

STAYING FAITHFUL TO THE STANDARDS OF PROOF

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Academics have never quite understood the standards of proof or, indeed, much about the theory of proof. Their formulations beget probabilistic musings, which beget all sorts of paradoxes, which in turn beget radical reconceptions and proposals for reform. The theoretical radicals argue that the law needs some basic reconception such as recognizing the aim of legal proof as not at all a search for truth but rather the production of an acceptable result, or that the law needs some shattering reform such as greatly heightening the civil standard of proof on each part of the case to ensure a more-likely-than-not overall result.

This Article refutes all those baroque rereadings. It shows that the standards of proof, properly understood on the law's own terms without a probabilistic overlay, work just fine. The law tells factfinders to compare their degree of belief in the alleged fact to their degree of contradictory disbelief. Obeying that instruction resolves mathematically the paradoxes that traditional probability theory creates for itself. Most surprising, the burden of proof, by which the proponent must prove all the elements and the opponent need disprove only one, does not produce an asymmetry between the parties.

The law's standards of proof need no drastic reconception or reform, because the law knew what it was doing all along. It deals with factual beliefs in a world that will remain uncertain, not with the odds of the facts becoming certain. And the well-established mathematics of beliefs are not the mathematics of odds.

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INTRODUCTION

Standards of proof are a simple concept, unless you stop to think about them. At the least, the law is quite clear in stating standards.¹ Here is a pattern civil jury instruction:

Plaintiff has the burden in a civil action, such as this, to prove every essential element of plaintiff's claim by a preponderance of the evidence. If plaintiff should fail to establish any essential element of plaintiff's claim by a preponderance of the evidence, you should find for defendant as to that claim.²

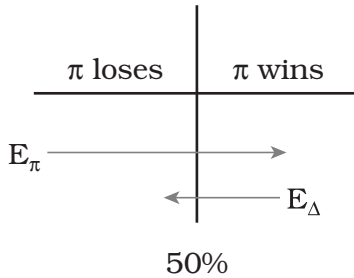
Doing their job, academics have stopped to think about the standards of proof. What is a "preponderance"? The courts tell us it means more likely true than not, which to the academics means more probable than not, which thus calls for use of traditional probability theory.³ The routinely taught result ap-

¹ See Ronald J. Allen & Sarah A. Jehl, *Burdens of Persuasion in Civil Cases: Algorithms v. Explanations*, 2003 MICH. ST. L. REV. 893, 897–904 (criticizing Dale A. Nance, Commentary, *A Comment on the Supposed Paradoxes of a Mathematical Interpretation of the Logic of Trials*, 66 B.U. L. REV. 947, 949–51 (1986) (finding the pattern jury instruction ambiguous)).

² 3 KEVIN F. O'MALLEY, JAY E. GREING & WILLIAM C. LEE, FEDERAL JURY PRACTICE AND INSTRUCTIONS: CIVIL § 104.01 (6th ed. 2011). The pattern jury instruction also verbalizes the process imposed implicitly on the judge when acting as factfinder.

³ See, e.g., *Brown v. Bowen*, 847 F.2d 342, 345 (7th Cir. 1988) ("[T]he trier of fact rules for the plaintiff if it thinks the chance greater than 0.5 that the plaintiff is in the right."); THOMAS J. MICELI, *THE ECONOMIC APPROACH TO LAW* 302–03 (3d ed. 2017) (giving a straightforward and uncritical account of the probabilistic approach); Edward K. Cheng, *Reconceptualizing the Burden of Proof*, 122 YALE L.J. 1254, 1256 (2013) ("As every first-year law student knows, the civil preponder-

pears below, showing the pull and haul of the plaintiff’s and defendant’s evidence, E, on a disputed issue, as plaintiff’s case in chief establishes the fact as more likely than not and then the case in defense pushes the probability back down:



We are off and running—right off a cliff. The traditional probabilistic model⁴ immediately introduces paradoxes, puzzles, and problems galore:

1. *Unrealistic factfinding.* Probabilistic thinking induces one to speak in quantified terms, even as one simultaneously admits that probability percentages are not how people naturally think.⁵ Speaking in numerical terms can only mislead the factfinder.⁶ For example, it is silly to speak in terms of a razor’s edge at 50%. A human factfinder cannot tell 49% from 51%. Equipose is a fuzzy zone in the factfinder’s mind.⁷
2. *Prior probability.* The academics’ cure for a lack of realism is to speak in ever more sophisticated terms, urging

ance-of-the-evidence standard requires that a plaintiff establish the probability of her claim to greater than 0.5.”)

⁴ By traditional probability, I am referring to the classical, frequentist, and subjective systems conforming to Kolmogorov’s axiomatization. See Alan Hájek, *Interpretations of Probability*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 1 (Edward N. Zalta ed., 2012), <https://plato.stanford.edu/entries/probability-interpret/> [<https://perma.cc/HAV8-QNFM>] (listing the axioms of nonnegativity, normalization, and additivity). But the usual particularization of probability for discussing legal proof is subjective probability. See KEVIN M. CLERMONT, STANDARDS OF DECISION IN LAW: PSYCHOLOGICAL AND LOGICAL BASES FOR THE STANDARD OF PROOF, HERE AND ABROAD 120–21 (2013) (discussing probability theories); Hájek, *supra*, § 3.3.1 (characterizing subjectivism, unfortunately, with the slogan of “Probability is degree of belief”).

⁵ See CLERMONT, *supra* note 4, at 68–75 (explaining why humans perform probabilistic tasks quite weakly).

⁶ See *id.* at 75–78, 113–14 (describing potential problems from quantifying decisionmaking standards, such as difficulty in meshing numbers with unquantified variables; also, “there is no convincing reason to expect that quantification would effectively invoke our nonprecise internal scale of judgment, or otherwise accord with the ingrained way of human thinking”).

⁷ See *id.* at 18–23 (establishing that equipose embodies a range of frequently occurring cases, not just the precise point of 50/50).

Bayes' theorem for discussions of factfinding in recent decades.⁸ Bayes tells us that we need to start with a prior probability, which the admitted evidence will alter. In the proper state of initial ignorance in a civil case, the plaintiff's claim has a 50/50 chance. Consequently, even though it comports with neither the actual probabilities nor the law's instructions, a popular starting point for the Bayesian factfinder is 50%.⁹ But among other difficulties,¹⁰ this prior probability would make the standard of proof ridiculously easy for the plaintiff to satisfy. Introducing a feather's weight of evidence would arguably suffice to carry the burden of production, as well as the burden of persuasion over a silent defendant. We all know the law is otherwise:¹¹ the rule on judgment as a matter of law requires plaintiff's evidence to create at least a reasonable possibility.¹²

3. *Infinite alternatives.* By contrast, the infinite range of possibilities alternative to the plaintiff's allegations would seem to make the plaintiff's burden nearly impossible to carry. Even if one invokes contextualism to pare down the range of plausible alternatives, one might still argue that almost no plaintiff could tell a story more than 50% true, given the theoretical difficulty of proving the truth by dissipating all the remaining alternatives.¹³ Indeed, in

⁸ See *id.* at 120–21 (laying out the basics of Bayes' theorem); Richard Lempert, *The New Evidence Scholarship: Analyzing the Process of Proof*, 66 B.U. L. REV. 439, 440–50 (1986) (championing Bayesianism). See generally SHARON BERTSCH MCGRAYNE, *THE THEORY THAT WOULD NOT DIE* (2011) (recounting the centuries of controversy generated by Bayes' theorem).

