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Preponderance, Probability and Warranted Factfinding

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PREPONDERANCE, PROBABILITY AND WARRANTED FACTFINDING*

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INTRODUCTION

Legal factfinding is a process governed by procedural rules, evidentiary rules on admissibility and exclusion, legal sufficiency rules, rules of presumption and standards of proof.

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It has as its goal the generation of warranted findings of fact. This Article explores what it means for a factual determination to be "warranted by a preponderance of the evidence," the traditional formulation of the standard of proof in civil litigation.[1] Courts have interpreted this standard as meaning that the party having the burden of persuasion on a proposition must prove that the proposition is "more probably true than false."[2] It is also said that the "weight" or "convincing force" of the evidence in favor of the proposition must be "greater than" the weight of evidence tending to establish the assertion's falsehood.[3]

Many courts and most theorists have gone further, however, explaining the meaning of "probably true" in terms of probability measured on a cardinal scale between 0 and 1,[4] and locating the threshold of "preponderance" on that scale as ½, 0.5 or 50%.[5] This further interpretation has sometimes led to

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[1] *See, e.g.*, 2 MCCORMICK ON EVIDENCE § 339, at 438 (John W. Strong ed., 4th ed. 1992).

[2] *See, e.g., id.* at 439; MICHAEL O. FINKELSTEIN, QUANTITATIVE METHODS IN LAW: STUDIES IN THE APPLICATION OF MATHEMATICAL PROBABILITY AND STATISTICS TO LEGAL PROBLEMS 65 (1978) ("A majority of courts and all commentators agree that the preponderance of evidence means, as McCormick puts it, 'proof which leads the jury to find that the existence of the contested fact is more probable than its non-existence.'") (quoting MCCORMICK'S HANDBOOK OF THE LAW OF EVIDENCE § 339, at 794 (Edward C. Cleary ed., 2d ed. 1972)); David Kaye, Book Review, *Naked Statistical Evidence*, 89 YALE L.J. 601, 603 (1980) (reviewing MICHAEL FINKELSTEIN, QUANTITATIVE METHODS IN LAW: STUDIES IN THE APPLICATION OF MATHEMATICAL PROBABILITY AND STATISTICS TO LEGAL PROBLEMS (1978)); J.P. McBaine, *Burden of Proof: Degrees of Belief*, 32 CAL. L. REV. 242, 247, 261 (1944).

[3] *See, e.g.*, FLEMING JAMES, JR., ET AL., CIVIL PROCEDURE § 7.14 (4th ed. 1992); McBaine, *supra* note 2, at 247.

[4] Measurement on a "cardinal scale" means classification on a scale using a standard unit of measurement, and which allows comparisons between gradations in terms of ratios (proportions or percentages). For example, height is normally measured on a cardinal scale, in units such as inches, and one person can meaningfully be said to be twice as tall as another person. By contrast, measurement on an "ordinal scale" is a mere ordering or ranking on the basis of some property, without a meaningful unit of measurement between categories. An ordinal scale for height might have only three categories: "short/medium/tall." *See* Vern R. Walker, *The Siren Songs of Science: Toward a Taxonomy of Scientific Uncertainty for Decisionmakers*, 23 CONN. L. REV. 567, 577-78 (1991).

[5] *See, e.g.*, United States v. Shonubi, 895 F. Supp. 460, 471 (E.D.N.Y. 1995), *vacated and remanded on other grounds*, 103 F.3d 1085 (2d Cir. 1997) ("there is a consensus among judges that burdens of proof can be stated in numerical terms," citing a survey of federal judges that "found general agreement" that the preponderance standard "translates into 50+ percent probability"); United States v. Fatico, 458 F. Supp. 388, 403 (E.D.N.Y. 1978), *aff'd*, 603 F.2d 1053 (2d Cir. 1979),

troubling results. In the "lost chance cases" in tort law, for example, this cardinal interpretation has led some courts to hold that the plaintiff must prove a "better-than-50% chance" of surviving but for the defendant's negligence, which may be impossible if the plaintiff's chance of survival was less than 50% even before the negligence.[6] Other courts facing lost chance cases have made radical changes in traditional concepts such as causation in order to avoid the harsh results of adopting such a "50% chance" rule.[7] In other cases, courts have held

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cert. denied, 444 U.S. 1073 (1980) ("Quantified, the preponderance standard would be 50+% probable."); Steve Gold, *Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence*, 96 YALE L.J. 376, 378, 384-86 (1986) (emphasis added).

For a discussion of theorists adopting such a quantitative interpretation of the preponderance standard, see, e.g., David Kaye, *The Limits of the Preponderance of the Evidence Standard: Justifiably Naked Statistical Evidence and Multiple Causation*, 1982 AM. B. FOUND. RES. J. 487, 493 ("Under the preponderance-of-the-evidence standard, all that is required is that the probability in question exceed ½."); Talbot Page, *On the Meaning of the Preponderance Test in Judicial Regulation of Chemical Hazard*, 46 LAW & CONTEMP. PROBS. 267, 268-71 (1983) (describing the "traditional interpretation" and "conventional wisdom" concerning the preponderance standard as requiring "that the plaintiff must convince the court that the probability that the defendant's activity caused the plaintiff's injury . . . is more than 50%"); David Rosenberg, *The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System*, 97 HARV. L. REV. 851, 857 (1984) (courts have typically equated the preponderance requirement "with a degree of certainty exceeding fifty percent"); Ralph K. Winter, Jr., *The Jury and the Risk of Nonpersuasion*, 5 LAW AND SOC'Y REV. 335, 335-39 (1971) ("the need is only to form *an actual belief as to the balance of probability*—that is, a belief as to which side enjoys the 50%+ advantage").

Cardinal probabilities can be expressed as fractions (such as ½), decimals (0.5), or percentages (50%), since each can denote a real value between 0 and 1. I typically employ decimals to refer to probabilities, however, and use percentages to refer to relative frequency statistics or parameters (such as the expected injury incidence in a group). This notational difference helps to reinforce the distinction between a probability and a relative frequency.

[6] *E.g.*, Dumas v. Cooney, 1 Cal. Rptr. 2d 584, 589-92 (Cal. Ct. App. 1991) (interpreting "probability" as "more likely than not," and in the face of a "not-better-than-even chance" of survival absent negligence, declining "to establish a more lenient standard of causation"); Fennell v. Southern Md. Hosp. Ctr., Inc., 580 A.2d 206, 210-14 (Md. 1990) (holding that the causation element and the preponderance standard require refusing full recovery for death, given a loss of "less than 50% chance" of survival). For discussion and citation to additional cases, see Vern R. Walker, *Direct Inference in the Lost Chance Cases: Factfinding Constraints Under Minimal Fairness to Parties*, 23 HOFSTRA L. REV. 247, 248-56 (1994).

[7] *E.g.*, Evers v. Dollinger, 471 A.2d 405, 413-15 (N.J. 1984) (adopting "substantial factor" causation); Herskovits v. Group Health Coop. of Puget Sound, 664 P.2d 474, 477-78 (Wash. 1983) (en banc) (adopting "substantial factor" causation); *see* DeBurkarte v. Louvar, 393 N.W.2d 131, 137 (Iowa 1986) (in lost chance case, by

that the "more likely than not" requirement translates into a quantitative threshold of statistical evidence.[8] In this Article, I argue that many of these problems and proposed solutions are premised on an ill-advised cardinal interpretation of the preponderance standard.[9]

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viewing the underlying injury and not the lost chance of survival as the compensable injury, and by allowing plaintiff to recover all damages resulting from the injury and not just proportional damages, courts "effectively allow[ ] a jury to speculate on causation because expert testimony that a physician's negligence *probably* caused the total damages is not required," and they thereby adopt "an extreme position" that "clearly distorts the traditional principles of causation"); *cf.* Werner v. Blankfort, 42 Cal. Rptr. 2d 229, 232-39 (Cal. Ct. App. 1995) (discussing range of positions on causation taken by recent courts). For discussion and citation to additional cases, see Walker, *supra* note 6, at 248-51.

[8] *E.g.*, in a Bendectin case, DeLuca v. Merrell Dow Pharmaceuticals, Inc., 911 F.2d 941, 957-59 (3d Cir. 1990), *cert. denied*, 510 U.S. 1044 (1994), the court of appeals reasoned directly from the plaintiff's "burden on causation under a more likely than not standard" to a requirement that epidemiologic evidence alone would be legally insufficient evidence of specific causation unless it showed a "relative risk of limb reduction defects" exceeding 2. The *DeLuca* court quoted with approval the following passage from Manko v. United States, 636 F. Supp. 1419, 1434 (W.D. Mo. 1986), *aff'd in relevant part*, 830 F.2d 831 (8th Cir. 1987):

> A relative risk of "2" means that the disease occurs among the population subject to the event under investigation twice as frequently as the disease occurs among the population not subject to the event under investigation. Phrased another way, a relative risk of "2" means that, on the average, there is a fifty per cent likelihood that a particular case of the disease was caused by the event under investigation and a fifty per cent likelihood that the disease was caused by chance alone. A relative risk greater than "2" means that the disease more likely than not was caused by the event.

See Daubert v. Merrell Dow Pharmaceuticals, Inc., 43 F.3d 1311, 1320-22 (9th Cir.), *cert. denied*, 116 S. Ct. 189 (1995) (following *DeLuca* in holding that in order "for an epidemiological study to show causation under a preponderance standard," the study "must show that children whose mothers took Bendectin are more than twice as likely to develop limb reduction birth defects as children whose mothers did not"); Bert Black & David E. Lilienfeld, *Epidemiologic Proof in Toxic Tort Litigation*, 52 FORDHAM L. REV. 732, 767-69 (1984) ("if, in an exposed population, more than half the cases of a disease can be attributed to the exposure, . . . then absent other information about a diseased individual, it is more likely than not that his or her illness was caused by the exposure"; moreover, epidemiologic evidence cannot be sufficient to establish causation unless the relative risk is "greater than 2").

[9] For other discussion concerning the cardinal interpretation of probability in a legal context, see generally Ronald J. Allen, *The Nature of Juridical Proof*, 13 CARDOZO L. REV. 373, 416 (1991) ("[t]he paradigm case of litigation is not one in which a cardinal theory of probability is appropriate; rather, the paradigm case of litigation requires an ordinal theory"); Ronald J. Allen, *On the Significance of Batting Averages and Strikeout Totals: A Clarification of the "Naked Statistical Evidence" Debate, the Meaning of "Evidence," and the Requirement of Proof Beyond*

Part I lays the foundation for this argument by using a traditional epistemological model of knowledge to identify policy objectives behind legal factfinding generally, considered without regard to the applicable standard of proof. In Part II, I argue that adopting a cardinal probability interpretation of the preponderance standard is not required by these general policy objectives, nor by the additional policy objectives behind the choice of the preponderance standard in civil litigation. I reject in particular the arguments that a "0.5 probability" interpretation either minimizes or equally distributes the rate of factfinding error. In fact, the legitimate institutional objectives behind the preponderance standard in civil litigation—namely, creating incentive to produce adequate evidence and treating all parties in an unbiased fashion—are better achieved without such a cardinal interpretation. Part III characterizes adequate theories of warrant for legal factfinding that need not employ a cardinal concept of probability. In addition, that part illustrates the kinds of "warrant rules" I have in mind by using the example of the lost chance cases.[10]

I. THE EPISTEMOLOGICAL MODEL AND CHARACTERISTICS OF WARRANTED FACTFINDING GENERALLY

The basic strategy of this Article is to understand legal factfinding by using the epistemological theory that knowledge consists of "warranted true belief."[11] That is, a person is cor-

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a Reasonable Doubt, 65 TUL. L. REV. 1093, 1096 (1991) ("The only difference between [his] proposal [for basing verdicts on the more plausible account] and present practice would be the elimination of any reference to a cardinal burden of persuasion. Instead, the burden of persuasion would be ordinal."); D.H. Kaye, *Do We Need a Calculus of Weight to Understand Proof Beyond a Reasonable Doubt?*, 66 B.U. L. REV. 657, 672 (1986) (arguing that "theories that employ cardinal probabilities to analyze factfinding in the legal process" have produced rich insights and "are amenable to further refinement and supplementation").

[10] Such cases illustrate some of the unfortunate results of uncritically adopting a cardinal conception of probative value and a 0.5 decision rule for factfinding. The cases involve inferences from statistical estimates of expected incidence in a group to probabilistic conclusions about a specific individual—for example, the inference from "75% of people in the plaintiff's circumstances would have died from causes unrelated to the defendant's negligence" to the conclusion that "this plaintiff probably would have died even absent the negligence (with probability = 0.75)." The logical problems associated with such cases are discussed *infra* Section III.B.

[11] *E.g.*, ALVIN PLANTINGA, WARRANT: THE CURRENT DEBATE 3-5 (1993); JOHN L.

rectly said to "know" that a proposition is true if, but only if: (1) the proposition is true; (2) that person believes the proposition to be true; and (3) there is adequate warrant for the proposition. I propose that legal factfinding has the goal of producing knowledge in this sense of "warranted true belief." The factfinder *ought* to "accept as true for legal purposes" those propositions that are sufficiently warranted, and *ought* to "reject as unproven" all other propositions. As I use the term "warrant," therefore, it is a normative concept. It is that property by virtue of which a proposition ought to be accepted as true within the context of legal factfinding.[12]

This epistemological model will be used in this part to examine the characteristics of warranted factfinding that hold generally, regardless of which legal institution conducts the factfinding and which standard of proof is employed. Therefore, these features should hold in judicial adjudication (civil or criminal) and in administrative adjudication, as well as in administrative rulemaking and legislative factfinding. Part II will then discuss additional objectives of factfinding within the institutional context of civil litigation, and specifically factfinding under a preponderance standard of proof.

A. *Accurate Description*

On the epistemological model of knowledge, a person *knows* that something was, is or will be the case only if this something was, is or will in fact *be* the case. If a factfinder claims to know that the plaintiff is injured, but in fact the

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POLLOCK, CONTEMPORARY THEORIES OF KNOWLEDGE 7-10 (1986); *cf.* Lea Brilmayer & Lewis Kornhauser, *Review: Quantitative Methods and Legal Decisions*, 46 U. CHI. L. REV. 116, 124 (1978) (to determine which rules of statistical inference are valid requires consideration of epistemological and logical questions about knowledge and justification).

[12] In this Article I do not pretend to give a complete analysis of warrant. Plantinga's "initial" and "first approximation" is also good enough for my present purposes: "warrant is a normative, possibly complex quantity that comes in degrees, enough of which is what distinguishes knowledge from mere true belief." PLANTINGA, *supra* note 11, at 4. For a sense of the complexities involved in devising a complete analysis of warrant itself, see, e.g., Edmund Gettier's classic article, *Is Justified True Belief Knowledge?*, 23 ANALYSIS 121 (1963), and the extensive philosophical literature commenting on the "Gettier problem." Fortunately, a complete analysis of warrant is not needed in order to analyze the preponderance standard in terms of warrant.

plaintiff is not injured, then the factfinder is mistaken—not only about the plaintiff's condition but also about the claim to have knowledge. The factfinder may indeed have a (false) belief about the plaintiff, may be making a good faith claim to knowledge, and may even be making an understandable error given the factfinder's view of the evidence. But that factfinder does not, in fact, have knowledge of an injury. Thus, truth (or accurate description) is a logically necessary condition for knowledge.

The ideal of legal factfinding is the attainment of human knowledge, which in turn entails attaining truth.[13] The fundamental task for the factfinder, on this conception, is to discover the truth about the course of events being disputed—that is, to determine which propositions constitute an accurate description of those events. A finding of fact that is a false description or prediction is to be avoided. But attaining "full" or "absolute" knowledge is generally not possible in law, and is certainly not required for factfinding. For example, the phrase "proof by a preponderance of the evidence" expresses the notion that legal factfinding can and should proceed on something less than full knowledge.[14] A proposition may be "found" to be true even if it is only "probably true."[15]

A theory of legal factfinding should therefore state what we mean by "probably true" in this context. What do we mean by being "close enough to truth" for legal purposes? One possible meaning stems from a relative frequency interpretation of probability familiar in everyday life from games of chance. On this frequency interpretation, the probability of a specific type of event (such as rolling a "6" on a die or drawing an "Ace" from a card deck) refers to the relative frequency with which it is expected to occur in a long run of occurrences (such as

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[13] *See, e.g.*, Jonathan J. Koehler & Daniel N. Shaviro, *Veridical Verdicts: Increasing Verdict Accuracy Through the Use of Overtly Probabilistic Evidence and Methods*, 75 CORNELL L. REV. 247, 249-50 (1990) ("Verdict accuracy is one of the principal goals of the trial process," where "verdict accuracy" means the extent to which the facts, if known to the factfinder, would require the particular verdict). The goal of discovering truth serves many purposes, such as increasing the effectiveness of legal decisions (e.g., reducing the incidence of injury through accurate determinations of causation) and grounding the legitimacy of judicial action.

[14] *E.g.*, 2 MCCORMICK, *supra* note 1, at 439-40.

[15] *See, e.g.*, V.C. Ball, *The Moment of Truth: Probability Theory and Standards of Proof*, 14 VAND. L. REV. 807, 808 (1961); McBaine, *supra* note 2, at 246-47.

throws or draws).[16] This same interpretation can be applied to other repeating events in nature, such as rain events in weather patterns, accident events in traffic patterns, disease events in living patterns.[17] When legal factfinding is about such repetitious events, the probabilities found by the factfinder are naturally interpreted as expected relative frequencies of those observable events. In such cases, to say that the event will "probably occur" is to say that the type of event is expected to occur more frequently than not in the long run of such circumstances.

