a plaintiff of age ten against the doctor who delivered him. The claim is that a symptom—let us say a tremor that began affecting the plaintiff’s left arm at age nine—was attributable to the way the doctor delivered him ten years before. The doctor may have no recollection of the delivery, for the plaintiff’s birth may have been one of thousands of then unremarkable births the doctor aided, and the doctor may have no clue as to what in fact causes the plaintiff’s tremor. Thus, all the doctor can say, unless perhaps he pays the costs of fully diagnosing the plaintiff’s condition, is that whatever the cause of the tremor that emerged at age nine, it does not lie in an earlier unremarkable delivery. Surely we do not wish to impose the costs of discovering the cause of the plaintiff’s condition on the defendant doctor. Not only may the cause be ultimately undiscoverable but, even if it is potentially discoverable, it may be unascertainable without the full cooperation of the plaintiff and his family.

Professor Allen suggests that in some circumstances his preferred mode of proceeding resembles the status quo. He writes, “A jury in evaluating evidence should conclude that the probability of the defendant’s versions of reality is the probability of the plaintiff’s versions subtracted from one only if it feels that it has before it all relevant versions of reality.”\(^\text{72}\) To say that an event happened in some way—that is in any possible way—other than as the plaintiff claimed is to offer the jury all relevant versions of reality since the plaintiff’s claim and the defendant’s negation exhaust the possible ways in which the accident might have occurred. If this sort of negation is allowed, then trials can proceed as they do now. If Professor Allen does not consider general demurrers of this sort exhaustive of possible realities, injustice may result when the plaintiff’s claim is improbable, as in the malpractice example, but an innocent defendant cannot be expected to know much about what really happened.

Now consider the situation where the plaintiff’s case-in-chief is under the current legal standard sufficient to survive a motion for a directed verdict. Here the defendant fails to offer a counter-story at his peril.\(^\text{73}\) Thus it is not surprising that civil defendants, unlike criminal defendants who sometimes are content to present no evidence and argue that the prosecution has not proved its case beyond a reasonable doubt, invariably offer a defense when confronted with a plaintiff’s case sufficient to get to the jury. While we have

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\(^{72}\) Allen, supra note 11, at 433.

\(^{73}\) Note that the counter-story need not involve presenting a case or even a different version of the events. It may be simply a story, conveyed through cross-examination, that the plaintiff’s version of events is not to be believed.
no systematic descriptions of what defense cases in civil trials typically consist of, it is likely that they present story lines that conflict with plaintiffs’ stories. The conflicting story may be as simple as “the plaintiff’s witnesses cannot be believed” or as complex as is necessary to explain the plaintiff’s injury while negating any implication that the defendant is responsible. Where a counter-story is offered, it is likely that factfinders decide by evaluating the relative plausibility of the competing versions. This is precisely what Professor Allen would have them do.

But Professor Allen writes as if deciding in this way is inconsistent with a system in which a “preponderance of the evidence” means “more likely than not” in the sense conveyed when we say that to prevail the plaintiff must show that there is at least a slightly better than .50 chance that his version of reality is correct. Thus in Professor Allen’s proposed scheme a plaintiff who offered a story or stories that had a .40 chance of being true would prevail over a defendant whose version or versions of what happened had only a .30 chance of being right.

Again, however, I think we are misled because objective probabilities are being used to analyze a situation in which the factfinder employs subjective estimates. The factfinder is not asked to evaluate the true probability of the plaintiff’s case. Rather he or she must decide on the basis of the evidence in the case whether the plaintiff’s case is more likely than not—that is whether it has a more than .50 chance—to be true. In most cases when a factfinder is presented with a plaintiff’s story that has a .40 chance of being true and a defendant’s story that has a .30 chance of being true, it can conclude that, on the basis of the evidence before it, the plaintiff’s story is more likely than not—not simply more likely than the defendant’s story—to be true. This is in part because if none of the evidence presented suggests other explanations for the incident which objectively has a .30 chance of being true, probabilities evaluated on the basis of the extant evidence will subjectively sum to more than .70—perhaps even to 1.0. The factfinder will not be conscious of other possibilities and so will not accord them some probability.