⁹ See Kevin M. Clermont, *Trial by Traditional Probability, Relative Plausibility, or Belief Function?*, 66 CASE W. RES. L. REV. 353, 368–69 (2015) [hereinafter Clermont, *Belief Function*] (discussing the situation of a lack of proof). On problems with choosing another prior probability, see Leonard R. Jaffee, *Of Probability and Probability: Statistics, Scientific Evidence, and the Calculus of Chance at Trial*, 46 U. PITT. L. REV. 925, 980–85 (1985).

¹⁰ See *State v. Spann*, 617 A.2d 247, 254 (N.J. 1993) (".5 assumed prior probability clearly is neither neutral nor objective . . ."); Lempert, *supra* note 8, at 462–67 (noting that employing 50/50 as the appropriate odds when ignorant of the true facts can cause many problems).

¹¹ See 2 MCCORMICK ON EVIDENCE § 338, at 654 (7th ed. 2013) ("A 'scintilla' of evidence will not suffice.").

¹² See, e.g., FED. R. CIV. P. 50(a) (stating standard of decision as whether "a reasonable jury would not have a legally sufficient evidentiary basis to find for the party on that issue").

¹³ See Michael S. Pardo, *Second-Order Proof Rules*, 61 FLA. L. REV. 1083, 1093 (2009) ("If the plaintiff must prove that some fact, X, is more probable than its negation, *not-X*, then the plaintiff should have to show not only the probability that the state of the world is such that X is true, but also the probability of every other possible state of the world in which X is not true. This would mean that in order to prevail, plaintiffs would have to disprove (or demonstrate the low likelihood of) each of the virtually limitless number of ways the world could have been at the relevant time. This would be a virtually impossible task, and thus, absent

many other ways tied to the idea that the plaintiff must prove each element while the defendant need disprove only one, traditional probability theory suggests that plaintiffs are in an asymmetrically disadvantaged position. If the procedural system were so slanted, it could never deliver on its promise of neutrality.¹⁴

4. *Element-by-element factfinding.* Error-cost minimization would seem to tell us to apply the standard of proof to the plaintiff's whole story. The plaintiff's tale of liability should be more likely than all versions of nonliability. Yet the pattern jury instruction says to proceed element-by-element, seeming to render critical how finely the law divides a claim into elements. Troublingly, probability's product rule says that each element's being more probable than not is no guarantee of efficiency's requirement that the elements' conjunction be more probable than not.¹⁵ Any proper model of the standards of proof must resolve this key theoretical paradox.¹⁶ Ultimately, the takeaway will be that probabilism fails not only as a description of how humans find facts, but also as an aspiration of how the ideal factfinder should proceed.
5. *Standards' purposes.* Most importantly, traditional probability theory departs from the standards' purposes. The standards, as developed and deployed by the courts, never embraced the spirit of probability,¹⁷ even when

conclusive proof, plaintiffs would lose." (footnote omitted)); cf. Patrick Rysiew, *Epistemic Contextualism*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 3.3 (Edward N. Zalta ed., 2016), <https://plato.stanford.edu/entries/contextualism-epistemology/> [<https://perma.cc/CL5K-JB8Z>] (formulating a response to the skeptical argument).

¹⁴ See *infra* Part III (discussing apparent asymmetries).

¹⁵ See Charles Nesson, *The Evidence or the Event? On Judicial Proof and the Acceptability of Verdicts*, 98 HARV. L. REV. 1357, 1385–88 (1985) (illustrating the product rule). For independent events a and b , the product rule says that the probability of conjoined events is the product of the events' probabilities. For interdependent events, the probability operation for conjunction is $p(a)$ multiplied by $p(b-a)$, so it is still multiplicative.

¹⁶ The conjunction paradox lies in this: Assume that a civil plaintiff needs to prove two elements, a and b . He proves element a to 70% and b to 60%, whatever that means. According to American law he wins, having proven each element by a preponderance. Paradoxically, he should lose according to American law professors, supposedly because he has proven the conjunction of a and b to only 42%. See Kevin M. Clermont, *Conjunction of Evidence and Multivalent Logic*, in LAW AND THE NEW LOGICS 32 (H. Patrick Glenn & Lionel D. Smith eds., 2017) [hereinafter Clermont, *Fuzzy Logic*] (resolving the conjunction paradox).

¹⁷ See *Sargent v. Mass. Accident Co.*, 29 N.E.2d 825, 827 (Mass. 1940) (defining preponderance to require that "it is made to 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"); *Lampe v. Franklin Am. Trust Co.*, 96 S.W.2d 710, 723 (Mo. 1936) ("The trouble with [a probability instruction] is that a verdict must be based upon what

they often spoke in the words of probability.¹⁸ The law is looking more for some sort of internal conviction on the part of its factfinders.¹⁹

Let me expand on that last point, which is the subject of this Article. I am not arguing against the academics' trying to get below the surface, or against future sophisticated thinking about the proof standards. I am arguing that traditional probability does not provide what we want from standards. Why not?

Traditional probability's fatal defect for this purpose is that, unbeknownst to most of us, it is built on an assumption of bivalence. That is, like classical logic, it assumes that facts must be treated as either true or false.²⁰ *Probability of truth in*

the jury finds to be facts rather than what they find to be 'more probable.' . . . This means merely that the party, who has the burden of proof, must produce evidence, tending to show the truth of those facts, 'which is more convincing to them as worthy of belief than that which is offered in opposition thereto.'" (quoting *Rouchene v. Gamble Constr. Co.*, 89 S.W.2d 58, 63 (Mo. 1935)); *Anderson v. Chi. Brass Co.*, 106 N.W. 1077, 1080 (Wis. 1906) (saying preponderant evidence "must be so as to satisfy or convince the minds of the jury of the truth of his contention"); John Leubsdorf, *The Surprising History of the Preponderance Standard of Civil Proof*, 67 FLA. L. REV. 1569, 1595–99 (2015) (discussing early formulations of degrees of belief); Richard W. Wright, *Haack on Legal Proof*, 68 ESTUDIOS FILOSÓFICOS 517, 523 (2018) ("[T]he references in the great majority of jury instructions in the United States to persuasion, conviction or belief in the truth of the facts at issue in the particular case, based on evidence specific to that case, are inconsistent with a standard of proof based on mathematical probability.").

¹⁸ See 2 MCCORMICK ON EVIDENCE, *supra* note 11, § 339 (citing many cases).