There are severe limits, however, to using such a frequentist interpretation for all probabilities in law. First, factfinding in law is often about unique events, such as the chain of causal events leading to a specific plaintiff's liver cancer or the events surrounding a specific plaintiff's injury. A relative frequency interpretation makes little sense when the event is not conceived as "repeatable."[18] Second, the law is often interested in propositions about things that are not amenable to frequentist measurement methods—propositions about such things as knowledge, intent, negligence or reasonableness.[19] Third, a factfinder might assign a probability to a

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[16] On frequency interpretations of probability generally, see, e.g., L. JONATHAN COHEN, AN INTRODUCTION TO THE PHILOSOPHY OF INDUCTION AND PROBABILITY 47-53 (1989); COLIN HOWSON & PETER URBACH, SCIENTIFIC REASONING: THE BAYESIAN APPROACH 202-20 (1989).

[17] Probabilities interpreted as the expected relative frequency of observable events satisfy the formal probability calculus. Walker, *supra* note 6, at 264-69.

[18] Allen, *The Nature of Juridical Proof*, *supra* note 9, at 376-79 (factfinding in trials typically involves propositions about unique events, with no relative frequency to measure, and in such circumstances "a relative frequency interpretation of the proof rules makes no sense"); James Brook, *Inevitable Errors: The Preponderance of the Evidence Standard in Civil Litigation*, 18 TULSA L.J. 79, 82-84 (1982) ("for the typical factual issue [in a trial], . . . it is difficult, if not impossible, to conceptualize what a large number of identical trials would mean"); John Kaplan, *Decision Theory and the Factfinding Process*, 20 STAN. L. REV. 1065, 1066 (1968) ("it is meaningless to speak of the probability of the defendant's guilt in terms of the number of times he would be guilty in an infinite number of exactly similar cases").

For an example of a legal theorist making a determined attempt to apply a frequentist interpretation to probability statements about propositions in legal factfinding, while recognizing the conceptual difficulties posed by propositions about specific individuals or unique events, see Ball, *supra* note 15, at 809-14.

[19] Because the primary goal in legal factfinding is accurate description, factfinding methods understandably defer to valid and reliable scientific methods whenever the latter are available. But legal factfinding is a different activity than

proposition (as opposed to an event) and intend it to be a measure of that factfinder's degree of confidence that the proposition is true, not a measure of relative frequency. The proposition might be about a unique event or even an expected relative frequency for a repeatable event, but in either case the probability *that* the proposition is true is intended as a measure of subjective factfinder confidence.[20] In these three circumstances, and perhaps others, the frequentist meaning of "probably true" has limited usefulness. There are instances when what we mean by "probably true" is an expected relative frequency of occurrence, but that interpretation is inadequate for legal factfinding in general. The next section discusses the second element of the epistemological model and explores a competing notion of "probably true."

B. *Subjective Confidence and Belief*

What could be meant by "probably true" other than the meaning based on relative frequency of occurrence? Some theorists have turned their attention away from the "truth" element of the "warranted true belief" model of knowledge, and have focused instead on the "belief" component. Perhaps approximations to knowledge should be measured by referring to degrees of confidence or belief. This theory is that the meaning of "probably true," when predicated of a proposition in the context of legal factfinding, is that the factfinder has a stronger belief that the proposition is true than he or she has that it is false. This theory is consistent with a legal tradition that holds that there is a strong logical connection between *finding* a proposition to be true and *believing* it to be true, or at least with having a sufficiently high degree of subjective confidence about its truth.[21]

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pure science, and must proceed in the face of uncertainties not yet resolved by scientific method and in pursuit of policies unrelated to that method (such as fairness to parties and judicial economy).

[20] *See* Gold, *supra* note 5, at 382-84 (distinguishing so-called "fact probability" having a frequentist meaning from "belief probability" in a subjectivist sense).

[21] *See* Sargent v. Massachusetts Accident Co., 29 N.E.2d 825, 827 (Mass. 1940):

> The weight or ponderance of evidence is its *power to convince* the tribunal which has the determination of the fact, of the actual truth of the proposition to be proved. After the evidence has been weighed, that proposition is proved by a preponderance of the evidence if it is made to

A number of reasons can be given for requiring the factfinder to have an actual belief that a proposition is true before accepting it as a finding. If actual belief is a *necessary* condition of appropriate factfinding, then factfinding would closely parallel the logical structure of knowing (interpreted as warranted true belief). At least as an ideal, the finder of fact with an actual belief could then approximate the knower. As a psychological matter, human factfinders might also produce more accurate factfinding if they conceive of their task as one of trying to "find out the truth"—that is, trying to come to true beliefs about the course of events under controversy. Moreover, some might think that human beings are intuitive "barometers" of at least some kinds of truths—that someone's *believing* that a proposition is true is (additional) evidence that it *is* true.

Nonetheless, the legal tradition in favor of requiring actual belief by the factfinder also has its challengers. One line of objection is that "degree of confidence" is too psychological and subjective, whereas factfinding should be based on a logical re-

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> appear *more likely or probable in the sense that actual belief in its truth,* derived from the evidence, *exists in the mind or minds of the tribunal* notwithstanding any doubts that may still linger there.

(emphasis added); *see* Allen, *The Nature of Juridical Proof*, *supra* note 9, at 397 ("A preponderance of the evidence means such evidence as . . . produces in your minds a belief that what is sought to be proved is more likely true than not true.") (quoting COMMITTEE ON PATTERN JURY INSTRUCTIONS, DISTRICT JUDGES ASS'N, PATTERN JURY INSTRUCTIONS (CIVIL CASES), BASIC INSTRUCTIONS 7A (5th Cir. 1980)).

Some have emphasized degree of belief as a primary test of whether a standard of proof has been satisfied. *See, e.g.*, Addington v. Texas, 441 U.S. 418, 423 (1979) ("the function of a standard of proof . . . is to 'instruct the factfinder concerning the degree of confidence our society thinks he should have in the correctness of factual conclusions for a particular type of adjudication'") (quoting *In re* Winship, 397 U.S. 358, 370 (1970) (Harlan, J., concurring)); Gold, *supra* note 5, at 383; McBaine, *supra* note 2, at 251-55.

Some arguments are not analyses based on meaning, but appear to be more pragmatic. *E.g.*, Fleming James, Jr., *Burdens of Proof*, 47 VA. L. REV. 51, 53-54 (1961) (proposing that a jury instruction on preponderance is "more meaningful and accurate" if it requires the jury "to believe that the existence of a fact is more probable than its nonexistence" before it may find the proposition to be true); *cf.* Winter, *supra* note 5, at 339 (disagreeing with the claim that the trier of fact may not find a proposition to be proved by a preponderance of the evidence unless the factfinder has an "'actual belief' in the existence of that proposition"; rather, "the need is only to form *an actual belief as to the balance of probability*—that is, a belief as to which side enjoys the 50%+ advantage").

lation between evidence and conclusion.[22] Intuitions are sometimes notoriously wrong, and stereotypes and prejudices can produce "factual predicates" for injustice. Under certain circumstances, purely subjective determinations have become suspect in employment decisions, jury selection, and sentencing and probation of criminals. Moreover, if we reduce the problem of factfinding to the issue of *who* decides the facts instead of *how* the facts should be decided, we might give up prematurely the quest for reasoned bases for factual determinations and drift away from the rule of law. Another objection is that focusing attention on the factfinder's beliefs diverts attention away from the underlying events being disputed.[23] Others object to the typical subjectivist interpretations of probability in terms of betting odds.[24]

Actual belief is a necessary condition for human knowledge. Standing alone, however, actual belief is inadequate as a complete account of the *meaning* of "probably true" in legal

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[22] *Cf.* Brook, *supra* note 18, at 96 (suggesting that forming an actual belief is "essentially a cultural or psychological question of when an individual is prepared, short of absolute certainty, to turn his innermost thoughts into a statement of 'I believe' on which others may judge both that of which he speaks as well as him personally").

[23] *Cf.* Charles Nesson, *The Evidence or the Event? On Judicial Proof and the Acceptability of Verdicts*, 98 HARV. L. REV. 1357, 1359 (1985) ("A verdict based on a high probability may be unacceptable if it fails to make a statement about what happened; conversely, a verdict based on a low probability may be acceptable if it makes such a statement.").

[24] The "betting odds" on the truth of a proposition determine the amount a bettor would lose if the proposition is false and the amount a bettor would win if it is true. Any reasonable person setting the betting odds would take into account his or her subjective belief about the likelihood that the proposition is true. *See* Walker, *supra* note 6, at 272-76. The subjectivist interpretation of probability statements is examined *infra* Section II.C. For arguments against using a subjective interpretation of probability statements in legal factfinding, see, e.g., Allen, *The Nature of Juridical Proof*, *supra* note 9, at 379-81 (arguing that a subjectivist interpretation of the "proof rules" used in law is implausible); Craig R. Callen, *Notes on a Grand Illusion: Some Limits on the Use of Bayesian Theory in Evidence Law*, 57 IND. L.J. 1, 3 (1982) (equating Bayesian theory with subjective probability); L. Jonathan Cohen, *Subjective Probability and the Paradox of the Gatecrasher*, 1981 ARIZ. ST. L.J. 627, 629-34; Edward Gerjuoy, *The Relevance of Probability Theory to Problems of Relevance*, 18 JURIMETRICS J. 1, 22-24 (1977) (explaining reasons why a subjective interpretation is likely to be no more useful than a frequency theory in dealing with legal problems); Charles Nesson, *Agent Orange Meets the Blue Bus: Factfinding at the Frontier of Knowledge*, 66 B.U. L. REV. 521 (1986) ("Probability, as a legal concept in the law of proof, suggests wisdom, probity, and approbation—not favorable betting odds.").

factfinding, or as a general criterion of warranted factfinding. To see why, it is useful to distinguish between justification and warrant.[25] Whether a proposition is "warranted" is an epistemological question, but whether a factfinder is "justified" in making findings is a deontological question that involves such considerations as duty, policy, and human psychology. This distinction needs to be explored further.

As used here, the term "justified" applies only to *persons* acting in specifiable circumstances. Justification rules address how people ought to act in various circumstances. A factfinder may be justified in making a finding, depending upon various psychological conditions (such as actual belief, good faith, lack of conscious bias) and other circumstances (for example, after all of the evidence has been presented). The policies at work in setting conditions for human justification surely include more considerations than merely the epistemological objective of attaining accurate description.

By contrast, *propositions*, not people, are "warranted." Whether a proposition is warranted depends primarily upon the character of the evidence, and upon other factors that vary with the content of the proposition. But warrant and justification are distinct. A certain factfinder might be justified under the particular circumstances in drawing a conclusion that is in fact unwarranted.[26] Moreover, a conclusion might be warranted, but the particular factfinder not justified in drawing it, due perhaps to lack of attention to key evidence.

This distinction between justification and warrant enables us to understand the logical role of subjective belief. In many circumstances, actual belief would seem to be a logically neces-

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[25] *See* PLANTINGA, *supra* note 11, at 11-29 (discussing "classical deontologism," his term for the major philosophical tradition in which to have knowledge is to have "*justified* true belief"; "[t]o be justified is to be without blame, to be within your rights, to have done no more than what is permitted, to have violated no duty or obligation, to warrant no blame or censure"). I see no need here to posit an "intellectual duty" for people who function as factfinders, or an "epistemic duty" grounded in their being rational. *Cf.* PLANTINGA, *supra* note 11, at 11-29 (discussing "classical deontologism"). In law we can manage quite well with a legal duty to "find facts" according to certain norms, which arises from the factfinder's role in the legal system.

[26] For example, a juror might have been justified in reaching the verdict on the evidence as the juror understood it, but that juror misunderstood the terminology used by an expert witness and the testimony actually made the finding unwarranted.

sary condition for being personally *justified* in making a finding or for accepting a proposition as true. It would be confusing for someone to say in good faith "I know it to be true, but I don't believe it," unless that person is merely choosing an emphatic way of saying "I find it hard to believe, but believe it nonetheless." As a general matter, factfinders are not justified in asserting something to be true unless they believe it to be true.

But the existence of actual belief is neither necessary nor sufficient for a proposition to be "probably true." First, having an actual belief is not logically necessary in the sense of "probably true" needed for factfinding. A proposition can be probably true but the factfinder not believe it to be true—due perhaps to a held stereotype about the plaintiff or the defendant. Second, having even a high degree of subjective confidence is not logically sufficient for a proposition being "probably true." Even if a factfinder is completely convinced that a proposition is true, this fact does not entail that the proposition is in fact "probably true." Any correlation between subjective confidence and accurate description is an empirical matter, and the degree of correlation varies with individual factfinders, with the content of propositions, and with types of evidence presented. So actual belief is neither necessary nor sufficient for a proposition to be "probably true," although degrees of belief may sometimes be good predictors for truth.

This logical disconnection is not remedied by moving to a communal version of subjective belief as an account of the meaning of "probably true." We might be tempted to say that a proposition sufficiently approximates knowledge for purposes of factfinding if there exists a high degree of consensus about it. There is something "objective," or at least intersubjective, about knowledge as contrasted with merely personal beliefs. The expected degree or level of consensus on the truth of a proposition can be referred to as the "expected scope of agreement" on it. Expected scope of agreement is a prediction about the distribution of subjective confidence or belief within a group of persons.[27] I personally can have different degrees of

[27] It is important to distinguish the expected scope of agreement, so understood, from "confidence intervals" in statistics. I reject cardinality and precision in interpreting the preponderance standard itself, *see infra* Parts II & III, so my

subjective confidence in my ability to make accurate predictions of different kinds, but I might expect my different conclusions to enjoy varying scopes of agreement.

In order to explore this further, we can distinguish between an idiosyncratic belief and a belief on which the factfinder expects some significant degree of consensus or agreement. An idiosyncratic belief is a particular individual's personal opinion made with an expectation of little or no agreement by others. For example, I might confidently make a prediction about the electoral college vote in the next presidential election, and assign to that prediction a very high subjective probability of its being a true prediction. Nonetheless, I might expect little agreement by others on that prediction. I might be thoroughly convinced that I can predict the future event from observing tea leaves or by using my personal polling technique, but I might expect few people to agree with my prediction. At the other extreme, a factfinder might expect nearly everyone who considers the same evidence to agree with the finding. Many probability statements enjoy such high expected agreement—for example, "the sun will probably rise tomorrow." In the wide range between such statements and idiosyncratic beliefs lie most of the factual judgments we make in daily life. We normally expect different scopes of agreement for different types of proposition, depending largely on the propositional content, the available evidence, and the methods used to draw the inference.

One might suggest that part of what we mean by "probably true" is that there will be a fairly wide scope of agreement on the proposition.[28] On this view, the different judicial stan-

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analysis is ultimately inconsistent with attempts to analyze the *meaning* of the preponderance standard using statistical confidence intervals. For what appears to be such an attempt, see Neil B. Cohen, *Confidence in Probability: Burdens of Persuasion in a World of Imperfect Knowledge*, 60 N.Y.U. L. REV. 385 (1985). For a critique of this attempt from within the statistical decision framework, see D.H. Kaye, *Apples and Oranges: Confidence Coefficients and the Burden of Persuasion*, 73 CORNELL L. REV. 54 (1987); and for a response, see Neil B. Cohen, *Conceptualizing Proof and Calculating Probabilities: A Response to Professor Kaye*, 73 CORNELL L. REV. 78 (1987). It may well be, of course, that particular warrant rules governing certain circumstances might employ the concept of confidence intervals.

[28] *Cf.* Richard Lempert, *The New Evidence Scholarship: Analyzing the Process of Proof*, 66 B.U. L. REV. 439, 445 n.22 (1986):

> 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 subjec-

dards of proof would correspond to different scopes of agreement. Under the preponderance standard, the factfinder would be expected to reach factual conclusions on which there would be agreement by many or most persons weighing the same evidence, but we might not expect anything close to unanimity. While factual determinations based on a preponderance of evidence should be worthy of wide respect as being "reasonable," we acknowledge that "reasonable minds may differ," and lack of wide consensus is therefore understandable. By contrast, under a "clear and convincing" standard of proof, we could expect a much wider consensus among persons familiar with the evidence; and factual determinations that are "beyond a reasonable doubt" would be expected to enjoy a very wide consensus.[29] Even under the weakest legal standard of preponderance, therefore, factual findings should be at least "probably true," and thus not "subjective" in the sense of being idiosyncratic. Moreover, if the appropriate scope of agreement were used as a criterion for factfinding, factfinders would not act with indifference to what other people might think. A factfinder would make a finding of fact only if she expected fairly wide agreement on that finding by other people weighing the same evidence. A conclusion would be probably true only if people considering the same evidence would tend to agree on that conclusion. An expectation of a fairly wide scope of agreement would be a necessary condition for possessing warrant.[30]

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tive 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.

[29] Numerous theorists have assumed that the differences between these standards of proof should be explained by the "degree of probability" assigned to the proposition. For example, on the subjectivist interpretation of probability the standards would be met by various degrees of subjective confidence. *See, e.g.*, David Kaye, *The Paradox of the Gatecrasher and Other Stories*, 1979 ARIZ. ST. L.J. 101, 103. The suggestion being discussed in the text distinguishes standards of proof in part on the basis of the expected scope of agreement. The expected scope of agreement on a finding is quite distinct from the subjective probability assigned to it, and can vary independently from it.

This goal of making findings that merit a degree of community consensus is distinct from, but consistent with, the goal of actually achieving community acceptance of verdicts. *Cf.* Nesson, *supra* note 23, at 1368-77 ("some procedures that are rationalized as truth-seeking devices are better understood as means to promote public acceptance of verdicts").