Where the factfinder is aware of other possibilities a spoliation inference may close an otherwise apparent gap. Assume, for example, that a plaintiff presents a story that strikes the factfinder as having a .40 chance of accurately recounting what has happened. The defendant presents an exonerative story that the factfinder estimates as having a .30 chance of describing what occurred. An additional exonerative possibility—also with an apparent .30 probability of describing what has occurred—is obvious to the factfinder. May the factfinder find that the plaintiff has proved his case by a preponderance of the evidence if this requires a rational conclusion that there is

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somewhat more than a .50 chance that the plaintiff’s story is true? I think so. The second exonerative possibility that was obvious to the factfinder should have been obvious to the defendant as well. The defendant’s failure to offer evidence in support of this possibility suggests that the defendant, and perhaps the plaintiff as well, knows from evidence not presented that this apparently plausible theory is not supported by the facts. Thus, the factfinder may rationally rely on the spoliation inference and treat the case as if there is a four in seven chance that the plaintiff’s version is correct.

Where the spoliation inference is unreasonable given the evidence, and the situation is as described above, I believe that the preponderance of the evidence standard should ordinarily and usually does require a verdict for the defendant even though the plaintiff’s story is more plausible than the account the defendant explicitly offers. It is, however, difficult to imagine such a situation, for in rebutting the spoliation inference, the defendant is, in effect, advancing the second exonerative story. He is seeking to persuade the factfinder that his failure to present more specific evidence in support of a plausible exonerative story does not suggest that the story is untrue. Specific supporting evidence is unavailable for reasons that are neither conditioned on the truth of the story nor within the defendant’s control.

A related situation exists when the defendant’s strategy is to destroy the

75 That is, the plaintiff presents an inculpatory story with a .40 chance of being true; the defendant presents an exonerative story with a .30 chance of being true; and there is an obvious second exonerative possibility with a .30 chance of being true that is not rendered less plausible by the defendant’s failure to support it with evidence.

76 If specific evidence supporting a third possibility or possibilities could be offered, the chances of the possibility should rise above the .30 probability that Professor Allen hypothesizes. This is so because the law’s factfinder is required to decide cases on the evidence presented, evaluated in the light of common sense. If a factfinder believes that there is an exonerative possibility not directly advanced and only indirectly supported (i.e., not ruled out by the evidence offered) which has a .30 chance of being true, it is almost certain to accord the possibility a greater than .30 chance of being true if specific supporting evidence is offered.

77 An exception to the defendant’s ability to take advantage of obvious exonerative possibilities not belied by the spoliation inference exists when the spoliation inference is untenable because some legal rule, e.g., a rule of privilege, prevents the defendant from supporting the possibility. Here, even though the defendant’s failure to offer evidence does not give rise to the inference that the possibility does not in fact exist, the factfinder ordinarily should not be able to consider the possibility in evaluating the strength of the plaintiff’s case. This is because the policy reasons that preclude the defendant from offering the evidence usually preclude verdicts based on assumptions—however plausible—of what the evidence would have contained. Where they do not, as in jurisdictions that allow the invocation of privileges to be mentioned in civil cases, the situation reverts to that described in the text. Where policy reasons do preclude such assumptions, the state has decided to sacrifice accurate verdicts to some officially more important value.
plaintiff's case through cross-examination, and the defendant offers little or nothing in the way of a case-in-chief. By Professor Allen's scheme it might appear that in this situation the plaintiff should prevail, as even a highly questionable story appears to outweigh no story at all. But our instincts tell us this cannot be right. It is not right because in relying on cross-examination the defendant is telling a story, and if the cross-examination is devastating the defendant's story is more plausible than the plaintiff's. The defendant's story is that the sequence of events resulting in injury did not occur in the way it must have for legal liability to attach to the defendant. The sequence has this appearance only because the plaintiff has found witnesses who are poor observers, forgetful, or deceptive.

That the defendant cannot explain how the injury occurred does not preclude a defense verdict. On the evidence before it the factfinder cannot conclude that it is more likely than not that the injury occurred in a way that justifies a decision for the plaintiff. In attacking the plaintiff's case through cross-examination, the defendant is suggesting numerous ways in which the facts, if relayed by credible witnesses, might exonerate him. When cross-examination has been artful, there may be no need for a defense case-in-chief.