¹⁹ See *infra* text accompanying notes 52–57 (explaining nature of belief). Incidentally, in the absence of Bayesian legal academics, civilian jurists speak without much opposition in terms of *intime conviction*, which is a peculiarly strong belief. See Kevin M. Clermont & Emily Sherwin, *A Comparative View of Standards of Proof*, 50 AM. J. COMP. L. 243, 245–51, 269–74 (2002) (explaining *intime conviction*); Mark Klamberg, *Epistemological Controversies and Evaluation of Evidence in International Criminal Trials*, in THE OXFORD HANDBOOK OF INTERNATIONAL CRIMINAL LAW (Kevin Jon Heller et al. eds., forthcoming 2019) (minimizing differences among civilian views); Mark Schweizer, *The Civil Standard of Proof—What Is It, Actually?*, 20 INT'L J. EVIDENCE & PROOF 217, 218 (2016) (exploring what standard civil jurists actually apply).

²⁰ See Clermont, *Fuzzy Logic*, *supra* note 16, at 36–40 (describing assumptions of classical logic and observing: "This multivalent form of logic boldly declines the simplification offered by two-valued, or bivalent, logic built on a foundation of true/false with an excluded middle. It instead recognizes partial truths. Both a proposition and its opposite can be true to a degree."). The semantic principle of bivalence holds that a proposition *P* is either true or false. Thus, *not-P* is not divided into further sets, but constitutes a single set called false. This principle underlies two-valued logic. It is indeed the intended (although not necessary) meaning, or semantic, of all classical logic, so that classical logic tends to induce bivalent thinking. Classical logic's slightly different, syntactic law of the excluded middle holds, as a matter of grammatical structure, that a proposition *P* is either true or not true; thus, in the universe of men, a person can be tall or not tall, rather than simply either tall or short. Bivalence implies the law of the

this black-and-white world, p , provides the chance of the fact being revealed as true. Moreover, the probability of the fact being revealed as false is the complement, $1-p$. Thinking in terms of the odds of certain truth or falsity produces all of the above five difficulties.

As this Article will develop, my first critical correction is away from bivalence and toward multivalence for the purposes of factfinding. Under multivalent logic, factfinders can believe facts as partly true, ranging in degree from zero to one.²¹ Legal factfinding should not aim to measure the probability of bivalent truth but rather to measure a partial conviction or belief established by the evidence. It is upon a *belief in truth* that the law should proceed.

My second critical correction is that, given imperfect evidence, the factfinder will leave some of its belief uncommitted when forming some degree of belief that the fact is true and some degree of belief that the fact is false. The committed belief and disbelief will add to less than one.²²

excluded middle, but the converse is not true. See Peter Suber, *Non-Contradiction and Excluded Middle* (1997), <http://www.earlham.edu/~peters/courses/logsys/pnc-pem.htm> [<https://perma.cc/S94C-Y49V>].

²¹ See generally GRAHAM PRIEST, AN INTRODUCTION TO NON-CLASSICAL LOGIC: FROM IF TO IS (2d ed. 2008) (discussing multivalent logic and the excluded middle); Siegfried Gottwald, *Many-Valued Logic*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY (Edward N. Zalta ed., 2015), <https://plato.stanford.edu/entries/logic-manyvalued/> [<https://perma.cc/LB9M-MVE7>]. Multivalent logic rejects as an assumption the law of the excluded middle.

²² Indeed, the belief function system is nonadditive. Additivity is one of traditional probability's three basic Kolmogorov axioms: "If two events cannot happen jointly, the probability that one or the other occurs is equal to the sum of their separate probabilities." TERENCE ANDERSON, DAVID SCHUM & WILLIAM TWINING, ANALYSIS OF EVIDENCE 251 (2d ed. 2005). In an additive system, a set and its complement add to the universe, or one. Thus, the probability that an event will happen and the probability that it will not happen add to one. See RAFIK AZIZ ALIEV, FUNDAMENTALS OF THE FUZZY LOGIC-BASED GENERALIZED THEORY OF DECISIONS 106, 108–09 (2013) (contrasting additive with nonadditive probability systems, and also showing belief functions to be nonadditive); ANDERSON ET AL., *supra*, at 254 ("[T]his additivity requirement puts a burden on you that you might not be willing to accept. The conventional system of probability requires that you must always commit all of your probabilistic belief to mutually exclusive and exhaustive events; you cannot hold back any of your belief or leave it uncommitted."); CLERMONT, *supra* note 4, at 151, 187, 203 (considering the effect of nonadditivity on legal proof); BENGT LINDELL, MULTI-CRITERIA ANALYSIS IN LEGAL REASONING 154 (2017) (calling additive and nonadditive probabilities, respectively, two-sided and one-sided probabilities); Rolf Haenni, *Non-Additive Degrees of Belief*, in DEGREES OF BELIEF 121, 123 (Franz Huber & Christoph Schmidt-Petri eds., 2009) (arguing "that the extreme case of total ignorance . . . should never lead to degrees of belief different from zero," so that belief and disbelief are both zero, "which is a particular case of the non-additivity assumption $Bel(h) + Bel(\neg h) \leq 1$ " and which means that "a proper distinction between uncertainty and ignorance" can exist); Ron A. Shapira, *Economic Analysis of the Law of Evidence: A Caveat*, 19 CARDOZO L. REV.

In sum, the choice comes down to probability of truth versus belief in truth. Factfinders can, do, and should focus on the latter. The standards of proof were never meant to deal with the betting odds of discovering truth with certainty, which is all that a bivalent model can deliver. The standards instead operate on multivalent degrees of belief.

This Article circles back from the frontiers of standards' theory where I have been exploring for thirty years,²³ and now tries to explain all in lawyer-friendly terms while extending my prior work. Part I will explain my multivalent-belief model of standards of proof, which is a nonradical elaboration of the existing law. Part II will extend my work by introducing the many radical models propounded to resolve the obvious difficulties with the popular probabilistic model; the most fruitful is inference to the best explanation, whose legal offspring turns out to be merely a variation of the multivalent-belief model but one that triggers some valuable insights. Part III will then show how the multivalent-belief model, illuminated by those insights, resolves the plaintiff/defendant asymmetries that the probabilistic model falsely suggests.

I

MULTIVALENT BELIEFS

One must begin by locating the topic of standards of proof within the subject of factfinding. As the very first step, "fact" can include anything that a court, other institution, or a person subjects to a proof process in order to establish what to treat as truth. The subject includes not only yes-or-no facts but also vague and normative terms like "fault" and many other applications of law to fact, as well as a variety of nonbinary opinions.²⁴ Nonetheless, discussion remains easiest when fo-

1607, 1613–16 (1998) (distinguishing additive from nonadditive). However, in a multivalent system that rejects the law of the excluded middle, a set can overlap its complement, which means that neither of the excluded middle's consequences (additivity and noncontradiction) prevails. See Timothy J. Ross & W. Jerry Parkinson, *Fuzzy Set Theory, Fuzzy Logic, and Fuzzy Systems*, in *FUZZY LOGIC AND PROBABILITY APPLICATIONS* 29, 33–34 (Timothy J. Ross et al. eds., 2002) (discussing fuzzy logic); *supra* note 20 (discussing excluded middle).