[30] A further appropriate distinction might be between agreement "that the

But there are some problems with this view as it has been stated. First, scope of agreement is not logically connected to probability of truth. Even complete consensus within a community is neither necessary nor sufficient for truth. A conclusion might enjoy a wide consensus among people familiar with the same evidence, but the conclusion might be unwarranted. Similarly, true propositions can be widely disbelieved. Communities of people have histories of fluctuating common belief. Even the history of science is filled with examples of the paradigms, assumptions and theories of one age giving way to the rethinking of the next.[31] The statistical methods of this century have revolutionized our understanding of how to prove general propositions, and our rules of inference or warrant have evolved significantly over that time.

Second, we do not normally tell the factfinder that expected scope of agreement is a necessary truth-condition for factfinding, or that such expected agreement should be used as a criterion by which to decide whether a proposition should be regarded as "probably true." Quite the contrary. We probably communicate to the factfinder the message that community beliefs are *not* the measure of probable truth.[32] We do not intend that a juror be a mere predictor for what the community thinks—or even for what the community would think if it were familiar with the evidence as presented.

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proposition is true" and agreement "that it is reasonable to find the proposition to be true." Under the preponderance standard, we might require fairly wide consensus on the former, but nearly unanimous consensus on the latter.

[31] The classic treatment is THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS (2d ed. 1970).

[32] *See, e.g.*, 2 CALIFORNIA JURY INSTRUCTIONS, CIVIL: BOOK OF APPROVED JURY INSTRUCTIONS § 15.30 (Charles A. Loringed ed., 7th ed. 1986) [hereinafter BAJI]:

> Each of you must decide the case for yourself, but should do so only after considering the views of each juror.
>
> You should not hesitate to change an opinion if you are convinced it is wrong. However, you should not be influenced to decide any question in a particular way simply because a majority of the jurors, or any of them, favor such a decision.

This message is consistent with instructions jurors might hear on weighing conflicting testimony. *See, e.g.*, 1 BAJI, *supra*, § 2.01 (instructing that "[t]he test is not the number of witnesses, but the convincing force of the evidence"); 1 BAJI, *supra*, § 2.41 (instructing that the jury "should consider the qualifications and believability of each [expert] witness, the reasons for each opinion and the matter upon which it is based").

For jurisprudential and practical reasons, however, we certainly hope that verdicts in fact enjoy widespread agreement.[33] And although wide scope of agreement may not be part of the *meaning* of "probably true," the two do seem to enjoy a logical link that goes beyond this hoped-for correlation. When we say that a conclusion is "probably true in light of the evidence," part of what we might mean is that "any *reasonable* person" familiar with that evidence would agree with the drawing of that inference, or perhaps that most people would agree that drawing that inference is a *reasonable* act. That is, we claim to be arriving at the conclusion reasonably, in a way that should be transparent to others who are also reasonable.[34] We convey this meaning to the factfinder by instructions that emphasize the proper role of the evidence in the factfinding.[35] The point here is how reasonableness supports an expectation of fairly wide scope of agreement. If a factfinder attends to the evidence and draws reasonable conclusions from it, we anticipate that the community will probably recognize the reasonableness of the decision and respect it. But community consensus is not part of the meaning of "probably true," nor does it confer warrant. The evidence and the reasonable inference themselves must warrant asserting the probability of truth.

To summarize, having an actual belief seems to be psychologically and logically necessary for having human knowledge. Moreover, we might not consider factfinders justified in making findings unless they have formed a belief that the finding is probably true. But having such a belief is neither necessary nor sufficient in order for the proposition to be probably true. Degree of belief cannot by itself assure the degree to which accurate description is approached. Nor can the expected scope

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[33] *Cf.* Nesson, *supra* note 23 (arguing that one object of judicial factfinding is the generation of verdicts "acceptable" to the public).

[34] Judges should set aside verdicts that have no reasonable basis in the evidence presented, even when the verdict is reached under the preponderance standard of proof. *See, e.g.*, JAMES ET AL., *supra* note 3, § 7.30 (standard for granting judgment notwithstanding the verdict is same as for directing verdict: "only one reasonable verdict is possible"). What "reasonableness" means in this context is discussed in greater detail *infra* Sections I.D, III.A.

[35] *E.g.*, 1 BAJI, *supra* note 32, § 2.60 ("Preponderance of the evidence' means evidence that has more convincing force than that opposed to it."); *see supra* note 32.

of agreement within the community. For approximating accurate description we turn to warrant, which in both epistemology and law entails drawing reasonable conclusions from the evidence.

C. *Minimal Fairness to Parties*

If the meaning of "probably true" is to be expressed in gradations of "being warranted," the third element of knowledge, what do we mean by "warranted"? I have argued elsewhere that if a factfinder assigns probability values to propositions with the intent that they be interpreted subjectively as expressing a degree of confidence, then minimal fairness to interested parties requires that those assignments must be "coherent" in the sense of satisfying the formal probability calculus.[36] That is, in order to avoid introducing an a priori bias against some party in the set of findings, a factfinder's determinations about subjective confidence must satisfy the axioms of the probability calculus.[37] There is likewise a minimal fairness argument that findings of fact must satisfy the calculus of deductive logic, as well as the rules of arithmetic and basic mathematics. And there may well be epistemological arguments for these formal requirements that are independent of fairness arguments. Findings of fact should be held to the standards of logical consistency and, where applicable, mathematical correctness.[38]

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[36] Walker, *supra* note 6, at 272-79 (a set of subjectively assigned "betting quotients" for the truth of propositions must satisfy the axioms of the probability calculus in order to be minimally fair—that is, in order to avoid being biased against some party a priori, independently of whether the betting quotients are correctly set and independently of the truth or falsehood of the propositions involved); *see* Ronald J. Allen et al., *Probability and Proof in* State v. Skipper*: An Internet Exchange*, 35 JURIMETRICS J. 277, 305-07 (1995) (remarks of David Kaye that the "bettor who violates the laws of the probability calculus leaves himself open to having book made against him"); David Kaye, *The Laws of Probability and the Law of the Land*, 47 U. CHI. L. REV. 34 (1979) (defending the subjective interpretation of probability statements in law against certain attacks).

[37] This constraint of satisfying the probability calculus, which I have argued is a constraint of minimal fairness on sets of factual findings, can also be considered a minimal requirement of reasonableness. While resort to the concept of a "reasonable person" is one way of conceptualizing the additional constraints being placed on factfinding, the primary rationale for those constraints should be fairness to parties.

[38] One reason for setting a threshold decision value at or above the mid-point

I propose, therefore, that it is not possible for a set of findings to be warranted if those findings contain incoherent probability assignments, internal contradictions, or mathematical miscalculations. This necessary condition will be referred to as the requirement for "coherence and consistency." But although coherence and consistency may be necessary for warrant, they are not logically sufficient. There may be many internally coherent and consistent sets of findings that are reachable given the evidence, but not all of them are warranted.[39] It is not enough for factfinders simply to achieve internal coherence and consistency within their findings, for they must also make those findings describe reality as accurately as possible.[40]

Another problem with relying solely upon coherence and consistency to explain what we mean by "probably true," in the sense of sufficiently approximating accurate description, is that coherence and consistency do not come in degrees. A set of factual determinations either satisfies these formal requirements or it does not. So coherence and consistency cannot measure the *degree* to which a proposition comes sufficiently close to being true, so as to warrant accepting it as true. A set of propositions needs more than internal coherence and consistency before it is probably true, or have sufficient warrant to be found as fact for legal purposes.

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on a scale of degree of warrant, *see infra* Part II, is so that a factfinder could not validly find both a proposition and its negation to be true. Thus, contradictions are avoided within a single set of findings. *Cf., e.g.*, HENRY E. KYBURG, JR., SCIENCE & REASON 66 (1990) (a set of propositions does not contain "both a statement and its denial, so long as the level of acceptance is chosen to be greater than .5").

[39] Walker, *supra* note 6, at 278-79 (being minimally fair does not guarantee that there exists a unique probability for every proposition in a given evidentiary situation); *see* Kaye, *supra* note 9, at 671 (the "formal property of coherence may be a necessary feature of a satisfactory normative theory of forensic proof, but . . . we ought to demand more than this").

[40] However, it is possible that in very special circumstances the requirement of minimal fairness can go a long way toward compelling a factfinding result. For example, in lost chance cases involving direct inference, it is minimal fairness that dictates and warrants the inference. *See infra* Section III.B.

D. *Sufficient Support in the Legally Available Evidence*

The previous section provides one necessary condition for a warranted finding of fact: Minimal fairness to parties requires that any set of findings be logically consistent and mathematically correct, and that any probability assignments within it must satisfy the axioms of the probability calculus. But what else must be required to explain the meaning of "probably true" within the context of legal factfinding? The further characteristic is that the conclusion must be "reasonably inferable" from a "basis in" that evidence that is "legally available" to the factfinder. The meaning of this additional condition will be discussed only briefly here, taking its three elements in reverse order.

We establish legal rules to identify what evidence is "legally available" to the factfinder—such as rules of procedure, rules of evidence governing judicial factfinding, and rules governing what constitutes "the record" for administrative factfinding. What is "in" the legally available evidence must provide a "basis" for the conclusion. That is, the particular information upon which the conclusion is based must be provided by the legally available evidence. Our notions of due process and governmental legitimacy require that the basis for warrant must be in that evidence that is legally available to the factfinder.[41] Finally, any inferences drawn on the basis of that information must be "reasonable." The reasoning used to draw the conclusion must be geared toward producing descriptions that are as accurate as possible, given the constraints imposed by what evidence happens to be legally available. A conclusion is therefore "probably true"—warranted as a finding—only if it is supported by the legally available evidence to such a high degree that it should be accepted as true for purposes of the legal proceeding.

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[41] *See, e.g.*, BAJI, *supra* note 32, § 1.00.5 (all questions of fact must be decided "from the evidence received in this trial and not from any other source"); *see also* Allen, *The Nature of Juridical Proof*, *supra* note 9, at 383 (the essential task of factfinding is "an evaluation of the evidentiary support for a proposition or a series of propositions"). Part of what proponents of frequentist theories of probability are trying to do is specify content for the concept of "supported by the evidence." *See, e.g.*, Ball, *supra* note 15, at 822-30.

Warrant comes in degrees, and thus has the needed logical structure for explaining what is meant by "probably true" and for measuring approximations to knowledge.[42] The legally available evidence provides gradations of support for findings.[43] Although concepts designed specifically for judicial factfinding identify qualitative tests for judicial scrutiny along this scale, such as the threshold of "legal sufficiency,"[44] the notion that evidence provides degrees of support for conclusions is a pervasive one. What in law we refer to as the "weight of the evidence" or its "probative value" is the degree to which the evidence supports or warrants a conclusion.[45]

The proposal is that the above two conditions for warrant are not only necessary, they are jointly sufficient. A proposition is *warranted* for purposes of legal factfinding if it satisfies the formal requirements of minimal fairness and has sufficient support in the legally available evidence, in the sense of being reasonably inferable from that evidence. If a conclusion is warranted, then a specific factfinder is *justified* in finding it to be true, provided he or she actually believes it to be true and satisfies any relevant additional requirements for justification. In the ideal case—in which the proposition is warranted, is actually believed by the factfinder, and is also true—the factfinder achieves knowledge of the facts. This is the epistemological as well as institutional ideal.

Given even this basic understanding of warrant, we can appreciate the relation between legal factfinding and scientific

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[42] *See* PLANTINGA, *supra* note 11, at 75-77.

[43] *Cf.* Lempert, *supra* note 28, at 458 n.48 (discussing weak and strong "spoliation inferences" in the context of "naked statistical evidence").

[44] "Legal sufficiency" is a rational floor or threshold in quality of evidence that provides the minimal weight or warrant needed before a reasonable (rational) factfinder could find or accept a proposition as true. *See* JAMES ET AL., *supra* note 3, § 7.19.

[45] It has been traditional to stress that the "preponderance" referred to in the standard is not a function merely of the number of witnesses or quantity of evidence. *See, e.g.*, James, *supra* note 21, at 53; McBaine, *supra* note 2, at 247. Weight of evidence is a function not of the evidence alone, but also of the conclusion. The same evidence can have different weight, depending upon the conclusion to be drawn from it.

In this Article, I intend to use the term "weight" as it is normally used by courts, as distinguished from more theoretical uses. *E.g.*, L. Jonathan Cohen, *The Role of Evidential Weight in Criminal Proof*, 66 B.U. L. REV. 635, 639 (1986) (contending that Keynes's concept of "weight" is, "very nearly," a "conditional probability's degree of evidential completeness").

proof. Although we expect jurors to bring to factfinding the warrant rules developed in the course of ordinary living, we also turn to specialized rules once those rules have been developed within particular sciences. When scientists develop new techniques of inductive inference, such as statistical sampling theory, the same reasoning that supports those new theories will also tend to warrant similar reasoning in legal factfinding. Although legal factfinding must also satisfy additional policies and institutional goals not at work in science, like science it aims at human knowledge and accurate description.[46] For the foreseeable future, however, scientific proof methods will continue to cover only a small portion of the factfinding necessary in legal contexts. And with respect to findings about unique events, such as specific causation in a particular plaintiff's case, scientific methods may never be adequate. Nevertheless, such findings are crucial in law, and the law must develop warrant rules suitable to its own needs.

A complete theory of warrant for legal factfinding would explain how degrees of warrant can be measured, how degrees of warrant for individual pieces of evidence can be combined into a measure of probative value for a conclusion, and when probative value is sufficiently high to trigger factfinding.[47] Although such a comprehensive theory of warranted factfinding does not seem feasible in the foreseeable future,[48] progress should be possible in limited areas of legal factfinding without first having a comprehensive theory. Moreover, "sufficient support" may be one of those open-ended concepts whose essential function includes resisting reductionist definition. Part of its value as a concept might be to allow and foster develop-

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[46] This is why law imports well-defined and well-accepted inference rules from other disciplines, and why valid and reliable scientific method enjoys evidentiary reliability by its nature. *See, e.g.*, FED. R. EVID. 702, 703; Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 590 & n.9 (1993) ("In a case involving scientific evidence, *evidentiary reliability* will be based upon *scientific validity*."). For a discussion of the generic types of scientific uncertainty and methods for reducing such uncertainty, see Walker, *supra* note 4.

[47] *See* Ronald J. Allen, *Factual Ambiguity and a Theory of Evidence*, 88 NW. U. L. REV. 604, 606, 616-30 (1994).

[48] A few theories of degree of support have been attempted. *See, e.g.*, Cohen, *supra* note 24, at 634 (describing his theory of "Baconian probability" developed in his book, *The Probable and the Provable*, as an attempt to develop a logic of grading-by-weight that could be used to grade the "validity of a proof").

ment of new models of reasonable inference. It is also consistent with the nature of legal institutions that theories of warrant would be evolved through close attention both to legal cases and to developments in knowledge-based enterprises outside the realm of law, such as the sciences and technical areas. In Section III.B, the kinds of warrant rules that can be developed without a general theory are illustrated, using the example of the lost chance cases.[49] Before discussing factfinding in those difficult cases, however, it is important to reject a widely held view that the probability of truth should be measured on a cardinal scale between 0 and 1, and that a proposition is warranted under the preponderance standard of proof if, but only if, that proposition is assigned a cardinal probability greater than 0.5.

II. REJECTION OF THE 0.5 DECISION RULE IN CIVIL LITIGATION

From the standpoint of the epistemological model of legal factfinding developed in the previous section, much of the jurisprudence interpreting the preponderance standard of proof in civil litigation has taken a very wrong turn. This conceptual wrong turn has led to errors in the way certain types of cases have been decided.

The wrong turn is possible in large part because of the ambiguities in the meaning of the word "probable." It is traditional to say that legal factfinding in general, and the preponderance standard of proof in particular, require that a proposition be "probably true" in order to be accepted as true for legal purposes. This use of "probably true" is unobjectionable so long as it is given the meaning of "warranted by the legally available evidence."[50] Particular warrant rules can then be intro-

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[49] *See infra* Section III.B.

[50] This proposal should not be confused with earlier attempts to interpret probability as a "logical" relation between evidence and conclusion. For discussions of logical probability, see, e.g., COHEN, *supra* note 16, at 74-80; HOWSON & URBACH, *supra* note 16, at 48-56. The concepts of probability and warrant, as used in legal factfinding, are unlikely to be definable in terms of a relation of logical entailment.

duced for specific types of evidentiary problems, and those rules might employ relative frequency statistics, subjective probabilities, and appropriate inference techniques.[51]

The wrong turn actually begins when the meaning of "probably true" is reduced to some measure other than epistemological warrant, such as objective relative frequency or subjective degree of confidence.[52] This wrong turn is exacerbated when judges and theorists use either of those interpretations of probability to define the *meaning* of "preponderance" as specifying a conclusion having a mathematical probability of at least 0.5 (or 50%).[53] The inference rule based on this misconception is that the factfinder should make a factual determination in favor of the party with the burden of persuasion if, but only if, that party succeeds in establishing that the probability of the proposition being true is greater than 0.5.[54] I will

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[51] This will be explored further *infra* Part III.

[52] *Cf.* IAN HACKING, THE EMERGENCE OF PROBABILITY 73 (1975) (distinguishing quantitative probability from a possibly qualitative "epistemic probability," but stating "as a matter of historical fact epistemic probability did not emerge as a significant concept for logic until people thought of measuring it").

[53] *See supra* note 9; *cf.* Callen, *supra* note 24, at 40 & n.193 (stating that "'probable' and 'probability' in evidence law are not delimited by mathematical notions," and suggesting that meeting the preponderance standard requires "evidence which is persuasive enough that it has an acceptable verification value").