Thus, I disagree with Professor Allen's suggestion that defendants be required to respond to plaintiffs assertions with "equally specific and affirmative allegations rather than with simple denials." I do not think Professor Allen's proposed reformulation of the rules of proof, a proposal rooted in his concern with the "negation problem," is workable in practice. It imposes unnecessary costs on defendants and may lead to injustice when either the factual situation or the rules of evidence are such that true defense stories are difficult to establish. Nor do I find the suggestion conceptually compelling. For the reasons I have just outlined, I don't think a negation problem of the kind Professor Allen outlines exists in most cases. This is because the factfinder must decide the case on the evidence before it, which will ordinarily involve comparing plaintiff and defense stories in such a way that the subjective probabilities of the plaintiff's and defendant's versions of events, taking into account spoliation inferences, will add up to one. Where this is not the case, I think it is appropriate to require the plaintiff to show that there is a better than .50 chance that he should prevail. I see no good reason why the defendant should not be able to take

78 Allen, supra note 11, at 426.
79 I also believe it appropriate to place on plaintiffs the burden of showing that there is a better than .50 chance that all legally necessary elements exist. While Professor Allen's suggestion that juries compare two fully specified versions of reality may eliminate the conjunction paradox, id. at 427, to the extent this is a problem, I believe the suggested solution's costs are too high. For example, the suggestion would apparently allow a tort plaintiff to escape a directed verdict at the close of his case even though he presents no evidence tending to establish the
advantage both of weaknesses in the plaintiff’s case and of the factfinder’s common-sense ability to spot theories specifically offered by neither party but rationally based on the evidence. In the long run I think that justice in the sense of accurate verdicts will be enhanced. This may in part reflect my feeling that the paradoxes that Professor Allen and others pose are not as serious as some think, and my belief that even if they pose conceptual problems this does not mean that the rules currently regulating trial proof make the trial an irrational fact-finding institution.

defendant’s fault. Moreover, if the defendant presents no evidence that he was not at fault Professor Allen would apparently let the case get to the jury at the close of all the evidence, for his view appears to be that if the parties do not wish to explore some feature of the case in great depth a court should not force them to do so. Id. at 428. This suggestion is troublesome for a variety of reasons. The first, to which I have alluded, is the cost of forcing the defendant to mount a defense when the plaintiff has no case. A second is that the argument assumes that proof is equally accessible to both parties. It may be harder for the defendant to prove a negative—absence of fault—than it is for a plaintiff to prove a positive violation of some duty of care. Third, to the extent that the rule leads to recovery where defendants are not at fault, social resources would, at least in theory, be misallocated as certain potentially careless activities bear more than their share of the costs they generate. Fourth, to change the rule as Professor Allen proposes would negate the evidentiary value of the spoliation inference and perhaps reduce confidence in judgments. Currently, if a plaintiff presents no evidence of fault in his case-in-chief, we can be confident that a directed verdict is just because the burden placed on plaintiffs means that if evidence of the defendant’s fault were available, the plaintiff would surely have presented it. Under Professor Allen’s proposed scheme, the plaintiff’s (or the defendant’s) failure to present evidence on a hitherto legally necessary element of the plaintiff’s case would justify only a lesser inference of nonexistence since the evidence might be withheld—perhaps knowing the other side could offer nothing on the point as well—for tactical reasons. Finally, Professor Allen’s scheme neglects certain symbolic and other hard to quantify values. The adversary system is not the law’s highest value. We may not wish our legal system to allow parties to recover in negligence without evidence of defendant’s fault even if both parties are willing to let the case go to the jury in this posture. The system does not exist to take cognizance of all disputes or to resolve all cases on the grounds the parties prefer.

The example of parties who in developing their specific stories choose not to present evidence of fault in a negligence case is an extreme example chosen to make a point. But I think many of the same arguments apply in other cases, such as Professor Allen’s example of the case where the parties both choose to rely on relatively crude statistical data. Id. The issue is not just whether the parties should be allowed to choose what evidence to present as Professor Allen suggests. Rather, given a variety of policy reasons like those sketched above, the issue is what should be the consequence of a party’s choice when the other side moves for a directed verdict. I don’t see the adoption of Professor Allen’s suggestions as improving the current rules.

Note that this latter possibility is symmetrical. Common-sense theories not specifically advanced may fill what would otherwise be gaps in the plaintiff’s case.
In sum, I do not think that Professor Allen offers us a theoretically or practically useful reconceptualization of trials. Nevertheless, I admire Professor Allen's article for the creativity that underlies some of his most controversial claims. His novel positions make his effort an interesting and stimulating piece of work. In this respect Professor Allen's article illustrates the virtues of the new evidence scholarship, for it suggests the controversy and intellectual excitement that are likely to accompany the move from a concern for rules to a concern for proof.