²³ See CLERMONT, *supra* note 4, at 5 n.4 (laying out my position, while citing my series of seven previously published articles on standards of proof that began in 1987). Since that 2013 book, I have written three supplementary articles: Clermont, *Belief Function*, *supra* note 9; Clermont, *Fuzzy Logic*, *supra* note 16; Kevin M. Clermont, *Common Sense on Standards of Proof*, 48 SETON HALL L. REV. 1057 (2018) [hereinafter Clermont, *Common Sense*].

²⁴ Cf. RICHARD H. FIELD, BENJAMIN KAPLAN & KEVIN M. CLERMONT, *MATERIALS FOR A BASIC COURSE IN CIVIL PROCEDURE* 1555–63, 1628–31 (12th ed. 2017) (defining "fact" for jury and appeal); William W. Schwarzer, *Summary Judgment Under the*

cluding mainly on the legal task of finding a historical fact that constitutes a single element of a claim or defense.

Next, if one divides the legal factfinders' task into a processing phase and an evaluating phase, the specific topic of standards of proof arises in the latter phase. Law imposes no enforceable restraints on the first phase's processing of pieces of evidence (E_1 , E_2 , etc.). Logicians have not managed to agree on how evidence should get processed.²⁵ Psychologists have made limited progress in figuring out how evidence actually gets processed. Cognition here remains a black box. The actual process may be rational²⁶ or intuitive,²⁷ although it should involve so-called critical common sense.²⁸ It may proceed at-

Federal Rules: Defining Genuine Issues of Material Fact, 99 F.R.D. 465, 469–80 (1984) (doing the same for judgment as a matter of law).

²⁵ See Symposium, *Artificial Intelligence and Judicial Proof*, 22 CARDOZO L. REV. 1365, 1365–67 (2001) (working on the need to formalize evidence processing for application of “computational intelligence”); James Franklin, *How Much of Commonsense and Legal Reasoning Is Formalizable? A Review of Conceptual Obstacles*, 11 LAW, PROBABILITY & RISK 225, 245 (2012) (taking a pessimistic view on formalizing common reasoning).

²⁶ See, e.g., Edmund M. Morgan, *Introduction to Evidence*, in AUSTIN W. SCOTT & SIDNEY P. SIMPSON, *CASES AND OTHER MATERIALS ON CIVIL PROCEDURE* 941, 943–45 (1950) (discussing the logical methods jurors use to process evidence). “Rational” means logical. See ANDERSON ET AL., *supra* note 22, at 56 (“[A] conclusion based upon the evidence can only be justified as rational through the use of [deductive, inductive, or abductive] logic.”); see also WILLIAM TWINING, *RETHINKING EVIDENCE: EXPLORATORY ESSAYS* 75–80 (2d ed. 2006) (describing the common law’s so-called Rationalist Tradition).

²⁷ See, e.g., Mark Spottswood, *The Hidden Structure of Fact-Finding*, 64 CASE W. RES. L. REV. 131, 171–93 (2013) (applying the dual-process psychological framework to legal factfinding). “Intuition” is analyzed in LINDELL, *supra* note 22, at 80–97.

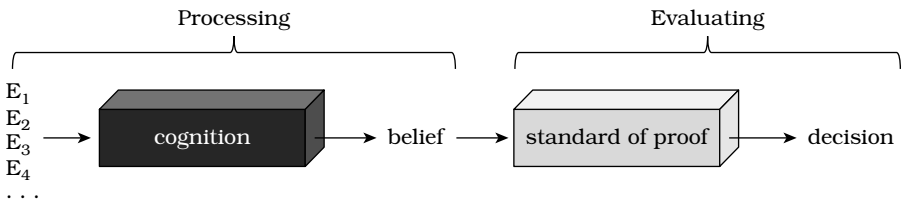
²⁸ See D. Michael Risinger, *Searching for Truth in the American Law of Evidence and Proof*, 47 GA. L. REV. 801, 813 (2013) (discussing “the notion of critical common sense and its attendant implication that participation in rational factfinding about legal issues is possible for most humans of normal intelligence”).

omistically²⁹ or holistically.³⁰ It needs to combine into a single measure all sorts of evidence on all sorts of facts, ranging from likelihood of uncertain occurrence to vague normative charac-

²⁹ American law seems to envisage an element-by-element approach. See Marijke Malsch & Ian Freckelton, *The Evaluation of Evidence: Differences Between Legal Systems*, in *LEGAL EVIDENCE AND PROOF: STATISTICS, STORIES, LOGIC* 117, 130–31 (Hendrik Kaptein et al. eds., 2009) (linking the adversary system to atomism). One atomistic approach envisaged by psychology is information integration theory. According to this theory, the human decisionmaker making a finding on an element's existence would begin with an initial impression, or predisposition, and then would process additional pieces of information. Each of these, including the initial impression, would receive a scale value, which is a measure of the evidenced likelihood of the element's existence. Each would also receive a weighting factor, which is a measure of evidential importance that takes into account both weight and credibility. The decisionmaker would then combine these into a weighted average that determines the element's likelihood. See Martin F. Kaplan, *Cognitive Processes in the Individual Juror*, in *THE PSYCHOLOGY OF THE COURTROOM* 197 (Norbert L. Kerr & Robert M. Bray eds., 1982) (explaining information integration).