[54] *See, e.g.*, Cooper v. Hartman, 533 A.2d 1294, 1299-1300 (Md. 1987) (stating that "[p]robability exists when there is more evidence in favor of a proposition than against it (a greater than 50% chance that a future consequence will occur)" and that "probability" means "greater than 50% chance" and "possibility" means "less than 50% chance") (quoting Pierce v. Johns-Manville Sales Corp., 464 A.2d 1020, 1026 (Md. 1983)); Cooper v. Sisters of Charity of Cincinnati, Inc., 272 N.E.2d 97, 103-04 (Ohio 1971) ("probable" in connection with standard of proof "is more than 50% of actual"); *see also, e.g.*, Ronald J. Allen, *A Reconceptualization of Civil Trials*, 66 B.U. L. REV. 401, 405 (1986); Cohen, *supra* note 27, at 394 ("[p]roponents of probabilistic decisionmaking generally agree" that the preponderance standard "is satisfied by demonstrating that the probability of the existence of the facts supporting liability exceeds 0.5"); Kaye, *supra* note 5, at 493; Koehler & Shaviro, *supra* note 13, at 249-52; Lempert, *supra* note 28, at 451-52, 454; Richard O. Lempert, *Modeling Relevance*, 75 MICH. L. REV. 1021, 1033-34 (1977) (in most civil cases, the "judge or juror *should* feel the same regret in reaching a mistaken decision for P [the plaintiff] that is felt in reaching a mistaken decision for D [the defendant]," and if so "regret is minimized by deciding for P whenever the probability of [D's] negligence is greater than .5 and deciding for D whenever the probability of negligence is less than .5"). For a contrary view, see Nesson, *supra* note 22, at 1359 ("The aim of the factfinding process is not to generate mathematically 'probable' verdicts, but rather to generate acceptable ones.").

There is some evidence that ordinary factfinders might give a different interpretation of the decision value in civil cases. *See* United States v. Shonubi, 895 F.

call this the "0.5 decision rule" for factfinding.[55] This reductionist meaning of preponderance as more than 0.5 on a cardinal scale ranging from 0 to 1 should be rejected.[56] Put another way, the 0.5 decision rule is inappropriate as a universal decision rule for factfinding in civil litigation, whether the probability involved is interpreted objectively or subjectively.[57] It is understandable how certain confusions have led to this interpretation and decision rule. Nevertheless, the objectives behind the preponderance standard can be better met by an explication based upon ordinal and more qualitative degrees of warrant. The reasoning to this conclusion begins by criticizing the standard arguments given in support of the 0.5 decision rule.

A. *Minimizing the Rate of Error*

A number of theorists have argued that one rationale for using the 0.5 decision rule is that it minimizes the total number of errors made in factfinding.[58] The argument is that

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Supp. 460, 471 (E.D.N.Y. 1995), *vacated and remanded on other grounds*, 103 F.3d 1085 (2d Cir. 1997) ("there is a consensus among judges that burdens of proof can be stated in numerical terms," citing a survey of federal judges that "found general agreement" that the preponderance standard "translates into 50+ percent probability"); Rita James Simon & Linda Mahan, *Quantifying Burdens of Proof: A View from the Bench, the Jury, and the Classroom*, 1971 LAW & SOC. REV. 319, 325, 329 & Tables 7-9 (while judges in sample interpreted preponderance as meaning about "5.5 probability" [presumably, 0.55 probability], students and persons on regular jury duty interpreted it as meaning about 7.5 [0.75 probability]).

[55] This is a decision rule interpreting the preponderance standard of proof for any issue of fact, not just a decision rule for deciding cases on the basis of mere statistical evidence. *See, e.g.*, Gold, *supra* note 5, at 386, 395 (discussing a 0.5 rule based on the magnitude of the incidence predicted by the statistical evidence).

[56] For an explanation of the distinction between cardinal scales and ordinal scales, see *supra* note 4.

[57] I leave open the possibility that for a specific type of circumstance the relevant warrant rules would establish the 0.5 decision rule as appropriate on a limited basis.

[58] *E.g.*, FINKELSTEIN, *supra* note 2, at 65-69 ("the maximization of correct results is a strong policy"); Ball, *supra* note 15, at 817, 824 (if cost or value of decision deemed to be the same for each party, "the standard [of proof or decision] should therefore be the one which causes the smallest number of mistakes"); Kaye, *supra* note 27, at 69-73 (if in civil litigation "a false alarm and a miss are equally serious mistakes," then the decision rule should "keep the total probability of these mistakes to a minimum without regard to the direction that they take," and the appropriate rule is the "more-probable-than-not decision rule" that accepts a hypothesis if, but only if, its a posteriori probability exceeds 0.5); Kaye, *supra* note 2, at 603-05 ("the conventionally accepted more-probable-than-not standard . . . has

choosing 0.5 as the decision value minimizes total errors because choosing a lower value, such as 0.4, would result in accepting as true propositions assigned a probability of (say) 0.45, when the error rate of doing so would be 0.55—because the proposition would be true only about forty-five times out of one hundred. Similarly, choosing a higher decision value, such as 0.6, would lead to rejecting as *un*proven a proposition assigned a probability of 0.55, with an error rate for doing so of 0.55. Thus, the error rates for decision values either lower or higher than 0.5 would be greater than the error rate from a decision value of 0.5.[59] Given a societal interest in effectively implementing the substantive law, it is argued that any shift from the decision value of 0.5 would be expected to increase the total number of factual errors in cases over the long run.

There are serious problems with this line of reasoning. First, the above argument for minimizing total error assumes that the factfinder's assignment of probability is a valid indicator of the likelihood of truth of a proposition over the long run.[60] This assumption is made when the probability assigned

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the virtue of minimizing the total number of incorrect verdicts"); Neil Orloff & Jery Stedinger, *A Framework for Evaluating the Preponderance-of-the-Evidence Standard*, 131 U. PA. L. REV. 1159, 1163 (1983) (compared to an "expected value" liability rule, "the preponderance-of-the-evidence rule always results in fewer erroneously decided cases"); Daniel Shaviro, *Statistical-Probability Evidence and the Appearance of Justice*, 103 HARV. L. REV. 530, 532 & n.12 (1989) (the preponderance standard suggests that a verdict error against either party is "considered equally regrettable and thus that the level of certainty required to support a verdict for the plaintiff is just over 50%"); Winter, *supra* note 5, at 337 ("[W]e want the correct result as often as possible and that means that preponderance of the evidence is only 50%+. Imposing a greater disadvantage on plaintiffs would tend to cause more incorrect decisions than correct ones."); *cf.* Addington v. Texas, 441 U.S. 418, 425 (1979) ("the function of legal process is to minimize the risk of erroneous decisions").

[59] On this reasoning, the effect of deciding *all* equipoise cases (probability = 0.5) against the proponent, instead of, for example, deciding all of them against the opponent or dividing them randomly and evenly between proponent and opponent, should not affect the *total* error rate. The choice is a matter of indifference from the standpoint of total errors: in any case, the error rate for the equipoise cases is expected to be 0.5. Of course, which rule is chosen for equipoise cases matters from the standpoint of *who* benefits by having the errors made in their favor. *See infra* Section II.B on equal distribution of errors; Ball, *supra* note 15, at 817-18.

[60] *Cf.* Ball, *supra* note 15, at 817 (the analysis based upon causing "the smallest number of mistakes" assumes "that the jury's mistakes are distributed about the 'true' estimate in such a way that their number will be at a minimum if the jury's estimate is always used, since if we knew that juries had a consistent error

by the factfinder to a proposition is used to deduce an error rate. The assumption is that a proposition *assigned* a probability of 0.45 is *in fact true* in forty-five cases out of one hundred, and has an error rate of 55/100.[61] But there is no general reason to think this is true.[62] The accuracy of legal factfinding is a matter to be resolved by empirical investigation.[63] Some factfinders are more accurate than others, and accuracy depends on many factors.[64] Whether the 0.5 decision rule is

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on one side we could decrease the total mistakes by changing the standard to allow for it."). Conceptualizing legal factfinding as a measurement process for truth, assignments of probability would be "valid" to the extent that they are accurate and there is no bias or systematic error in the results. Validity should be contrasted with "reliability" or "precision"—the ability of the measurement process to produce the same assignments when repeatedly applied to the same evidence and issues. *See* Walker, *supra* note 4, at 580-88; *cf.* Kaye, *supra* note 5, at 501-02 n.45 (discussing bias in estimators).

[61] *E.g.*, Kaye, *supra* note 2, at 604 (reasoning on assumption that the factfinder's "estimates are good, so that we can take them as accurate statements of the probability of" the truth of the fact at issue); *cf.* Kaye, *supra* note 5, at 496-500 (basing an argument for a "$p > ½$" liability rule on a statistical decision theoretic model, in which the error rates used to compute the expected loss functions are assumed to equal the probabilities found by the factfinder, and acknowledging that in any particular case, "we do not know which state of nature actually pertains").

[62] This assumption has been questioned elsewhere. *See* Allen, *The Nature of Juridical Proof*, *supra* note 9, at 376 ("the factfinder virtually never has the data that would permit . . . a determination" of the relative frequency with which a proposition would be true in a set of similar cases); Brilmayer & Kornhauser, *supra* note 11, at 140-41; Koehler & Shaviro, *supra* note 13, at 271 ("At present, there is no direct empirical evidence showing whether [using] probabilistic logic or intuition [to combine frequency statistics with other verdicts], as applied in the legal setting, leads to greater verdict accuracy."); Alan L. Tyree, *Proof and Probability in the Anglo-American Legal System*, 23 JURIMETRICS J. 89, 97-98 (1982) (there is no a priori reason why use of a "50 percent rule" to define the preponderance standard inevitably entails a fixed rate of errors).

[63] Detailed models for describing factfinder behavior are difficult to validate, for practical as well as theoretical reasons. *See generally* INSIDE THE JUROR: THE PSYCHOLOGY OF JUROR DECISION MAKING (Reid Hastie ed., 1993).

[64] We do have increasing information relevant to the validity of determinations for certain limited types of proposition—such as "perceived risks" of accidental injury. *E.g.*, William R. Freudenburg, *Perceived Risk, Real Risk: Social Science and the Art of Probabilistic Risk Assessment*, 242 SCIENCE 44 (1988); C. Karpowicz-Lazreg & E. Mullet, *Societal Risk as Seen by the French Public*, 13 RISK ANALYSIS 253 (1993) (comparing mean magnitude of perceived risk of 90 hazards among samples of people from France, the United States, Hungary and Norway); Paul Slovic, *Informing and Educating the Public About Risk*, 6 RISK ANALYSIS 403, 408 (1986) (nonexperts' judgments of risk often differ markedly from experts' assessments of risk, particularly when adverse effects are uncontrollable, dreaded, catastrophic, fatal, not offset by compensating benefits, or delayed in time). We are a

more effective than other rules at producing accurate findings is an entirely empirical matter that is not deducible a priori.

There are also conceptual problems with the argument that the 0.5 decision rule actually minimizes the factfinding error rate. The argument seems to apply a relative frequency meaning of "probability" to the event of *determining* that a proposition is "probably true." We are invited to imagine a long series of trials reaching the same conclusion on the same evidence, and to treat the probability assigned as an estimate of the relative frequency of true findings in this long imaginary series. The probability assigned to the proposition is interpreted as an estimate of the rate of error for the event of finding that proposition under similar circumstances. But this interpretation of the probability assignment runs into several difficulties.[65]

First, we do not *think* we are asking the factfinder to predict the rate of accurate factfinding for a long run of factfinders. We are not asking the factfinder to make any prediction concerning the relative frequency of accurate outcomes in "repeated litigations." Rather, the task of the factfinder is to approximate knowledge by determining the degree of warrant conferred on a given proposition by the legally available evidence in the particular litigation at hand.

Second, we do not *want* the factfinder to engage in an empirical inquiry into the factfinding accuracy of other factfinders in similar circumstances. We do not want the factfinder wondering about the relative frequency of truth in other cases in order to conclude that "probably this witness is lying" or "this plaintiff probably does have severe back pain." We do not instruct the factfinder to do so. Moreover, the factfinder is not given the evidence to perform such a task properly: The question about expected frequency in repeated court trials would be extremely difficult to investigate, even for social scientists. It may be difficult enough to decide the evidence and case at hand, without wondering about a long series of other such cases.

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long way, however, from any generally valid data on factfinding accuracy. Some theorists have been thoroughly agnostic. *E.g.*, Brook, *supra* note 18, at 108 ("We expect there will be errors, but in general we will never discover which decisions are our mistakes, nor will we know the actual level or distribution of the errors.").

[65] *See supra* note 18.

Third, suppose we *were* asking the factfinder to predict the relative frequency with which the "same conclusion" would be true when drawn from the "same evidence." Presumably, the factfinder is to imagine that all aspects of the present legal proceeding are held constant and repeated, and the factfinder is to predict the number of times that the non-trial events at issue would vary, thus making the finding sometimes true and sometimes false. To *count* the number of such cases in which the finding is *true* presumably involves being able to determine the truth on a case-by-case basis. But if the factfinder has the ability to determine truth in any particular case, he or she should simply do so for *this* case. It is not plausible that we can explain what we are asking the factfinder to do in a single case by saying that we are asking him or her to do it for a large number of other cases as well.

A fourth conceptual problem is conceiving of the production of evidence in the present legal proceeding as a repeatable event. We must be able to determine what counts as a "similar trial" if we are to estimate the relative frequency with which a similar finding would occur in those circumstances. If the factfinder's task is to predict how often other factfinders would reach the "same conclusion" based on the "same evidence," what is to count as a "repeated trial" of the "same issue" on the "same evidence"? How many aspects of the evidence need to be identical to have the "same evidence" repeat even once?[66] Does it include the "same" witness demeanor and the "same" background experience of the factfinders?[67]

In conclusion, it is difficult to conceptualize a factfinder's probability assignments *to* propositions as expressing relative

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[66] This problem is related to, but more difficult than, the frequentist problem of identifying the appropriate level of descriptive detail for a relatively simple observable event (such as a die roll). If we specify *all* causal factors in identifying what will count as a repeat of the "same event" (for example, the molecular structure of the die, the force vectors between molecules), the same outcome could occur every time "the event" occurs, depending upon how deterministic the universe is at that level of description. On the other hand, if we specify simply a few factors (the same die, shaken in and thrown from a cup), then a frequency distribution can be projected for results. *See, e.g.*, HOWSON & URBACH, *supra* note 16, at 223.

[67] For a fascinating detailed account of the various kinds of evidence forming the basis for a factual conclusion about a specific individual, see United States v. Shonubi, 895 F. Supp. 460 (E.D.N.Y. 1995), *vacated and remanded*, 103 F.3d 1085 (2d Cir. 1997).

frequencies.[68] This misconception of preponderance is perhaps somewhat understandable given what I have called the legitimate expectation for a "wide scope of agreement" that attends the use of even the weakest legal standard of proof.[69] If factfinders make reasonable legal findings, then we hope for a fairly wide scope of agreement with their findings. This hope is based on the likelihood of consensus among reasonable people reviewing the same evidence. But this is far different from saying that what factfinders are expected to do is to *assign a probability* to a proposition *by predicting a relative frequency* about repeated trials of the "same issue" with the "same evidence." Factfinding is not poll-taking. This would seem not only objectionable on policy grounds, but unworkable on conceptual and practical grounds. Moreover, polls, even if feasible and accurate, are not adequate surrogates for warrant.

In general, therefore, there are serious difficulties with attempts to justify a 0.5 decision rule on the argument that it minimizes the rate of error in legal factfinding. We cannot deduce error rates for particular propositions from general principles, and therefore should not infer that a decision rule of 0.5 will in fact minimize total errors in the long run.[70] Moreover, the relative frequency interpretation underlying this argument faces conceptual and methodological difficulties. Thus, there is little merit to this rationale for adopting a 0.5 decision rule for the preponderance standard of proof in civil litigation.[71]

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[68] Of course, the relative frequency interpretation of probability is often intended as part of the *content* of a proposition at issue. In a lost chance case, for example, the jury may be asked to determine the probability of survival for patients with the plaintiff's pre-existing condition.

[69] *See supra* Section I.B.

[70] One commentator, adopting a frequentist interpretation of probability, has explicitly (and incorrectly) argued on the basis of error reduction:

> We know that most of the men who have motive to murder do not commit it; that not everyone who needs money borrows it; that some mail goes astray. There is nothing in our statements, even if they be made numerically precise and correct to the last item, which tells whether the case at hand is one or the other of the two kinds covered. Nonetheless, *lacking more specific information, we shall make the fewest mistakes* if we treat those *statistics* as representing the *probability* that the case is one or the other and acts [sic] accordingly.

Ball, *supra* note 15, at 813 (emphasis added).

[71] The vacuous nature of this argument is more evident *infra* Section III.B, where I discuss the lost chance cases. The lost chance cases present situations in

B. *Equally Distributing Error*

The United States Supreme Court has stated that the preponderance standard causes the litigants to "share the risk of error in roughly equal fashion."[72] This statement could mean simply that the standard of proof should not systematically favor one type of party (plaintiff or defendant) over the other, in which case the policy goal is what I will later discuss as unbiased treatment of the parties.[73] I argue here, however, that if "equal risk of error" is understood to mean that plaintiffs and defendants would experience equal numbers of errors, equal rates of error,[74] or even equal probabilities of error in a frequentist sense, then this is *not* a plausible rationale for the 0.5 decision rule. Such a rationale is based on a misconception of the preponderance standard of proof.[75] The critique of this

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which "finding out the truth" is for all practical purposes impossible. It is simply not true that we employ a preponderance standard because we know that it minimizes the error rate of factfinding.

[72] Addington v. Texas, 441 U.S. 418, 423 (1979). This statement has been reaffirmed. Grogan v. Garner, 498 U.S. 279, 286 (1991); Herman & MacLean v. Huddleston, 459 U.S. 375, 390 (1983).

[73] *See infra* Section II.E.

[74] *E.g.*, FINKELSTEIN, *supra* note 2, at 67-69 ("[i]f the burden of errors is deemed to be the same for both parties," a "premise" that he regards as "clearly correct," then one plausible aim would be "equal rates of errors for both parties over some assumed class of cases").