³⁰ American practice seems to follow a holistic approach. See Dan Simon, *A Third View of the Black Box: Cognitive Coherence in Legal Decision Making*, 71 U. CHI. L. REV. 511, 559–69 (2004) (arguing that factfinders consider evidence holistically rather than atomistically). Holistic methodologies are typified by the well-known story model, which posits that the factfinder would judge the likelihood of the proponent's whole story rather than judging its parts separately. See ANDERSON ET AL., *supra* note 22, at 280 ("Empirical research . . . suggests that American juries determine 'the truth' about alleged past events mainly by constructing . . . stories rather than critically evaluating arguments from evidence. These findings have been confirmed in other disciplines (e.g., medical diagnosis and history) and extended to fact determination by legal professionals and the police Simply put, the widely accepted thesis is that human beings need stories in order to make certain kinds of decisions and, more generally, to make sense of the world."); Dan Simon, *Thin Empirics*, 23 INT'L J. EVIDENCE & PROOF 82 (2019) (clarifying the distinction between holism and the story model). See generally JEFFREY T. FREDERICK, *THE PSYCHOLOGY OF THE AMERICAN JURY* 296–99 (1987) (providing a brief overview of the story model of evidence processing); Reid Hastie & Nancy Pennington, *The Psychology of Juror and Jury Decision Making*, in REID HASTIE, STEVEN D. PENROD & NANCY PENNINGTON, *INSIDE THE JURY* 15, 22–23 (1983) (providing a brief summary of empirical studies supporting the story model); Paula L. Hannaford, Valerie P. Hans, Nicole L. Mott & G. Thomas Munsterman, *The Timing of Opinion Formation by Jurors in Civil Cases: An Empirical Examination*, 67 TENN. L. REV. 627, 629–33 (2000) (discussing three predominant models of jury decisionmaking); Reid Hastie, *What's the Story? Explanations and Narratives in Civil Jury Decisions*, in *CIVIL JURIES AND CIVIL JUSTICE* 23, 31–32 (Brian H. Bornstein et al. eds., 2008) (expanding the story model to allow for a party's multiple stories); Jill E. Huntley & Mark Costanzo, *Sexual Harassment Stories: Testing a Story-Mediated Model of Juror Decision-Making in Civil Litigation*, 27 LAW & HUM. BEHAV. 29, 29 (2003) (presenting research that "extends the story model to civil litigation and tests a story-mediated model against an unmediated model of jury decision-making"); Nancy Pennington & Reid Hastie, *The Story Model for Juror Decision Making*, in *INSIDE THE JUROR: THE PSYCHOLOGY OF JUROR DECISION MAKING* 192 (Reid Hastie ed., 1993) (detailing the story model and summarizing empirical studies testing it).

terization of blameworthiness.³¹ The best view based on psychology, and introspection, posits that factfinders process the weight and credibility of the evidence largely by intuition and in an approximate and nonquantified way, perhaps while looking at the whole case at once. They then take a stab at forming a belief in the truth. The stabs seem to be generally reliable. Happily, however, the persistent blackness of the cognitive box is not an impediment for present purposes because, it will turn out, the particular methodology followed by the factfinders in processing the evidence does not affect the proper working of the standards of proof.³²



Getting to the evaluation phase whereby belief leads to legal decision, psychologists have thus far had little to contribute to our understanding of the standards of proof. Philosophy and logic take over here, dictating the standards to achieve policy goals. The law accordingly specifies by its standards the measure of sureness required for decision about fact in an uncertain world.

A final step in orientation is to observe that what my theory holds as to standards of proof for past events does not spill over to other standards of decision in law. The unique feature of the standard of proof is that we expect the factfinder to retain uncommitted belief in the decisionmaking process. When a decisionmaker employs other standards, even the standard of review, we expect it roughly but directly to estimate probability and measure the estimate against the given standard. We do not expect the judges to retain uncommitted belief in applying a standard of review, because the “evidence” for applying the standard is deemed complete. We want from the judges the likelihood of legal error in the lower court’s deciding for the

³¹ See CLERMONT, *supra* note 4, at 157–66 (discussing the need for a common currency); *infra* note 113 (discussing statistical evidence).

³² See *infra* text accompanying note 116 (“[I]t makes irrelevant whether the evidence processing stage proceeded holistically or atomistically, or whether it ended in a stab at forming a belief or in something more rigorous.”). However, I provide at least a structure for factfinding *infra* notes 118–120.

winner, with the complement being the likelihood of legal correctness in deciding for the winner.³³

A. How Should We Conceive What the Factfinder Finds?

I have been using “belief” to characterize the output of evidence processing. Is that appropriate? Philosophy is of assistance here. But philosophers like to start upstream. They might pick up my inquiry at the “correspondence theory,” which states that what goes on in our heads should correspond to an external reality.³⁴ The law seemingly buys into this theory as an assumption.³⁵

What is “truth” then? Truth is the condition where a statement accurately reflects that external world.³⁶ Thus, a statement is true if and only if it corresponds to the reality it describes.³⁷

³³ See CLERMONT, *supra* note 4, at 141–44 (establishing the uniqueness of the standards of proof among the many varieties of standards of decision). Another example, besides the standard of review, is the trial judge’s application of the standard for judgment as a matter of law. See Clermont, *Belief Function*, *supra* note 9, at 381 n.87 (“We want from the judge the likelihood of jury error in finding for the plaintiff, with the complement being the likelihood that the jury has authority to find for the plaintiff.”).

³⁴ See ANDREW NEWMAN, *THE CORRESPONDENCE THEORY OF TRUTH: AN ESSAY ON THE METAPHYSICS OF PREDICATION 1* (2002) (“The simplest version of the correspondence theory of truth is that a proposition or a sentence is true when it corresponds to an appropriate fact, which is something in the world that makes a proposition or a sentence true.”); Marian David, *The Correspondence Theory of Truth*, in *STANFORD ENCYCLOPEDIA OF PHILOSOPHY* (Edward N. Zalta ed., 2015), <https://plato.stanford.edu/entries/truth-correspondence/> [<https://perma.cc/3J4M-KXD3>].

³⁵ See H.L. HO, *A PHILOSOPHY OF EVIDENCE LAW: JUSTICE IN THE SEARCH FOR TRUTH* 55 (2008) (“That primary facts exist as external realities is a basic assumption that renders the purpose of a trial intelligible.”); Risinger, *supra* note 28, at 811 (“The shared assumptions of the standard rationalist model allowed (and continue to allow) both practitioners and the vast majority of descriptive academics to skip over many issues that might interest professional philosophers, entering the discourse concerning truth at a point where thorny epistemological issues have been resolved by assumption, since such controversies are unimportant to the law as a practical discipline. As a practical matter, we assume the reality of an exterior material world; arguing either radical skepticism or the primacy of some form of philosophical idealism will not cut any ice in a courtroom.”); *cf.* CLERMONT, *supra* note 4, at 136 (discounting the coherence theory as a competitor to the correspondence theory in legal theory).

³⁶ See TIMOTHY M. MOSTELLER, *THEORIES OF TRUTH: AN INTRODUCTION* (2014) (discussing various definitions of truth); David, *supra* note 34, § 2.3 (similar). *But see* Zachary Halaschak, *Biden Tells Iowans: “We Choose Truth over Facts,”* WASH. EXAMINER, Aug. 8, 2019, <https://www.washingtonexaminer.com/news/truth-over-facts-biden-fumbles-during-iowa-speech> [<https://perma.cc/DZE7-8YV7>] (quoting gaffe).

³⁷ See David, *supra* note 34, § 3 (“*x* is true iff *x* corresponds to some fact . . .”).

What is “knowledge”? As Plato classically put it, knowledge is a justified true belief.³⁸ We know something if and only if both it is true³⁹ and we are justified in believing it. At least in its modern sense, “belief” is the mental acceptance of a statement as true.⁴⁰ “Justification” lies in having reasons in evidence and logic for the belief.⁴¹

Is legal proof aimed at either certain truth or full knowledge? No, they are unattainable in the legal world, even if we frequently say one aim of the legal process is knowing the truth.⁴² Legal proof of historical fact proceeds mainly by inductive logic.⁴³ Accumulating observations can fortify a hypothesis. But additional observations can never verify a fact to the

³⁸ See Jonathan Jenkins Ichikawa & Matthias Steup, *The Analysis of Knowledge*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 1 (Edward N. Zalta ed., 2017), <https://plato.stanford.edu/entries/knowledge-analysis/> [<https://perma.cc/KP8H-DZY2>] (“There are three components to the traditional (‘tripartite’) analysis of knowledge.”); Matthias Steup, *Epistemology*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 1 (Edward N. Zalta ed., 2005), <https://plato.stanford.edu/entries/epistemology/> [<https://perma.cc/6484-WEX2>] (treating knowledge as the subject of epistemology); Michael S. Pardo, *Group Agency and Legal Proof; or, Why the Jury Is an “It.”* 56 WM. & MARY L. REV. 1793, 1812–14 (2015) (explaining that for knowledge, the justified true belief cannot be accidentally true, following Edmund L. Gettier, *Is Justified True Belief Knowledge?*, 23 ANALYSIS 121 (1963)); cf. Ichikawa & Steup, *supra*, § 11 (discussing the knowledge-first view of TIMOTHY WILLIAMSON, KNOWLEDGE AND ITS LIMITS (2000), that knowledge is a fundamental state not subject to further analysis).

³⁹ There cannot be knowledge without truth. See PLATO, THEAETETUS 201b–c (c. 369 B.C.), <http://www.perseus.tufts.edu/hopper/text?doc=perseus%3Atext%3A1999.01.0172%3Atext%3DTheaet.%3Asection%3D201b> [<https://perma.cc/9NEB-8F8J>] (“Socrates: Then when judges are justly persuaded about matters which one can know only by having seen them and in no other way, in such a case, judging of them from hearsay, having acquired a true opinion of them, they have judged without knowledge, though they are rightly persuaded, if the judgment they have passed is correct, have they not?”); Pardo, *supra* note 38, at 1812 (“[A]n agent’s knowledge of X requires that X be true.”).

⁴⁰ See Ichikawa & Steup, *supra* note 38, § 1.2 (elaborating belief); Jessica Moss & Whitney Schwab, *The Birth of Belief*, 57 J. HIST. PHIL. 1, 2–3 (2019) (“[T]here is nowadays a widely accepted notion of belief as the generic attitude of taking something to be the case or taking something to be true. ‘Taking’ here refers not to a provisional attitude, but to one of endorsement or commitment.” (footnotes omitted)).

⁴¹ See Steup, *supra* note 38, § 2 (elaborating justification).

⁴² *E.g.*, FED. R. EVID. 102 (“These rules should be construed so as to administer every proceeding fairly, eliminate unjustifiable expense and delay, and promote the development of evidence law, to the end of ascertaining the truth and securing a just determination.”); see Risinger, *supra* note 28, at 802–17 (explaining how the law’s Rationalist Tradition buys into truth as an aim, but accepts probability as a way of acknowledging uncertainty).

⁴³ See ANDERSON ET AL., *supra* note 22, at 100 (“In analyzing the available evidential data and identifying and marshaling the inferences that those data support in preparing for trial, the lawyer relies primarily on inductive reasoning.”); JOHN HENRY WIGMORE, THE SCIENCE OF JUDICIAL PROOF § 9 (3d ed. 1937) (same).

point of proven certainty, even if a single observation can effectively falsify the fact. Of course, this situation troubled David Hume no end.⁴⁴ Yet this situation causes the law no worry because the law does not seek or demand complete truth or knowledge.⁴⁵

Now, I am not veering off into postmodernism, where objective truth can become irrelevant or cease to exist.⁴⁶ The law does value truth in factfinding, but realizes that it will never get completely there. Retaining a veritistic even if not veracious goal, the law must find a way to operate practically, upon less than certainty. To allow forming beliefs in truth, the law embraces naturalized epistemology. This branch of epistemology incorporates the social sciences' learning on individuals' mental processing under social influence.⁴⁷

Naturalized epistemology further recognizes that knowledge can comprise beliefs that were produced by a reliable means to seek truth.⁴⁸ Does the law employ a reliable means?

⁴⁴ See Leah Henderson, *The Problem of Induction*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 1 (Edward N. Zalta ed., 2018), <https://plato.stanford.edu/entries/induction-problem/> [<https://perma.cc/A8RX-MRS9>] ("The original source of what has become known as the 'problem of induction' is in Book 1, part iii, section 6 of *A Treatise of Human Nature* by David Hume, published in 1739.")

⁴⁵ See L. JONATHAN COHEN, *THE PROBABLE AND THE PROVABLE* 351–56 (1977) (rejecting Hume's skepticism as applied to legal factfinding).

⁴⁶ See Ronald J. Allen & Brian Leiter, *Naturalized Epistemology and the Law of Evidence*, 87 VA. L. REV. 1491, 1492 (2001) (lamenting "the unfortunate fascination in some quarters of the legal academy with 'postmodern' conceptions of knowledge and truth, conceptions notable for their superficiality and for the fact that almost no philosophers subscribe to them").

⁴⁷ See ALVIN I. GOLDMAN, *EPISTEMOLOGY AND COGNITION* 9 (1986) ("The multidisciplinary conception of epistemology I like to call *epistemics*, to distinguish it from other, more autonomous, conceptions of the field."); Allen & Leiter, *supra* note 46, at 1493–501 (explaining empirically based naturalized epistemology in the context of the law of evidence and contending that "naturalized epistemology provides a fruitful way of understanding evidence law"); Pardo, *supra* note 38, at 1810–16 (extending the theory's reach to group factfinding); Steup, *supra* note 38, § 6.2 (describing extreme and moderate versions of naturalized epistemology). An alternative route to relaxing the standards for knowledge lies in the recent emergence of contextualism. See Rysiew, *supra* note 13, § 1.

⁴⁸ Classical epistemology treats a belief as justified "when it is reasonable or rational, from S's own point of view, to take *p* to be true. According to *evidentialism*, what makes a belief justified in this sense is the possession of evidence." Steup, *supra* note 38, § 1.1. Nonclassical epistemology, like naturalized epistemology, "conceives of the role of justification differently. Its job is to ensure that S's belief has a high objective probability of truth and therefore, if true, is not true merely because of luck. One prominent idea is that this is accomplished if, and only if, a belief originates in reliable cognitive processes or faculties. This view is known as *reliabilism*." *Id.*; see Allen & Leiter, *supra* note 46, at 1494–95 (discussing Goldman's reliabilism); cf. Risinger, *supra* note 28, at 811 ("In [law], we assume that knowledge (or something counting as knowledge) about past events is

Yes, somewhat,⁴⁹ but legal factfinding's methods have always been a bit peculiar in two regards.⁵⁰

First, the law depends on the parties to present the evidence to the factfinder. Accordingly, the legal factfinder decides by making a choice between the two positions of belief and disbelief in the proponent's position. Thus, while the resulting belief in truth is justified within its limited scope, it is merely a relative belief. This quality of relativity likely disqualifies the belief from the strict status of knowledge.