[75] A number of theorists have argued a utility analysis of equality: that the civil law should treat dollar losses as having the same utility, regardless of which party suffers the loss. The argument is that if the *utility* of a dollar's worth of loss is *deemed* to be equal for plaintiffs and for defendants, then this satisfies our concern for equality, and we can freely pursue the goal of "maximizing expected utility." Kaye, *supra* note 2, at 605-08 & nn. 26, 28 ("equalization, or allocating errors to plaintiffs and defendants in roughly equal proportions" is in general of dubious value, and the true objective should be to maximize expected utility); Kaye, *supra* note 5, at 496-500 (interpreting preponderance as a decision value of 0.5 probability minimizes the sum of expected costs of errors); *cf.* Ball, *supra* note 15, at 817-18, 823 ("in civil cases, the value of the decision should be treated as equal on each side"); Kaplan, *supra* note 18, at 1072 (preponderance standard reflects "assumption of equal disutilities": "the consequences of an error in one direction are just as serious as the consequences of an error in the other"); Winter, *supra* note 5, at 337 ("in civil actions, unlike criminal actions, there is no particular reason to disadvantage one party substantially"; "[w]e cannot say, as we do in criminal cases, that saving one innocent defendant is worth absolving x number of guilty ones").

For theorists critical of at least some aspects of such equalization arguments, see, e.g., Kaplan, *supra* note 18, at 1072 ("The assumption that an erroneous verdict in favor of the defendant is no more serious than one in favor of the plaintiff

misconception begins with the context of the lost chance cases, and then reaches conclusions about civil litigation generally.

In a paradigmatic lost chance case, there is sound evidence that, out of a group of patients in the relevant set of circumstances, some percentage under fifty percent, such as twenty-five percent, would suffer a compensable injury as a result of the defendant's negligence. For example, twenty-five percent of patients whose cancer is misdiagnosed at a certain stage of development would survive were it not for the negligent misdiagnosis. The remaining seventy-five percent of the patients would suffer the injury in any case, due to background causes unrelated to the defendant's actions. We are sometimes fairly confident about the *magnitude* of the true proportion that are

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is, of course, open to question."); Kaye, *supra* note 5, at 496 n.39 (although law generally deems dollar losses to have identical utility functions for plaintiffs and defendants, it is possible that utilities diverge in classes of cases—e.g., if large businesses are "risk neutral" and individuals with small assets are "risk averse"); Nesson, *supra* note 23, at 1377-78 & n.67 (disagreeing with the premise "that the object of the decision rule is to minimize the cost of expected error"); Orloff & Stedinger, *supra* note 58, at 1167 (treating "each 'unit of error' equally ignores the disproportionate difference in hardship caused by large errors").

In *The Limits*, *supra* note 5, Kaye uses a statistical decision model for factfinding by comparing the loss functions based on expected aggregate disutility errors for decision rules. He compares a decision rule setting the threshold value at 0.5 and requiring payment of full damages ($D) with a rule under which the defendant always pays but is assessed only proportional damages ($pD, where p is the proportion of defendant-caused injuries). Such an analysis is extended in Orloff & Stedinger, *supra* note 58, at 1161 (examining the number, size and distribution of errors under the preponderance and "expected value" rules). For other analyses of factfinding in terms of statistical decision theory, see, e.g., Kaplan, *supra* note 18; Kaye, *supra* note 27, at 54-55 (succinctly describing "Bayesian decision theory"); *cf.* Saul Levmore, *Probabilistic Recoveries, Restitution, and Recurring Wrongs*, 19 J. LEGAL STUD. 691, 691-704 (1990) (discussing extension of decision theory model concerned with error minimization to cases involving recurring defendants, but with ambiguity between frequentist and subjectivist interpretations of probability).

To the extent that statistical decision models employ probabilities interpreted either as relative frequencies or as subjective confidence, they are subject to criticisms made in numerous places in this Article. Moreover, under my analysis in terms of warrant, no assumptions are made about the measurability, commensurability or distribution of the "costs" or utility associated with error. Thus, I see no reason to agree either with Ball, *supra* note 15, at 823, or with FINKELSTEIN, *supra* note 2, at 67, that "the value of the decision" or "the burden of an error" is deemed to be equal for a plaintiff or for a defendant, or with the assumption posited by Kaye that, from the standpoint of "institutional values," "[a] dollar mistakenly paid by defendant . . . is just as onerous as a dollar erroneously paid by a plaintiff." Kaye, *supra* note 5, at 496 & n.39. It seems to me sufficient that we try to treat all parties in an unbiased fashion. *See infra* Section II.E.

defendant-caused cases. The problem is that we do not know, and cannot reasonably determine, whether any *specific* plaintiff is a defendant-caused case or a baseline case. Let us make for the moment the simplifying assumptions that all the members of the group bring suit and that the damage amounts are equal for all the plaintiffs, so that a mistaken judgment in one suit has the "same value" as a mistaken judgment in any other suit.[76] It has been shown that in order to equalize the errors between plaintiffs and defendants, the factfinding must result in a proportion of plaintiff victories that is identical to the true proportion of defendant-caused cases.[77] For example, if in the reference situation twenty-five percent of plaintiffs are defendant-caused cases, then equalizing the number of errors requires that twenty-five percent of cases must be decided for plaintiffs.[78] Only if exactly twenty-five of the cases are decided for the plaintiffs can we be certain that the errors, however many there are, are distributed equally between plaintiffs and defendants. If the correct overall percentage is achieved, any decisions awarded erroneously to plaintiffs must be matched by an equal number awarded erroneously to defendants.

The critique of the 0.5 decision rule begins with asking what decision rule is appropriate in such circumstances. If equal distribution of the rate of error is the goal, and if the correct proportion of defendant-caused cases is known, then we risk not achieving that objective unless we use a decision rule that guarantees that we will produce that same proportion of plaintiff judgments. For example, for a group of cases with twenty-five percent defendant-caused injuries, an approach that guarantees equal error distribution would have to decide cases so as to ensure achieving twenty-five percent of the final judgments for plaintiffs. Such a direct approach, however, is unacceptable. If we see that early cases are being decided at

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[76] There are also a number of other simplifying assumptions, such as: that the only legal remedy in the civil action is compensatory damages; that the amount of damages can be determined for each patient who suffers the injury; that the utility of a dollar can be determined and is the same for defendants and plaintiffs, as well as between plaintiffs; and that there are no timing issues (time-value of money, or changes in utility over time) or problems due to defendants with insufficient funds.

[77] *See* FINKELSTEIN, *supra* note 2, at 67-68; *cf.* Brook, *supra* note 18, at 106-08 (usefully recounting the Finkelstein analysis).

[78] *See* FINKELSTEIN, *supra* note 2, at 66-69, 74-78.

the rate of thirty-five percent for plaintiffs, we would not consider "giving" the defendants a certain number of later cases just to make the overall error rate equal to twenty-five percent.[79] If equal distribution of errors is a policy objective at all, it is not a very strong one.[80]

There is a second point. Even if we adopt a goal of error equalization, and the proportion of meritorious, defendant-caused cases is known, it is impossible to achieve the distribution goal through choosing a *decision value.* If we want a set of outcomes with twenty-five percent of the decisions favorable to plaintiffs, no single decision value could achieve this result. In lost chance situations in which the probative statistical evidence is identical in all the cases and no plaintiff-specific information differentiates the cases, no single decision value could yield twenty-five percent plaintiff verdicts. The only decision rule that could achieve twenty-five percent plaintiff verdicts and seventy-five percent defendant verdicts out of a set of such cases would be a rule that treats cases that are similar from the standpoint of evidence *dis*similarly from the standpoint of liability.[81] When forced to choose between equal distribution of error and equal treatment of the same evidence, we choose the latter. This should convince us that, in general, the equality that is our goal is not equal distribution of errors, but equal treatment of similar evidence.[82] This analysis should also lead

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[79] *See* Kaye, *supra* note 2, at 607-08. There is merit in David Kaye's intuition:

> [W]hy should we care about "equalization" [of the proportion of errors to plaintiffs and defendants] in the first place? Mistakes do not cancel one another out: it is no solace to the defendant who should have prevailed but did not that somewhere there is or will be a similarly affected plaintiff.

Kaye, *supra* note 2, at 607.

[80] Of course, if we could find all the facts accurately in every individual case, the result would be that the proportion of plaintiff successes would equal the proportion of defendant-caused cases, but this is a collateral effect and not the primary objective.

[81] That is perhaps one reason why proposals for such cases have departed from being purely liability rules and have introduced proportional damages. *See, e.g.*, Joseph H. King, Jr., *Causation, Valuation, and Chance in Personal Injury Torts Involving Preexisting Conditions and Future Consequences*, 90 YALE L.J. 1353 (1981).

[82] Kaye argues that maximizing expected utility is the overriding objective of a rational decisionmaker and that a decision value of 0.5 achieves such maximization, as compared to a decision rule that always makes the defendant pay proportional damages equal to the proportion of defendant-caused cases. *See* Kaye, *supra*

us to suspect that error rate equalization is not even a *relevant* policy objective in setting any decision value, be it 0.5 or any other value.

When we generalize from the lost chance cases to general civil cases, additional problems exist. In any group of civil cases, the errors will not be distributed equally between plaintiffs and defendants unless the proportion of plaintiff verdicts equals the proportion of *meritorious* cases. And while we might be able to determine whether this is true for a set of lost chance cases, we can never know whether this is true for any general group of cases. If error equalization is an implausible rationale for the 0.5 decision rule in lost chance cases, it is even more implausible in general cases in which we have no benchmark for successful equalization.

Moreover, in the general case, the argument for error equalization has the same conceptual confusion at its foundation as the rationale of error rate minimization, at least if error equalization is an objective the factfinder is supposed to try to achieve.[83] The concept of an "error distribution rate" presupposes a conception of a relative frequency of accurate factfinding, which involves the conceptual difficulties discussed in the previous section.

The intuition runs deep, however, that "equality" has some logical connection to a 0.5 decision rule. Any acceptable interpretation of the preponderance standard, therefore, must address this intuition. The analysis of general factfinding characteristics in Part I supplies some content for the intuition that

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note 2, at 608; *supra* note 5, at 492-500. Despite this intuition and reasoned conclusion, however, even Kaye recognizes an important exception: a special case in which there is "*justifiably* naked statistical evidence" and "a single defendant faces the possibility of numerous suits from similarly situated plaintiffs and the probability that this defendant is liable is the same in each of these cases." Kaye, *supra* note 5, at 492, 502 (emphasis added). In such cases, the one-sided effect of the 0.5 rule is too striking to allow Kaye to pursue maximizing expected utility single-mindedly, because depending upon whether the proportion of defendant-caused cases is below or above 0.5, the defendant will either win or lose all the cases. While Kaye's confidence in the 0.5 rule is not shaken entirely, he is prepared to concede that in such situations always requiring the defendant to pay a proportion of the damages "seems superior to the p>1/2 rule." Kaye, *supra* note 5, at 502, 514-15 & n.76. The exceptional case scenario addressed by Kaye is different from the lost chance cases, because many lost chance cases also involve nonstatistical, particularistic evidence and they usually involve different defendants.

[83] *See supra* Section II.A.

similar cases should be treated equally—namely, a guarantee of minimal fairness to parties, an expectation of fairly wide consensus, and a requirement of sufficient support in the legally available evidence. These requirements promote fairness within and between cases, primarily through a support relation between the evidence and the findings. But we should not confuse either fairness or equal treatment of evidence with an equal distribution of error. The analysis in terms of warrant accepts uncertainty about the extent of factfinding accuracy as a serious fact of legal process, and tries to treat each party fairly within the judicial system while maintaining a conceptual ideal that approximates knowledge. Our intuitive desire for equal treatment should be satisfied by this analysis, without any quest for equalization of error.

C. *Satisfying Subjective Confidence Criteria*

A few careful theorists have been consistent in employing a subjectivist or degree-of-confidence interpretation when explaining probability assignments to findings.[84] On such an interpretation, the 0.5 decision rule must be understood in terms of degree of confidence, not in terms of relative frequency of being true. The 0.5 decision rule is then understood as requiring the factfinder to accept a proposition as true for legal purposes if, but only if, the factfinder's degree of confidence in the truth of the proposition is greater than his or her degree of doubt about its truth.[85]

The first criticism of this rationale for the 0.5 decision rule is that all the arguments against adopting subjective belief as a logically necessary or sufficient condition for being "probably true" apply just as forcefully here.[86] Indeed, a subjectively interpreted 0.5 decision rule is a quantitative extension of the

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[84] *E.g.*, Kaye, *supra* note 9, at 661-62 & n.13 (making the distinction between "minimizing expected losses" in the sense of "minimizing the losses expected" and in the sense of "minimizing the *expectation* of the loss function"; when used in the latter sense, "the decision-theoretic interpretation does not mean that actual losses necessarily are minimized").

[85] *See, e.g.*, Gold, *supra* note 5, at 383, 395 (a finding by the preponderance of the evidence usually means "that the jury believes a knowable fact with more than 50% confidence").

[86] *See supra* Section I.B; see also *supra* note 24 for theoretical objections to using a subjective interpretation of probability statements in legal factfinding.

actual belief condition.[87] As argued in Section I.B, having an actual belief might be logically necessary for having knowledge or for being justified in making a finding, but it is neither logically necessary nor sufficient for being probably true or being warranted.[88]

A subjectivist might object that findings should not be interpreted as probability assignments measuring the actual degree of confidence of the particular factfinder, but rather as probabilities measuring the degree of confidence that an "ideal rational factfinder" would assign. The contention then is that the 0.5 decision rule is the correct decision rule for this ideal reasoner. The particular individual might or might not reach the same conclusions or have the same reasoning as the ideal reasoner, but each factfinder *should* do so.

There are several responses to this version of the argument. First, to give up as a useful criterion for factfinding the factfinder's own personal degree of confidence, which presumably is directly known by introspection, is to give up one of the most enticing features of subjectivism. If the relevant degree of confidence is not that being subjectively experienced by the individual factfinder, then epistemological problems develop about "access" to the "mental state" of the ideal factfinder. How is the human factfinder to decide the relevant "degree of confidence" of the ideal factfinder? Such dualisms cause difficulty for knowledge theories.

Second, in the search for criteria to use to discern the "mind" of the ideal, rational factfinder, we are really looking for inference rules for drawing warranted conclusions from evidence. But if we need inference rules to identify the

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[87] Of course, an actual-belief theorist need not adopt a subjectivist interpretation of probability, nor a 0.5 decision rule. But the two positions are consistent, and the latter develops a quantitative extension of the former. *See* Cohen, *supra* note 45, at 645-48 ("[s]ubjectivism provides us with a way of putting guesses into mathematical uniform").

[88] Cohen has expressed a related logical objection as follows:

> [O]n a subjectivist interpretation [of probability], if I think one of your judgements of probability may be incorrect, I am just doubting your description of your own state of mind, and any reasons that I advance in favor of my view must be reasons that bear either on your ability to introspect your own mind accurately or on the honesty with which you report your introspections. But arguments of such a nature are quite out of place in the context of forensic proof.

Cohen, *supra* note 45, at 647.

"thought patterns" of the ideal reasoner, then positing such an imaginary reasoner does not help us to discover inference rules. The imaginary reasoner is not a useful tool but a gratuitous appendage. We might as well dispense with the ideal factfinder altogether, and move on to devising and defending inference rules. This is indeed my proposal.

Third, a number of theorists have responded to the problem by proposing that we use Bayes' Theorem to calculate the "degree of confidence" of this ideal reasoner.[89] Without recounting the various caveats to this use of Bayes' Theorem, it is worth mentioning that objections to Bayesian calculations as impractical[90] are particularly relevant if Bayesian calculations are offered as a sufficient test for the human factfinder to use to discern the degree of confidence of the ideal factfinder. Warrant rules are useful to human factfinders only if employing them is humanly feasible.

A degree-of-warrant theory can incorporate Bayesian reasoning when it is appropriate to do so, without reducing the preponderance standard to a subjectivist interpretation of the 0.5 decision rule. For example, Bayes' Theorem is important under a degree-of-warrant theory when either subjective or frequentist probabilities occur in the *content* of findings. If these probabilities are to be internally coherent and satisfy the probability calculus,[91] they must also satisfy Bayes' Theorem, at least if conditional probabilities are employed. In addition, whenever subjective probabilities are assigned by the factfinder *to* propositions, then minimal fairness to parties requires that those subjective assignments must also satisfy the probability calculus.[92] But what is *not* entailed by the kind of degree-of-warrant theory proposed in this Article is that the preponderance standard requires factfinders to assign

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[89] *E.g.*, Kaye, *supra* note 27; Koehler & Shaviro, *supra* note 13; Lempert, *supra* note 54; *see* United States v. Shonubi, 895 F. Supp. 460, 485 (E.D.N.Y. 1995), *vacated and remanded on other grounds*, 103 F.3d 1085 (2d Cir. 1997) (Bayesian legal theorists "have convinced much of the current generation of evidence scholars that Bayes' Theorem provides a helpful description of appropriate legal fact-finding techniques.")

[90] *See, e.g.*, Allen, *supra* note 47, at 607, 618; Callen, *supra* note 24, at 4-7, 10-15 ("The application of Bayesian theory might even be so complicated as to be of no practical use.").

[91] *See supra* Section I.C.

[92] *See* Walker, *supra* note 6, at 289-97; *supra* Section I.C.

cardinal probabilities to every proposition at issue, that all warrant rules must be reducible to calculations of frequentist or subjective probabilities, or that the probability calculus (including Bayes' Theorem) provides a sufficient test of warrant. Indeed, the subjectivist's distinctive wrong turn in interpreting the preponderance standard is in thinking that probabilistic coherence is either necessary or sufficient for warrant.[93]

In conclusion, there are a number of reasons to reject a subjectivist interpretation of the 0.5 decision rule as an analysis of the meaning of the preponderance standard of proof. On the other hand, a degree-of-warrant theory might be able to incorporate the desirable elements of a subjectivist theory, including satisfaction of the probability calculus when a factfinder chooses to assign subjective probabilities to findings.[94] But a degree-of-warrant theory need not adopt any cardinal measure of "probably true," nor employ the subjectively interpreted 0.5 decision rule to explain the preponderance standard.