Second, the law demands a decision now. It cannot leave decision for another day. Other disciplines can leave a question open, or call a result statistically insignificant, and await more evidence and greater certainty to emerge. But legal actors (and all of us in our daily lives) often must come to an immediate decision. Moreover, the resulting belief is a tentative one, in that it will rest on evidence that is imperfect at the time decision must be made. This quality of tentativeness likely also disqualifies the belief from the strict status of knowledge.⁵¹

A relative and tentative belief is not even a belief, at least in the categorical sense of mental acceptance of a fact as true.⁵² But a legal factfinder can arrive at a partial belief, a "degree of belief" that measures the strength of belief in the truth of the fact.⁵³ A degree of belief can coexist with a degree of disbelief as

possible, even if it is not perfect. Platonic arguments about how perfection is necessary to the concept of true knowledge are beside the point.").

⁴⁹ See, e.g., Kevin M. Clermont & Theodore Eisenberg, *Trial by Jury or Judge: Transcending Empiricism*, 77 CORNELL L. REV. 1124, 1154 (1992) ("Apparently, judge trial and jury trial combine to operate a decisionmaking system that is, at least in [its ability to treat like cases alike], highly reliable."); Thomas B. Metzloff, *Resolving Malpractice Disputes: Imaging the Jury's Shadow*, LAW & CONTEMP. PROBS., Winter 1991, at 43 (showing trial system's usual competence and fairness by an empirical comparison of medical malpractice verdicts and insurers' pretrial evaluations).

⁵⁰ See Sophie Grace Chappell, *Plato on Knowledge in the Theaetetus*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 7.6 (Edward N. Zalta ed., 2013), <https://plato.stanford.edu/entries/plato-theaetetus/> [<https://perma.cc/G377-TNXT>] ("Plato seems to offer two incompatible explanations of why the jury don't know: first that they have only a limited time to hear the arguments (201b3, 172e1); and second that their judgement is second-hand (201b9).").

⁵¹ See David Enoch, Levi Spectre & Talia Fisher, *Statistical Evidence, Sensitivity, and the Legal Value of Knowledge*, 40 PHIL. & PUB. AFFAIRS 197, 211–15 (2012) (arguing that law's primary interest is accuracy, not knowledge).

⁵² See HO, *supra* note 35, at 124–29 (discussing categorical and partial beliefs). *But see* M.T. EDVARDSSON, A NEARLY NORMAL FAMILY 10 (2019) ("I like to say I'm a believer, not a knower."); SARAH MOSS, *PROBABILISTIC KNOWLEDGE* (2018) (arguing that probabilistic beliefs can constitute knowledge).

⁵³ See Franz Huber, *Belief and Degrees of Belief*, in DEGREES OF BELIEF, *supra* note 22, at 1, 1 (exploring generally the new thinking on degrees of belief, and saying: "Degrees of belief formally represent the strength with which we believe

produced by the evidence, that is, a belief in the contradiction of the fact. Moreover, the factfinder can withhold part of its belief, leaving belief uncommitted to an extent dependent on the amount, nature, and quality of the evidence and thus causing belief and disbelief to add to less than one.

Perhaps one might be more comfortable characterizing a degree of belief as an inclination to believe.⁵⁴ But this suggestion does not mean that the law is accepting a quasi-belief in lieu of truth. Truth still matters. The law simply recognizes that a multivalent degree of belief in truth is the best it can do. Although such a belief does not require solid truth, it is still not a New Age idea or a subjective sensation.⁵⁵ It is neither firm knowledge nor a squishy personal feeling. This belief is instead the factfinder's attempt to express its *degree of sureness about the state of the real world as represented by the evidence put*

the truth of various propositions. . . . For instance, Sophia's degree of belief that it will be sunny in Vienna tomorrow might be .52, whereas her degree of belief that the train will leave on time might be .23. The precise meaning of these statements depends, of course, on the underlying theory of degrees of belief."); cf. SUSAN HAACK, *Epistemology and the Law of Evidence: Problems and Projects*, in EVIDENCE MATTERS: SCIENCE, PROOF, AND TRUTH IN THE LAW 1, 13 (2014) (describing her epistemology as "gradational," resulting in degrees of "warranted belief"); Eric Schwitzgebel, *Belief*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 2.4 (Edward N. Zalta ed., 2015), <https://plato.stanford.edu/entries/belief/> [<https://perma.cc/ZS29-3863>] (describing degrees of belief, but failing to account for uncommitted belief).

⁵⁴ Philosophers sometimes phrase degrees of belief as credences, see Lara Buchak, *Belief, Credence, and Norms*, 169 PHIL. STUD. 285, 285 (2014), or as partial beliefs, see Keith Frankish, *Partial Belief and Flat-Out Belief*, in DEGREES OF BELIEF, *supra* note 22, at 75.

⁵⁵ See GLENN SHAFER, A MATHEMATICAL THEORY OF EVIDENCE 20 (1976) (defining the factfinder's belief as an act of judgment "that represents the degree to which he judges that evidence to support a given proposition and, hence, the degree of belief he wishes to accord the proposition"); Glenn Shafer, *The Construction of Probability Arguments*, 66 B.U. L. REV. 799, 801-04 (1986) (developing a constructive interpretation of probabilistic reasoning that is neither too objective nor too personalistic). *But compare* DAVID CHRISTENSEN, PUTTING LOGIC IN ITS PLACE 12-13, 69 (2004) (saying that some use "belief" as an unqualified or categorical assertion of an all-or-nothing state of belief), with L. Jonathan Cohen, *Should a Jury Say What It Believes or What It Accepts?*, 13 CARDOZO L. REV. 465, 479 (1991) (using "belief," for his purposes, in the sense of a "passive feeling," and arguing that factfinders should deal instead in acceptance), and Jordi Ferrer Beltrán, *Legal Proof and Fact Finders' Beliefs*, 12 LEGAL THEORY 293, 294 (2006) ("[T]he proof of *p* should be explained in terms of its acceptability (and not simply of its acceptance).").

before it by a reasonable process.⁵⁶ The output is a roughly justified belief, to some degree, in truth.⁵⁷

A degree of belief in a fact's truth of 0.40 represents proof to 40% of full knowledge. It is not a 40% chance of the fact being revealed as true. The latter measure would be a probability of certain truth, assuming that there were a way to discern the certain truth. To get the latter measure, the factfinder would shift from a multivalent view to a bivalent view. The shift would require the factfinder somehow to allocate all belief between the two positions of true and false, rather than leaving some belief uncommitted. The allocation would require performing one of the variety of pignistic (or betting) transforms from the credal (or belief) stage.⁵⁸ The resulting betting odds would fall somewhere in that middle range of previously uncommitted belief in the next diagram. That is, if you wanted to get the odds for betting on *a*, you would have to allocate all belief to *a* or *not-a*, while retaining no second-order uncertainty about the allocation. The process thus might invoke your attitudes toward risk. You can bet with very little information in hand, but you nevertheless must allocate all belief between two possible outcomes, in order to place your bet accordingly.