D. *Creating Incentive to Produce Adequate Evidence*

I will argue in Part III below that: (1) preponderance should be interpreted in terms of degrees of warrant; (2) degrees of warrant can be understood on an ordinal, as opposed to cardinal, scale; and (3) further quantification of degrees of warrant is inappropriate at this stage of development of warrant rules. In this present section, however, I argue only that a cardinal 0.5 decision rule is *not necessary* in order to attain the institutional judicial goal of creating an incentive to produce adequate evidence. Creating an incentive for evidence production is a convincing policy rationale for choosing a mid-range decision value as the threshold for "preponderance," but it does

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[93] I do not need to take a position here on whether an assignment of cardinal probability should be necessary for knowledge or for personal justification. *See supra* Section I.B and text accompanying note 89.

[94] *Cf.* Kaye, *supra* note 9, at 671 ("the use of subjective probability in an idealized theory of forensic proof does not preclude the attempt to formulate a philosophically adequate account of the interpersonal and logical standards that promote accurate estimation of the probability").

not require frequency or subjective probabilities in a fully quantitative sense, measured on a cardinal scale, or a precise 0.5 decision rule.

In civil adjudication, the courts try to provide a fair and impartial structure within which opponents can litigate a case or controversy.[95] Within that institutional structure, courts in the United States are largely dependent on private parties to produce evidence.[96] Unlike most administrative agencies, which have institutional capabilities for generating evidence, American civil courts render their binding decisions of government largely without the benefit of being able to produce their own evidence.[97] In such an institutional context, if warrant comes in degrees, then the use of a mid-range decision value for factfinding can be defended as the value most likely to create an incentive to produce adequate evidence.

One function of a high standard of proof is to induce the party with the burden of persuasion to produce not only the minimal evidence needed to survive a directed verdict motion, but also enough evidence to convince the factfinder at trial. Because the generation, discovery, and presentation of evidence costs money and consumes other resources, parties must continually reassess how important any given factual issue is to their case, and how much evidence is enough to persuade the factfinder.[98] If factfinders were given a low standard of

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[95] It has been argued that one policy behind the 0.5 interpretation of the preponderance standard is that it would be arbitrary to pick any decision value other than 0.5. FINKELSTEIN, *supra* note 2, at 66-67. It does not follow automatically, however, that because any threshold value that is chosen should be nonarbitrary, 0.5 is in fact that value. In criminal cases, for example, we choose a higher decision value because "our legal system has a fundamental tenet that it is better that an undetermined number of guilty [persons] . . . should go free rather than that one innocent [person] be convicted." Kaplan, *supra* note 18, at 1077; Winter, *supra* note 5, at 337. What follows from the requirement of nonarbitrariness is only that *any* decision rule must be justified by demonstrating that it is a permissible means that promotes legitimate judicial ends.

[96] *Cf.* Brilmayer & Kornhauser, *supra* note 11, at 124-30 (arguing that statistical models for inference may be "more or less apt" depending on whether they are developed for use by courts, administrative agencies or legislatures).

[97] Some courts have express authority to appoint experts. *E.g.*, FED. R. EVID. 706. However, "[t]he most conspicuous fact about this authority is that it is rarely used." Samuel R. Gross, *Expert Evidence*, 1991 WIS. L. REV. 1113, 1190-91.

[98] The amount of evidence to provide depends upon many factors, not least of which are the a priori probability of the proposition being true, the likelihood of obtaining evidence of a kind that will significantly affect that a priori probability,

proof, then parties confident of a sympathetic factfinder might not make significant efforts to produce more than minimal evidence.[99] The three standards of proof employed in litigation all help to create an incentive to produce more evidence than is sufficient to avoid suffering judgment as a matter of law.

On the other hand, this policy objective is self-regulating to a certain extent. If the decision value is set too high, then the party that does not have the burden of persuasion may be more inclined to rest on the noncredibility of the proponent's proofs, and less inclined to produce affirmative evidence. A mid-range decision value creates an incentive for the opponent to produce an alternative account of the facts and the evidence to support it. Both parties will need to decide whether to produce additional evidence, and these decisions will be driven more by such factors as the strength of the other party's evidence and the net benefits of producing more evidence, rather than by the standard of proof. Thus, a "mere preponderance" rule may be more effective at producing evidence on both sides of a factual issue.[100]

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the ease of access to evidence, the cost of producing such evidence, the extent of the party's resources, and the party's aversion to risk. *Cf.* Craig R. Callen, *Adjudication and the Appearance of Statistical Evidence*, 65 TUL. L. REV. 457, 488 (1991) ("Assuming . . . that a correct decision [in everyday life] would have some utility, one would expend the resources available to gather more information as long as the prospective value of the information for accurate decisionmaking would warrant that expenditure.").

[99] For example, one would expect that the high standard of proof of criminal cases creates a great incentive on prosecutors to develop and produce as much evidence as possible, and that a lower standard would lead to somewhat less incentive. *Cf.* Lempert, *supra* note 28, at 472-73 (stating that "it is not surprising that civil defendants, unlike criminal defendants . . . , invariably offer a defense when confronted with a plaintiff's case sufficient to get to the jury," even if the defense is a story as simple as "the plaintiff's witnesses cannot be believed").

[100] A traditional factor to be considered in allocating the burden of persuasion on a factual issue is access to relevant information. *E.g.*, JAMES ET AL., *supra* note 3, § 7.16, at 344; 2 MCCORMICK, *supra* note 1, § 337, at 429-30. Allocating the burden of persuasion on the basis of access might lower the cost of evidence production, as well as generate evidence that otherwise might not be produced.

A related line of reasoning concerns judicial rules not allowing cases to be decided on the basis of "naked statistical evidence." Such rules might be justified as creating an incentive to produce additional evidence particular to the case. *E.g.*, Callen, *supra* note 98, at 485-92; Kaye, *supra* note 2, at 610 & n.37; Kaye, *supra* note 5, at 488-89. For the application of similar reasoning to particular probability assignments instead of to the standard of proof itself, see Kaye, *supra* note 29, at 106; Lempert, *supra* note 28, at 454-62; Laurence H. Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329, 1349-50 (1971)

While adequate evidence production is a sound reason for interpreting the threshold for "preponderance" to be a mid-range degree of warrant, it does not require adopting a cardinal 0.5 decision rule. If an ordinal scale for degree of warrant is preferable to a cardinal scale, then it is appropriate to select the mid-range ordinal category as the threshold for findings under a preponderance standard. This rationale does not require adopting a cardinal scale, however, let alone selecting precisely 0.5 as the decision value on such a scale.

E. *Treating Parties in an Unbiased Fashion*

A second institutional advantage to be gained by adopting a mid-range decision value is that such a value constitutes a nearly equal treatment of the parties despite the fact that one party will bear the burden of proof. The judiciary usually places on the proponent of a factual issue a "burden of production" and a "burden of persuasion."[101] Under the preponderance standard, the civil court system pursues the objective of fairness to parties beyond minimal fairness[102] by setting a mid-range decision value instead of some higher or lower value.[103]

(citing an unexplained failure to produce additional evidence as a plausible reason for assigning a *subjective* probability to a particular proposition that is lower than *frequency* statistics would suggest); *infra* note 128 (discussing relevance of completeness evidence). Those adopting a decision-theoretic model might disagree that such rules can be justified if case-specific considerations are ignored. *See* Levmore, *supra* note 75, at 696 ("no conclusive [decision-theoretic] comparison of the various [decision] rules can be made without some assessment of the true social cost of additional investigation").

[101] Traditionally, the "burden of proof" has included two distinct concepts. The "burden of production" is the burden of producing enough evidence to defeat a motion challenging the "legal sufficiency" of the evidence. Whether a party has satisfied this burden is decided by the judge. The "burden of persuasion" is the burden of persuading the trier of fact that the weight of evidence satisfies the standard of proof (e.g., preponderance of the evidence). Whether a party has satisfied the "burden of persuasion" is decided by the finder of fact. *See, e.g.*, James, *supra* note 21, at 51-58. When I refer simply to "burden of proof," I am referring to the combination of the burdens of production and persuasion.

[102] Minimal fairness merely requires that any factual determinations be consistent and coherent. *See supra* Section I.C.

[103] *See* Herman & MacLean v. Huddleston, 459 U.S. 375, 390 (1983) ("[a]ny other standard [than the preponderance standard] expresses a preference for one side's interests"); Winter, *supra* note 5, at 337; *cf.* Allen, *supra* note 54, at 434 (maintaining that "the ambiguity in a case should be distributed over the parties" and would be under his theory of civil trials); Allen, *The Nature of Juridical*

This mid-range value occurs where the evidence for a proposition is equally balanced with the evidence for its negation. Such a decision value at "equipoise" minimizes any institutional favoring of parties.

The preponderance standard is only nearly unbiased because the plaintiff has a net disadvantage in all civil cases with regard to the factual elements of the plaintiff's prima facie case. The initial burdens of production and persuasion on those elements are on the plaintiff. Plaintiffs should lose as a matter of law if they fail to produce legally sufficient evidence, and the factfinders should decide against them on factual issues when the weight of the evidence is equally balanced.[104] These disadvantages take on increasing importance in cases where there is little or no evidence available on key factual

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Proof, supra note 9, at 409-11 (proposing to further equality by distributing logical and epistemological problems "equally over plaintiffs and defendants"); David H. Kaye, *Statistical Significance and the Burden of Persuasion*, 46 LAW & CONTEMP. PROBS. 13, 15-17, 19-20 (1983) (the various standards of proof reflect the courts' assessments of the relative costs of erroneous verdicts, and under the preponderance standard a mistaken verdict for the plaintiff is treated "as neither better nor worse than a mistaken verdict for the defendant").

[104] *See, e.g.*, McBaine, *supra* note 2, at 243 ("courts have concluded that it is just and reasonable" that the party seeking a court judgment must bear the burden of proving that the defendant has failed or refused to perform a legal duty). Various considerations may be relevant in allocating the risk of nonpersuasion. *See generally* James, *supra* note 21, at 58-63 (discussing readier access to information and contentions that "depart from what is expected in the light of ordinary . . . experience").

A "tie-breaker" rule for evidence in equipoise at the decision value is in principle necessary for any such value (whether 0.5, 0.7 or even 0.9), but it might appear to have more practical import under the 0.5 value. *Cf.* United States v. Gigante, 39 F.3d 42, 47 (2d Cir. 1994) ("The preponderance standard is no more than a tie-breaker dictating that when the evidence on an issue is evenly balanced, the party with the burden of proof loses."); Winter, *supra* note 5, at 339 ("the *only* function burden of proof [persuasion] plays in civil cases is to resolve ties") (emphasis added).

For the sake of simplicity, I sometimes refer to "plaintiff" and "defendant" in lieu of "party having the burden of persuasion" and "party not having the burden of persuasion," respectively. Of course, the discussion is really about the latter distinction, for defendants often have a burden of persuasion on a factual issue (e.g., in affirmative defenses).

issues.[105] They are also important in types of cases in which the plaintiff's evidence is almost certain to be deficient, such as in lost chance cases.[106]

Occasionally the courts have identified types of case in which the initial burden of production, and occasionally persuasion, is "shifted" away from the plaintiff.[107] For example, the warrant rules known as res ipsa loquitur establish certain conditions under which an inference of defendant's negligence is warranted, and in some jurisdictions the plaintiff's proof of these conditions places a burden of production for rebuttal on the defendant.[108] The courts have relied upon various fair-

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[105] *See, e.g.*, W. PAGE KEETON ET AL., PROSSER AND KEETON ON THE LAW OF TORTS §§ 39-40, at 242-62 (5th ed. 1984) (cases in which plaintiffs and judges invoke res ipsa loquitur). Courts also establish substantive rules of law that favor one side or the other systematically, in pursuit of substantive policy objectives. For example, strict liability rules in product liability cases are intended to advantage plaintiffs. *Id.* § 98, at 692-93. Examples of substantive rules favoring defendants include rules establishing lesser duties for possessors of land toward trespassers. *Id.* § 58, at 393-99.

[106] *See infra* Section III.B. The lost chance case is a particular species of the more general case involving "residual baseline risk." Vern R. Walker, *The Concept of Baseline Risk in Tort Litigation*, 80 KY. L.J. 631, 665-72 (1991-92).

[107] Sometimes the courts have shifted merely the burden of production. *See, e.g.*, CAL. EVID. CODE §§ 604, 646 (1995) ("res ipsa loquitur is a presumption affecting the burden of producing evidence," but if defendant in fact produces sufficient evidence, then "[t]he jury shall not find that a proximate cause of the occurrence was some negligent conduct on the part of the defendant unless the jury believes . . . that it is more probable than not that the occurrence was caused by some negligent conduct on the part of the defendant"). Sometimes the burden of persuasion is shifted as well. *See, e.g.*, 1 BAJI, *supra* note 32, § 3.80 ("However, under such circumstances, a defendant is not liable if [the defendant] establishes by a preponderance of the evidence" that his or her "negligence was not a . . . cause of plaintiff's injury."); Summers v. Tice, 199 P.2d 1, 3-5 (Cal. 1948) (holding that under certain circumstances the "burden of proof" on causation must be shifted to defendants, and "it should rest with [the defendants] each to absolve himself if he can"); *cf.* Levmore, *supra* note 75, at 694-97 (discussing the civil law goal of creating incentives to bring about behavior change to reduce factfinding uncertainty).

[108] In the classic case of Ybarra v. Spangard, 154 P.2d 687, 689 (Cal. 1944), the California Supreme Court stated the traditional three conditions for res ipsa loquitur, quoting from *Prosser, Torts*, at page 295:

> (1) the accident must be of a kind which ordinarily does not occur in the absence of someone's negligence; (2) it must be caused by an agency or instrumentality within the exclusive control of the defendant; (3) it must not have been due to any voluntary action or contribution on the part of the plaintiff.

The court describes this as a "simple, understandable rule of circumstantial evidence, with a sound background of common sense and human experience." If these

ness rationales to justify a burden shift, including the reasoning that the probative evidence is accessible to the defendant but not to the plaintiff[109] and that the defendant owed the plaintiff a duty of care in providing protection.[110]

In addition, the principle of unbiased treatment of parties also yields on certain types of factual issue. Courts impose a higher standard of proof, such as "clear and convincing" evidence, for factual issues that trigger a protective policy for certain parties. For example, protective policies may override when there is a possible deprivation of individual rights, a special danger of deception, or a particular type of claim disfavored on policy grounds.[111] In such cases, courts adopt a heightened standard of proof in the hope that factfinders will make fewer mistakes adversely affecting the protected interest.[112]

Unbiased treatment of parties must be distinguished, moreover, from a goal of equally distributing errors among

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three conditions are satisfied, the defendant receives a burden of production. *See* CAL. EVID. CODE, *supra* note 107; Newing v. Cheatham, 540 P.2d 33, 42-43 (Cal. 1975).

[109] *E.g.*, *Ybarra*, 154 P.2d at 689.

[110] *See id.* at 690:

> [E]very defendant in whose custody the plaintiff was placed for any period was bound to exercise ordinary care to see that no unnecessary harm came to him . . . . Plaintiff was rendered unconscious for the purpose of undergoing surgical treatment by the defendants; it is manifestly unreasonable for them to insist that he identify any one of them as the person who did the alleged negligent act.

[111] 2 MCCORMICK, *supra* note 1, § 340, at 441-45 (commitment to a mental hospital or deportation, claims involving wills or charges of fraud); *see* Herman & MacLean v. Huddleston, 459 U.S. 375, 388 n.27 (1983) (chancery courts of equity imposed more demanding standard of proof when concerned that claims to set aside presumptively valid written instruments would be fabricated); Addington v. Texas, 441 U.S. 418, 423 (1979) (standard of proof serves "to indicate the relative importance attached to the ultimate decision"); James, *supra* note 21, at 61 (citing as a "disfavored contention" a claim presented against an estate never presented to the decedent during his lifetime, prompting some courts to require clear and convincing evidence).

[112] *See In re* Winship, 397 U.S. 358, 370-71 (1970) (Harlan, J., concurring) ("Because the standard of proof affects the comparative frequency of these two types of erroneous outcomes, the choice of the standard to be applied in a particular kind of litigation should, in a rational world, reflect an assessment of the comparative social disutility of each."). Raising the standard of proof with the goal of making certain errors less likely should be distinguished from the claims that a 0.5 decision rule will minimize or equally distribute errors. *See supra* Sections II.A, II.B.

parties.[113] Unbiased treatment of parties is possible and desirable in the face of our ignorance about the number or distribution of actual errors. On a degree-of-warrant theory, unbiased treatment of parties involves treating similar evidence similarly. It does not assume that errors will be equally distributed.

In civil cases, therefore, courts are initially and presumptively unbiased in factfinding as between the party having the burden of proof and the opponents, and this policy favors a mid-range decision value.[114] As suggested above, this policy may be overridden by other policy considerations. But this policy of unbiased treatment does not require interpreting warrant in terms of either frequency or subjective probabilities, nor does it require adopting a cardinal 0.5 decision rule. A degree-of-warrant theory could accomplish unbiased treatment of parties by applying the same warrant rules to the same evidence and inferences, regardless of which party seeks to establish the proposition.

III. A DEGREE-OF-WARRANT PROPOSAL FOR JUDICIAL FACTFINDING

As argued in Part I, what we mean when we say that a proposition is warranted for purposes of legal factfinding is that (1) it satisfies the formal requirements of minimal fairness, coherence and consistency, and (2) it has sufficient support in the legally available evidence, in the sense of being reasonably inferable from that evidence. Under the preponderance standard of proof, we also anticipate a fairly wide scope of agreement on the findings, at least by reasonable people weighing the same evidence. This analysis of warranted factfinding rests upon general principles applicable to all legal factfinding, whether performed by courts, administrative agencies, or other institutions of government.

Part II focused on factfinding under the preponderance standard of proof in civil litigation, and concluded that there is no merit to traditional rationales for interpreting that stan-

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[113] *See supra* Section II.B.

[114] *See Herman & MacLean*, 459 U.S. at 390 (any standard of proof other than preponderance "expresses a preference for one side's interests").

dard as a cardinal 0.5 decision rule. However, the two institutional policies of creating an incentive on all parties to produce adequate evidence and of treating parties in an unbiased fashion do favor a mid-range decision value—a value around which the weight of the evidence is roughly in equipoise. These initial policies might be overridden in particular types of cases by additional fairness, deterrence or protection objectives, but they provide a basic default value under the preponderance standard.[115] Those institutional considerations, however, do not require reducing the concept of weight of evidence to either frequentist or subjectivist probabilities.

As an alternative interpretation, I propose in this part that weight of evidence be understood as degree of warrant, and that degree of warrant be used to give meaning to "probably true" in the context of legal factfinding. My objective is to use the epistemological model of knowledge and the concept of warrant summarized above to provide an understanding of the preponderance standard itself.

I am not proposing here a comprehensive theory of warrant. Indeed, I am skeptical that such a unified theory is achievable even in principle, let alone in the foreseeable future.[116] While a complete theory of warrant rules adequate for legal purposes is not available,[117] warrant rules for limited evidentiary circumstances are being developed. The lost chance cases provide an extended illustration of such warrant rules, and of the potential to incorporate within warrant rules both frequentist and subjectivist probabilities in appropriate ways.

A. *General Comments on Any Adequate Theory of Warrant*

Of the necessary and jointly sufficient conditions for warrant, those least in need of analysis are the formal requirements for coherence and consistency.[118] Not that the mean-

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[115] Craig R. Callen, *Cognitive Science and the Sufficiency of "Sufficiency of the Evidence" Tests*, 65 TUL. L. REV. 1113, 1117-22 (1991) ("Burdens of proof, and legal rules in general, serve as default standards.").

[116] *See supra* Section I.D.

[117] *See* Allen, *supra* note 47, at 616-30 ("There is no robust articulated conventional theory of juridical evidence.").

[118] *See supra* Section I.C.

ings of these conditions are perfectly clear, but they are tolerably clear for practical purposes. Jurists can say with considerable clarity what it means to satisfy these conditions—that is, what those conditions themselves mean. Moreover, judges can police the formal requirements when jury findings violate them.[119]

It is far more difficult to say what we mean by "sufficient support in the legally available evidence."[120] The criteria for what evidence is legally available are worked out in the rules of procedure and evidence, as well as in occasional rules of substantive law.[121] The main task for a theory of warrant, therefore, is to specify and justify rules for determining which propositions are sufficiently supported (warranted) on the basis of particular evidence. Such warrant rules would necessarily reflect an understanding of how to determine weight of evidence and probative value in at least some regions of an ordinal scale. That is, by helping to determine which conclusions are "weakly warranted" or "strongly warranted" given the evidence, the rules would provide guidance on the weight of that evidence. Such warrant rules would also generate comparisons between warrant relations, providing guidance on whether various sets of evidence are weaker or stronger relative to a given conclusion. Stronger evidence either supports a conclusion more strongly or warrants stronger conclusions. Thus, warrant comes in degrees, and an adequate ordinal theory of warrant should show what this means by indicating when certain conclusions are more warranted than others.[122] But

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[119] *Cf.* Nesson, *supra* note 23, at 1369-72 (directed verdicts can prevent verdicts that are not publicly acceptable, as in cases when the evidence is too circumstantial).

[120] *See supra* Section I.D.

[121] Nesson, *supra* note 23, at 522-23 ("Viewed broadly, the standard of proof consists not only of the guidance courts give juries, but also of the evidentiary rules of admissibility courts use to shape the body of evidence the jury considers, and the rules of sufficiency by which courts decide whether juries will be allowed to consider the evidence.").

[122] A recent example of an ordinal weight-of-evidence framework from the realm of administrative law is found in Environmental Protection Agency, Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17,960, 17,981-17,990 (1996) (outlining weight-of-evidence evaluation for potential human carcinogenicity).

such a theory need not assume that weight or warrant are properties that can be measured by an integrated value on a cardinal scale between 0 and 1.

The discussion from Part II leads to two general features of a degree-of-warrant analysis of the preponderance standard as employed in civil litigation. First, if degree of warrant can be measured at all, even on an ordinal scale, then the requisite degree of warrant for factfinding under the preponderance standard should be the mid-range of that scale, somewhere roughly equidistant from both extremes. Second, traditional rationales for a precise decision value on a cardinal scale are unconvincing. Each of these points will be discussed in turn.

First, if any measurement scale for degrees of warrant is possible, then the appropriate decision value for factfinding under the preponderance standard is in the mid-range between a very low degree of warrant and a very high degree. The policy reasons for this are, first, creating an incentive on all parties to the controversy to produce adequate evidence and, second, treating all parties in an unbiased fashion. If degrees of warrant could be meaningfully, validly and reliably measured on a cardinal, linear scale ranging from 0 to 1, then a decision value somewhere around 0.5 would be appropriate.[123] On the other hand, if degrees of warrant are measured in rough ordinal categories (for example, "weak/moderate/strong"), then these same policies would be satisfied by using the mid-range category ("moderate") for factfinding purposes.[124]

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[123] Talking about "a 0.5 decision rule" may be useful if it is merely a shorthand way of referring to the mid-range. But such talk does not necessarily posit a workable and useful cardinal scale, any more than does the colloquial expression of rating something "a 5 on a scale of 1 to 10." In a colloquial setting, rating the service at a restaurant, for example, "on a scale of 1 to 10" is usually a locution for classifying it on a subjectively determined, ordinal scale. Moreover, we assume that what is meant by the score "5" is the mid-range category, even though 5 is not the quantitative midpoint between 1 and 10. Although the classification scale has the trappings of cardinality, we know when we use it that we are not asserting a cardinal measurement.

[124] Traditional heuristic formulations of the preponderance standard work well within an ordinal framework. Traditional jury instructions sometimes analogize to "weighing" on a mental "scale" the evidence for a proposition and the evidence for its negation, and instruct the jury to find as fact the proposition toward which the scale inclines ever so slightly. *See, e.g.*, Ostrowski v. Atlantic Mut. Ins. Cos., 968 F.2d 171, 187 (2d Cir. 1992) (trial judge charging jury on preponderance standard should avoid requiring the jury to be "convinced" of or "confident" in the truth; the jury should be told "to conclude that a fact has been proven" if the jury "find[s]

Second, the traditional rationales for a precise decision rule such as 0.5 are unconvincing. Pursuit of the two policies just mentioned does not require that the mid-range decision value be specified in a quantitatively precise way. On the contrary, it is preferable under these two policies *not* to dictate as a matter of law a precise mid-point decision value on a cardinal scale.[125] Even in cardinal terms, it would be better to allow the factfinder some flexibility in adjusting the decision value around the mid-point within an acceptable range, provided this were done for valid reasons.[126] For example, judges, in allocating the burden of production on a factual issue, and occasionally even the burden of persuasion, sometimes take

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that the scales tip, however slightly, in favor of the party with th[e] burden of proof") (quoting LEONARD B. SAND ET AL., MODERN FEDERAL JURY INSTRUCTIONS ¶ 73.01, at 73-4 (1992)). The image of weighing on a scale is a use of metaphor to refer to the mid-range without conceptualizing a cardinal measurement scale.

[125] A classic statement of the cautions against undue quantification in legal factfinding is Tribe, *supra* note 100, at 1358-77.

[126] *See* Allen et al., *supra* note 36, at 309-10 (remarks of Richard Friedman that characteristics of the evidence might be factors "affecting the burden of persuasion in a particular case"); *cf.* United States v. Shonubi, 895 F. Supp. 460, 472 (E.D.N.Y. 1995), *vacated and remanded on other grounds*, 103 F.3d 1085 (2d Cir. 1997) (in applying preponderance standard in sentencing context, "many sentencing judges employ a sliding scale, adjusting burdens of proof in proportion to the significance of the fact at issue"); Orloff & Stedinger, *supra* note 58, at 1173 ("Studies of jury deliberations suggest that jurors readily appreciate the need to apply different burden of persuasion rules to different situations.").

It should not be surprising that the same policy considerations that influence the allocation of the burden of production, the allocation of the burden of persuasion, and the creation of presumptions would also be relevant in adopting a particular threshold value in the circumstances of a particular case. *Cf., e.g.*, James, *supra* note 21, at 58-61, 65-66, 68 (considerations relevant to allocating burdens of production and persuasion, as well as to creating presumptions, include access to information and probabilities of occurrence in light of ordinary experience, as well as substantive policy objectives). These same considerations of fairness, convenience and policy might lead to somewhat divergent decision threshold values in different kinds of cases, and there would seem to be no reason either to deny this fact or to deny the jury the authority to take such factors into account in their factfinding.

Flexibility concerning the degree of warrant needed to make a finding is also appropriate when the inference rules applicable to the case are least amenable to formulation. *Cf.* Barbara D. Underwood, *Law and the Crystal Ball: Predicting Behavior with Statistical Inference and Individualized Judgment*, 88 YALE L.J. 1408, 1420-24 (1979) (discussing the possibility that predictions about human behavior based on the subjective judgment of experienced decisionmakers might be more accurate than predictions based on statistics "if the available data are too diverse, and the understanding of the phenomenon too weak, to support the formulation of a useful rule for combining factors to make predictions").

into account access to information.[127] Factfinders should be allowed, or even encouraged, to take into account in a particular case a failure to produce evidence to which a party probably has access, at least if the nonproduction is unexplained.[128] Common sense warrant rules undoubtedly discount the weight of some evidence when other expected evidence is not produced. Moreover, factfinders might be justified in making findings despite their lack of subjective confidence or belief, if that subjective uncertainty is due to one party's culpable failure to produce expected evidence. We would see this as a case in which the finding is warranted, despite the subjective uncertainty concerning the truth of the finding. The factfinder is not

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[127] *See supra* text accompanying note 109. In theory, assigning the burden of persuasion on an issue is simply establishing a tie-breaking default rule in case the weight of evidence is evenly distributed. *See supra* note 104. If the preponderance standard is interpreted on a cardinal scale, with 0.5 as the midpoint, then the burden of persuasion should decide cases only in those relatively rare situations where the evidence is perfectly balanced. If the cardinal scale conception is misguided, however, and we measure weight or degree of warrant in broad ordinal categories, then the mid-category might contain a significant number of cases, and the burden of persuasion will take on increased importance as a tie-breaker and will decide the outcome in a greater number of cases.

[128] Theorists have discussed taking completeness of evidence into account, although primarily in the context of assigning a probability to a proposition, not in interpreting the preponderance standard itself. *See, e.g.*, Craig R. Callen, *Kicking Rocks with Dr. Johnson: A Comment on Professor Allen's Theory*, 13 CARDOZO L. REV. 423, 431-39 (1991) (discussing the role of evaluating the completeness of the evidence produced in deciding upon the use of default rules in factfinding); Cohen, *Conceptualizing Proof*, *supra* note 27, at 85-86 (before making a legal finding that some event occurred, we need to be convinced that it more likely than not occurred, which in turn requires more "than simply noting that the best guess of the probability exceeds 0.5"; also relevant is how likely that best guess is to "hold up" if all available evidence had been produced); Kaye, *supra* note 9, at 658 (using "conventional probability theory" to incorporate the accepted proposition that "[o]ne must examine the completeness of a body of evidence and the circumstances under which the evidence was gathered if one is to assess its probative value"); Lempert, *supra* note 54, at 1047-48 (if the prosecutor's failure to produce expected evidence is more consistent with the defendant's innocence than with the defendant's guilt, a juror "would be justified in lowering his odds on the defendant's guilt" if that evidence is not produced); Lempert, *supra* note 28, at 473-74 (suggesting that the failure of the parties to produce evidence relevant to an alternative story that is consistent with the evidence is itself evidence that the otherwise plausible story is not supported by the facts); Tribe, *supra* note 100, at 1349-50 (using a subjective interpretation of probability statements, and suggesting that a probability assignment to a particular proposition might be lowered due to the proponent's unexplained failure to produce additional evidence); *see generally* Kaye, *supra* note 9; *cf. supra* note 100 (discussing incentive to produce additional evidence).

thereby changing the civil standard of proof, but rather applying the traditional preponderance standard in light of the evidence in the case.[129]

Concern for fairness has also led courts to shift the burden of proof or to set a higher standard of proof, such as clear and convincing evidence.[130] Fairness has played a major role in establishing res ipsa loquitur as a judicial doctrine,[131] or in holding manufacturers to the standard of knowledge of an expert in products liability cases.[132] Fairness is a legitimate reason for judges to modify the burden or standard of proof precisely because fairness to parties and unbiased treatment of parties are reasons for adopting a preponderance standard in the first place.[133] Factfinders, as well as judges, should have

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[129] *Cf.* James, *supra* note 21, at 54 (suggesting that the tendency of the average juror "will always be to interpret the charge [on the preponderance standard] in a personal and subjective way—in terms of his own feelings and experiences"). For a similar point in a criminal context, see Charles R. Nesson, *Reasonable Doubt and Permissive Inferences: The Value of Complexity*, 92 HARV. L. REV. 1187, 1197 (1979) (The "[r]easonable doubt [standard of proof] defies exact definition precisely because it is a concept meant to encompass many different, individual views of how probable guilt must be (or how unlikely innocence must be) to warrant conviction."). *But see* Winter, *supra* note 5, at 340-42 (arguing that the jury's role in civil cases should be "strictly as a factfinder" with minimal discretion to exercise leniency and apply legal rules, unlike in criminal cases).

[130] *See supra* text accompanying notes 107-112. These factors may justify a continuum of reasonable decision values on the various factual issues in any single case that would be difficult to capture in jury instructions. Jury instructions traditionally recognize only the "preponderance" standard, the "clear and convincing" standard, and the "beyond a reasonable doubt" standard. *See* 2 MCCORMICK, *supra* note 1, §§ 339-41, at 437-49.

[131] *See supra* text accompanying notes 108-110.

[132] *See, e.g.*, Feldman v. Lederle Lab., 479 A.2d 374, 384-89 (N.J. 1984) (distinguishing strict liability doctrine from negligence doctrine, and holding that "[i]n strict liability warning cases, unlike negligence cases, . . . the defendant should properly bear the burden of proving that the information was not reasonably available or obtainable and that it therefore lacked actual or constructive knowledge of the defect"); *see also* George v. Celotex, 914 F.2d 26, 28-31 (2d Cir. 1990); Borel v. Fibreboard Paper Prod. Corp., 493 F.2d 1076, 1089-90 (5th Cir. 1973), *cert. denied*, 419 U.S. 869 (1974); U.S. Gypsum Co. v. Mayor and City of Baltimore, 647 A.2d 405, 414-16 (Md. 1994). Even if a given manufacturer has not prematurely marketed the product in the face of fairly chargeable uncertainty, it has still derived an economic benefit on the basis of the societal uncertainty.

[133] There are, of course, numerous judicial goals, objectives and policies beyond those essential to the factfinding function. I am not persuaded that it is useful to conceive of the factfinding function as incorporating all of them. *Cf., e.g.*, Nesson, *supra* note 24, at 522 (contending that "the acceptability of a conclusion is not a simple function of mathematical probability, but rather is a complex matter of communication that depends on the nature of the issue, the process of decision,

a certain flexibility to consider fairness in applying the preponderance standard to the evidence in a particular case. As we will see in the next section, in the lost chance cases the existence of a physician-patient relationship might weigh against interpreting the mid-range decision value as precisely 0.5, when the available statistics show only about a 45% chance of survival for similarly placed patients. A reasonable factfinder might decide that the costs of uncertainty should be borne in fairness by the defendant physician, not by the plaintiff.[134]

In conclusion, interpreting the preponderance standard as a cardinal 0.5 decision rule is not required by the policies underlying that standard. In addition, such an analysis of its meaning is not advisable. It seems neither possible nor wise to reduce all warrant rules to calculations on a cardinal scale, and certainly no practical theory now exists for doing so.[135] Moreover, the two policies concerning incentive for evidence production and fairness to parties advise leaving a certain flexibility to the factfinder to apply the preponderance standard under the evidentiary circumstances presented by particular cases, and to make formal findings that take into account both access to information and fairness.[136] We should focus our efforts on refining warrant rules using an ordinal measure of weight, leaving open the possibility that such rules might

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and the purposes and audiences the conclusion serves").

[134] Perhaps the factfinder should be given guidance on which fairness considerations can be relevant to factfinding. There may be a danger that the factfinder would substitute vague feelings of equity for the substantive law. Not just *any* default rules are appropriate, but only those legitimated under the epistemological model or institutional constraints for legal factfinding.

[135] *Cf.* Allen, *The Nature of Juridical Proof*, *supra* note 9, at 412-13 ("How the juror is to reflect on the evidence; how probable a possibility must be; the relationship between the trial evidence and the asserted episodes; all are left unspecified [by his proposal], as they must be. There is no precise algorithm available to explain to jurors, or for that matter to historians, anthropologists, or astrophysicists, how to connect evidence to organizing theories.").

[136] This proposal suggests an empirical hypothesis that the factfinder's choice of a decision value is in part a function of the evidence presented in the case. If this hypothesis is true, we should not be surprised to find variation in the choice of a decision value, depending on the type of case and evidence presented. *Cf.* Simon & Mahan, *supra* note 54, at 325 & Table 7 (reporting that in survey "preponderance" meant "a little more than half or a 5.5 probability" to judges, but about "7.5" to students and jurors; individual variation within each test group was substantial).

usefully employ cardinal probabilities in well-defined types of inference.[137] The lost chance cases illustrate some features of such legal warrant rules.

B. *Illustrations from the Lost Chance Cases*

The typical lost chance case is characterized by the following evidentiary features. The plaintiff, at an initial point in time ("t_1"), had a higher-than-50% risk that death or some injury would occur to him or her within some specifiable time frame.[138] For example, the plaintiff might have had a 60% probability of dying from lung cancer within five years. Some negligent act by the defendant then caused an increase in risk for that same injury. Perhaps the defendant's negligent misdiagnosis caused the risk of death to increase to 80% by the time a correct diagnosis was made (at time "t_2"). When the plaintiff subsequently dies, experts are unwilling to testify that it was probably the defendant's negligence that caused this plaintiff's death (specific causation). This is because, out of a group of

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[137] In addition, once we discard the cardinal 0.5 decision rule in favor of a warrant-rule interpretation of preponderance, we may open the way to explore innovative decision rules that meet the particular needs of legal factfinding, including dynamic inference rules. What would be useful is a system of dynamic rules that warrant provisional conclusions from evidence, subject to adjustment or revision by other kinds of evidence. To be "warranted" does not mean to be true, let alone to be certainly true. A proposition that is warranted is one that a reasonable factfinder is entitled to accept as true at a given time, given the nature of the supporting evidence. This acceptance may be in an important sense provisional, with the warranted proposition subject to "defeaters." *See, e.g.*, JOHN L. POLLOCK, NOMIC PROBABILITY AND THE FOUNDATIONS OF INDUCTION 75-107 (1990). Such theories would provide useful guidance on what evidence warrants what conclusion, while identifying factors that the factfinder might take into account in provisionally reaching or later revising those conclusions. *See* Brilmayer & Kornhauser, *supra* note 11, at 123-24 (unlike a "summary statistic," a "rule of inference indicates which set of factual conclusions may be drawn from a set of premises or facts").

[138] *E.g.*, Falcon v. Memorial Hosp., 462 N.W.2d 44 (Mich. 1990) (chance of dying from amniotic fluid embolism in childbirth about 62.5% even if intravenous line had been connected prior to onset of the embolism); Kallenberg v. Beth Israel Hosp., 45 A.D.2d 177, 357 N.Y.S.2d 508 (1974), *aff'd*, 37 N.Y.2d 719, 337 N.E.2d 128, 374 N.Y.S.2d 615 (1975) (60-80% chance of dying from hemorrhage from cerebral aneurysm even with proper treatment); Herskovits v. Group Health Coop. of Puget Sound, 664 P.2d 474 (Wash. 1983) (61% chance of dying within five years at the time lung cancer was misdiagnosed).

people similarly situated to this plaintiff and who die, only 25% are expected to die because of the defendant's negligence, and 75% are expected to die from baseline causes alone.

These cases are often characterized by two further features. The first concerns the completeness of the available risk information. There may be good reason to believe that no additional, unproduced information is available to either party by which the factfinder could determine that the plaintiff is probably a defendant-caused case or a baseline case. As with most diseases, the state of scientific knowledge may be such that some risk factors are known, while many others are unknown. With regard to any specific plaintiff, we probably have some information about known risk factors for which we possess risk statistics, some information about suspected but unquantified factors, and some information about the plaintiff the relevance of which is totally unknown. But this state of factfinder ignorance, about both the disease and plaintiff, is not necessarily due to any party's failure to produce available evidence. The ignorance about the relevance of the available particularistic information may be a background feature of the state of scientific knowledge, perhaps due in part to societal decisions about funding for basic research. Nevertheless, some courts have justified assisting the plaintiff by arguing that the defendant's negligence itself caused the lack of probative evidence.[139] They reason that if the defendant had not been negligent, the factfinder would now know whether the particular patient was a baseline case or a survivor, because there would then be no defendant-caused cases.

The second feature of many lost chance cases is that the defendant had entered into a special relationship with the plaintiff, usually a physician-patient relationship. Given this relationship, some courts have held that the defendant undertook a duty of care to the plaintiff to increase the likelihood of survival.[140] This special relationship between plaintiff and defendant has led courts to assist the plaintiff in the face of the seemingly intractable proof problem about causation in the

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[139] *E.g.*, Thompson v. Sun City Community Hosp., Inc., 688 P.2d 605, 616 (Ariz. 1984); *Falcon*, 462 N.W.2d at 49-51; *cf.* Haft v. Lone Palm Hotel, 478 P.2d 465, 474-77 (Cal. 1970).

[140] *E.g.*, *Thompson*, 688 P.2d at 615-16; *Falcon*, 462 N.W.2d at 51-52.

specific case. The special relationship grounds a fairness argument for modifying traditional legal doctrines by placing the risk due to uncertainty on the defendant.

The interest in this Article is not in the broad question of how liability in the lost chance cases should be decided. Rather, the focus here is on factfinding with regard to specific causation. The lost chance cases present a factfinding problem that logicians call "direct inference": the inference from frequency statistics about groups to a probability judgment about a specific individual, from the finding that only 25% of deaths are defendant-caused deaths to the finding that probably the defendant did not cause this plaintiff's death. The question is what warrant rules should govern direct inferences in such cases, and thereby warrant a conclusion that the particular plaintiff is probably a baseline or a defendant-caused case.

I have elsewhere developed, and sought to justify, a theory of warrant for such direct inferences in the lost chance cases.[141] I will not reproduce that entire argument here. In summary, I argued that an inference to a probabilistic conclusion about the specific plaintiff is warranted provided certain conditions are met.[142] First, the factfinder must have warrant for finding that this specific plaintiff is characterized by certain known risk factors C_1, C_2, . . . , C_n—which include such circumstances as a lung tumor advanced to a certain stage or a certain family history, as well as the circumstance of the defendant's negligence. Second, the factfinder must make a warranted finding that in a group of persons characterized by C_1, C_2, . . . , C_n and who suffer the same type of injury as the plaintiff, a certain percentage would suffer defendant-caused injuries. For example, the factfinder must make a warranted finding that 25% is the appropriate frequency estimate of defendant-caused injuries in a group of people with the same known risk factors and injury as the plaintiff.[143] These two

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[141] *See* Walker, *supra* note 6.

[142] *See* Walker, *supra* note 6, at 280-81, 292-98.

[143] One feature of many lost chance cases, as opposed to many toxic tort cases, is that there is good evidence available to warrant such a finding. *See* Levmore, *supra* note 75, at 719 (it is distinctive of lost chance cancer cases that there is "a respectable body of statistical information about the likely consequences of a delayed or missed diagnosis that provides the factual information for using a probabilistic approach"); Walker, *supra* note 6, at 252 n.12.

types of proposition—one about the specific plaintiff and the other about groups of persons similarly situated—themselves require warrant rules. For example, frequency predictions for groups are subject to various types of uncertainty or potential for error, and scientists have developed techniques for warranting inferences in the face of those uncertainties.[144]

Under certain conditions these two findings, if warranted, warrant the factfinder to assign a certain subjective probability to the proposition that the specific plaintiff is a defendant-caused case. If the factfinder concludes that the characteristics $C_1, C_2, \ldots, C_n$ include only risk factors that are causally related to the type of injury suffered by the plaintiff, that they are significant risk factors in the sense of being directly and non-spuriously related to that injury, and that they include a reasonably complete set of significant causal factors for that injury, then the causal model used to generate the 25% group prediction is a reasonably well-specified causal model for the injury in such groups. The causally-based frequency estimate of 25% is therefore not expected to change substantially as new information about risk factors becomes available. Moreover, this causal model, based on the plaintiff's set of known risk factors, compels the conclusion that no subjective probability other than 0.25 should be assigned to the proposition that this plaintiff was a defendant-caused injury.

This inference to a probabilistic assessment of specific causation, however, is not compelled by the scientific data or by a scientific methodology, but by the requirement of minimal fairness to the parties—the same requirement of minimal fairness discussed above as a property of legal factfinding generally.[145] My argument is that if such findings about the causal model are warranted, and if a subjective probability is assigned to the proposition about specific causation, then the

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[144] Warrant rules would govern inferences to predicted incidence rates and generic causation from such evidence as epidemiologic studies, animal data, anecdotal case reports and theories about causal mechanisms. Such evidence would be subject to uncertainties inherent in concept selection, measurement, sampling, modeling and causal attribution. *See generally* Walker, *supra* note 4.

[145] *See supra* Section I.C. For a discussion of the minimal fairness requirement for factfinders, see Walker, *supra* note 6, at 272-79, 292-97. I now suggest that the requirement of minimal fairness is a basic property of legal factfinding generally, not just in civil litigation or in the lost chance cases.

factfinder is compelled by minimal fairness to assign a corresponding subjective probability to the individual case. For example, if the causal model is adequately specified and is the basis for a frequency estimate of 25%, then no subjective probability other than 0.25 should be assigned to the proposition that this specific plaintiff suffered a defendant-caused injury. The justification for this warrant rule is minimal fairness to the parties—the policy of not allowing the factfinder to draw a set of conclusions that contains an a priori bias against any party. If any assigned subjective probability did not equal 0.25, we could determine a priori that those findings systematically disadvantage some party, regardless of the truth of the findings.

Such an inference rule is best understood, however, as an idealization describing a kind of equilibrium point in a dynamic flow of reasoning. It is an inference model that guides our thinking as we approach that point, or as we adjust our thinking after that point. But the reality of factfinding generally falls far short of the ideal. What if the factfinder sees no warrant for finding an adequately specified causal model? What is the role of the particularistic information about the plaintiff's other probable risk factors, whose effect on risk is unquantified? Can a factfinder be warranted in concluding that although the expected relative frequency of defendant-caused injuries based on some known risk factors is only 25%, other characteristics of this plaintiff warrant a finding that this was a defendant-caused case?

This Article provides a more robust understanding of legal factfinding generally, and in particular for factfinding under the preponderance standard in civil litigation. These additional insights can help round out a theory of warrant for lost chance cases. In addition to minimal fairness, there is the general factfinding requirement for sufficient support in the legally available evidence. A factfinder who wishes to determine specific causation by taking into account some feature of the plaintiff, such as hair color or genetic composition, should not do so unless there is evidence sufficient to warrant finding a significant causal link between that feature and the type of injury. Without such evidence and finding, the factfinder would be speculating and the inference to specific causation would be unwarranted. The factfinder is not free to speculate about

characteristics of the plaintiff not in evidence, or about the causal significance of factors for which there is no produced evidence of causal link. There is more flexibility in reaching conclusions than under a higher standard of proof, but we still expect the factfinder to be able, at least in principle, to provide a reasonable account of his or her inference.

Also relevant to the lost chance problem are the additional institutional goals of adequate evidence production and unbiased treatment of parties. With regard to evidence production, a factfinder might be warranted in finding facts for a proponent on less support in the evidence produced than one might normally wish, provided the opponent had the ability to produce the missing information and inexplicably failed to do so. A factfinder might find facts for the plaintiff, for example, if the weight of evidence on specific causation is somewhat even but the defendant ought to have produced more evidence than it did, for example on the generic risk factors or on the circumstances surrounding the events in the specific plaintiff's case.[146] The factfinder should be able to charge to the defendant those uncertainties due to the defendant's failure to produce evidence.

Similarly, although courts are committed to treating parties in an unbiased fashion, courts occasionally shift the burden of persuasion in certain types of cases upon an initial showing by the plaintiff, out of a concern for fundamental fairness and equity. Factfinders should also have a certain flexibility, when justified by the evidence in a particular case, to shift the burden of persuasion somewhat by finding for the plaintiff on evidence that provides less support than normal or ideal.[147] In a lost chance case involving a physician-patient relationship, for example, the factfinder faced with somewhat even statistical probabilities might find against a defendant doctor on specific causation because it would not be fair to hold the plaintiff responsible for the lack of quantified information

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[146] Another example might be if the relevant information does not exist due to the negligence of the defendant. If the factfinder finds that information tying a relevant risk factor to the particular plaintiff is missing from the evidence, and that it is probably missing because the defendant negligently failed to conduct a diagnostic test or record its results, the factfinder may reflect in his or her conclusion the degree of uncertainty due to the missing information.

[147] *See supra* text accompanying notes 107-110, 130-134.

about a probable risk factor, even if that information is at the time of trial not accessible to either party to produce. A reasonable factfinder might conclude that as the patient's chance of survival given proper diagnosis improves (closer to 50% than 5%), the physician-patient relationship warrants charging the defendant with certain residual uncertainties. In a somewhat close case, the factfinder would be warranted in finding specific causation, despite the fact that the quantifiable expected frequency of defendant-caused cases is somewhat less than 50%.

If degree of warrant is understood as an ordinal concept with relatively broad qualitative categories, such as "weak/moderate/strong," we should not expect mathematical precision in the warrant rules governing findings of fact. If we are able to develop adequate theories of warrant that employ cardinal measures, we might incorporate them into our warrant rules on a case-by-case basis. We have done so with many scientific estimates of incidence in groups, such as inferences based on sampling theory. We might also do so with direct inferences based on reasonably well-specified causal models, as in many lost chance cases. But conclusions about specific individuals cannot always be warranted in such a quantitative way. As this discussion of lost chance cases illustrates, our theories of warrant for findings about individuals still rely heavily on considerations of evidence production and fairness. In addition, a significant warranting role is surely played by broader notions of coherence and plausibility, such as those captured by the requirement that there be a plausible "story" that incorporates the proposition found to be true.[148] All of these considerations counsel against interpreting preponderance as requiring more than a 0.5 probability.

In conclusion, the dynamics of legal factfinding must occur within the judicially imposed burdens of production and persuasion.[149] In the lost chance cases we can envision a theory

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[148] I believe that my analysis of the preponderance standard is compatible with Allen's "equally well specified case proposal." *See* Allen, *The Nature of Juridical Proof, supra* note 9; *cf.* Allen, *supra* note 54; Nesson, *supra* note 23, at 1388-90 (in each case "the legal system strives to produce the single most probable story").

[149] I have suggested elsewhere that in the lost chance cases, plaintiffs and defendants might be assigned different burdens of production and persuasion, varying with the different propositions on which findings are required. Walker, *supra* note 6, at 302-03.

of warrant that induces the eventual generation of accurate causal models, while dealing fairly with litigants in the meantime. We can articulate the evidentiary ideal that would compel a subjective probability assignment, while also articulating which considerations of completeness and fairness warrant provisional conclusions when we fall short of that ideal. The goals of legal factfinding are best served if the factfinder has flexibility around a mid-range level of preponderance, where the weight of evidence of specific causation might be in rough equilibrium. In that mid-range the factfinder should find the facts by also taking into account an unexplained failure to produce relevant evidence and certain fairness concerns. But interpreting the preponderance standard of proof by using a cardinal conception of probability and a 0.5 decision rule can mislead us into thinking that such dynamic flexibility is inconsistent with the objectives of legal factfinding. On the contrary, courts should not take a close case away from the jury simply because the quantifiable incidence of defendant-caused injuries is somewhat less than 50%.

CONCLUSION

Instructing that factual determinations should be made "by a preponderance of the evidence" may well convey to the factfinder, fairly and succinctly, the major policies at work in legal factfinding. Further describing the factfinder's task as deciding what is "probably true" is also useful, since it points toward the ideal of approximating knowledge. Any further steps, however, should be accompanied by caution. It is a conceptual wrong turn to interpret "probably true" as measured on a cardinal scale, whether the notion of probability intended is objective relative frequency or subjective degree of confidence. Moreover, it is even more misguided to interpret the preponderance standard as adopting a precise mid-point on such a cardinal scale, such as 0.5 on a scale from 0 to 1, as a threshold decision point for purposes of legal factfinding. To do so is to invite the mistakes made by those courts in the lost chance cases that have granted summary judgment to the defendant simply because the baseline injury rate in similar cases was 50% or more. The same misinterpretation has also encouraged

the mistaken attempts by legal theorists to argue that the preponderance standard, as a 0.5 decision rule, minimizes error rates or equally distributes error.

In place of this wrong turn, I have drawn upon an epistemological model of knowledge in proposing that the factfinder's general task under the preponderance standard is to decide what is "probably true" in the sense of "being warranted by the evidence." To be warranted in this sense, a legal finding must be minimally fair, in the sense of meeting the formal requirements of coherence and consistency. It must also have sufficient support in the legally available evidence, that is, be reasonably inferable from that evidence. In addition, legal factfinding under the preponderance standard in civil litigation is intended, first, to create an incentive on all parties to produce adequate evidence and, second, to treat all parties in an unbiased fashion, even though certain parties bear a burden of persuasion on any given issue. These additional policy objectives support the argument that a cardinal 0.5 decision rule is inappropriate, and that factfinders should have a certain flexibility in finding facts when evidence is roughly in equipoise.

Over time, legal theorists and courts develop theories of warrant for identifiable types of issues. I have illustrated such theories by discussing the issue of specific causation in the lost chance cases. In the lost chance cases, the general properties of warranted factfinding, as well as my proposed rejection of a cardinal 0.5 decision rule, support letting marginal cases go to the finder of fact and letting that factfinder have a certain flexibility in making findings about specific causation. In making those findings, the factfinder should be able to take into account such factors as failure to produce evidence and fairness to parties in special relationships—the same types of factors that judges take into account in occasionally deciding to shift the burden of proof. A preoccupation with interpreting the preponderance standard in terms of cardinal probability can blind us to the appropriateness of such flexibility.