The choice for legal factfinding is whether to deal in probabilities of truth or degrees of belief in truth. The choice is one of wise policy, based on which measure will better handle the problem at hand. Bear in mind Bertrand Russell's warning that "the rational man, who attaches to each proposition the

⁵⁶ See SUSAN HAACK, *Legal Probabilism: An Epistemological Dissent*, in EVIDENCE MATTERS: SCIENCE, PROOF, AND TRUTH IN THE LAW 47, 54 (2014) ("[S]tandards of proof should be understood, *not* as a simple psychological matter of the degree of jurors' belief, but as primarily an epistemological matter, the degree of belief warranted by the evidence."); Jaffee, *supra* note 9, at 937 (saying that the preponderance standard "is intended to assure that the factfinder will not believe an assertion of fact without evidence *adequate in logic and experience* to support the belief").

⁵⁷ See HO, *supra* note 35, at 89–110 (describing justified belief as the epistemic requirement, with truth as the measure of correctness).

⁵⁸ See Barry R. Cobb & Prakash P. Shenoy, *A Comparison of Methods for Transforming Belief Function Models to Probability Models*, in SYMBOLIC AND QUANTITATIVE APPROACHES TO REASONING WITH UNCERTAINTY, 7TH EUROPEAN CONFERENCE 255 (Thomas Dyhre Nielsen & Nevin Lianwen Zhang eds., 2003) (surveying several transform methods); Haenni, *supra* note 22, at 129 (discussing betting probabilities); Philippe Smets, *Decision Making in the TBM: The Necessity of the Pignistic Transformation*, 38 INT'L J. APPROXIMATE REASONING 133 (2005) (discussing difficulties of the transform); cf. Nicholas J.J. Smith, *Degree of Belief Is Expected Truth Value*, in CUTS AND CLOUDS: VAGUENESS, ITS NATURE, AND ITS LOGIC 491, 503–05 (Richard Dietz & Sebastiano Moruzzi eds., 2010) (discussing the transform as applied to vague concepts).

right degree of credibility, will be guided by the mathematical theory of probability *when it is applicable*. The concept 'degree of credibility', however, is applicable much more widely than that of mathematical probability"⁵⁹

Admittedly, legal factfinding could choose to deal in probabilities of truth. The factfinder could take an extra step with the case's uncertainty, by allocating the uncommitted belief to either true or false, although doing so while largely in the dark. Yet, not only is there no accepted way to allocate other than by hunch, but also this extra step would not add anything to our knowledge of the past. Moreover, as we have already seen, the extra step would conflict with judicial instructions and raise many logical and practical problems.

Instead, as a descriptive and normative matter, the legal factfinder concerns itself with degrees of belief based on the evidence presented. The factfinder as a rational agent can, does, and should decide with a keen awareness of how much is unknown because of imperfect evidence. The degrees of belief and disbelief could be below 0.50, even when added together. The question is what to do with the leftover uncertainty. The factfinder should decide by comparing its sureness in the fact to its sureness in the fact's contradiction, leaving the rest of its sureness uncommitted. It then is perfectly rational to believe *a* more than *not-a*, and to do so without the illusion that the probability of *a*'s truth exceeds 50%. The factfinder can ignore the odds for betting on unattainable truth. As we shall see,⁶⁰ this approach would conform to judicial instructions and avoid many logical and practical problems.

The law wants only the sureness measure of the factfinder's beliefs, rendered with a sharp sense of what the factfinder does not know. This position does not rest on anti-probabilist prejudice. Traditional probabilities have many another role to play properly in legal proof, as in the handling of statistical evidence.⁶¹ Rather, this position rests on the view

⁵⁹ BERTRAND RUSSELL, HUMAN KNOWLEDGE: ITS SCOPE AND LIMITS 399 (1948). On how to make the choice, see Mary A. Meyer, Kenneth B. Butterfield, William S. Murray, Ronald E. Smith & Jane M. Booker, *Guidelines for Eliciting Expert Judgment as Probabilities or Fuzzy Logic*, in FUZZY LOGIC AND PROBABILITY APPLICATIONS, *supra* note 22, at 105 (treating the factors that sometimes make a fuzzy measure, rather than traditional probability, the appropriate measure for the agent's response).

⁶⁰ See *infra* text accompanying notes 87–92 (explaining advantages relative to probabilism).

⁶¹ See *infra* note 113 (discussing statistical evidence); see also Michael S. Pardo, *A Comment on Statistical Evidence and Standards of Proof*, 25 SUP. CT. ECON. REV. 59 (2018) (same). For another example, in calculating the odds of

that traditional probability's proper roles do not include measuring sureness in factfinding.

Therefore, the law asks for a degree of belief in truth, not for certain truth or the odds of certain truth. What turns on this subtlety between degree of belief and probability of truth? Plenty. First, the two measures invoke different vocabularies and thoughts. Jurists tend to speak in terms of a strong-enough belief on the part of the factfinder, while Bayesian academics invoke traditional probabilist terminology. Second, the two measures do differ in magnitude. Because of uncommitted belief, the degree of belief in a fact will be smaller than the probability of the fact.⁶² Third, as we shall also see,⁶³ the two measures entail different mathematics. Multivalent degrees of belief based on imperfect evidence combine in ways very different from how bivalent predictions of perfect knowledge combine.

B. How Does the Factfinder Formulate Degrees of Belief?

The idea of multivalent degrees of belief received formalization and elaboration from Rutgers Professor Glenn Shafer in 1976.⁶⁴ His imposing work on “belief functions” is highly mathematical, but its imagery nevertheless nicely captures the actual legal-factfinding scheme.⁶⁵ Indeed, the imagery represents how evaluation of processed evidence *should* proceed in light of

future events, as in computing expected costs on a motion for a preliminary injunction, the product rule would be appropriate. See CLERMONT, *supra* note 4, at 176–77 (discussing appropriate roles for probabilism in evidence); HO, *supra* note 35, at 118–21 (same).

⁶² See Clermont, *Common Sense*, *supra* note 23, at 1067 (showing this result for the pignistic transform from a belief).

⁶³ See *infra* text accompanying notes 104–121 (explaining MIN and MAX rules).

⁶⁴ SHAFER, *supra* note 55 (using “evidence” in a much broader sense than legal evidence), reviewed by Lotfi A. Zadeh, *AI MAG.*, Fall 1984, at 81, 83 (treating Shafer's theory as a version of fuzzy logic's possibility theory); see Glenn Shafer, *Perspectives on the Theory and Practice of Belief Functions*, 4 *INT'L J. APPROXIMATE REASONING* 323 (1990) (summarizing, simplifying, and updating his theory). For the historical background of the theory, see Haenni, *supra* note 22, at 127–33.

⁶⁵ For a defense of using a broad view of belief function theory as imagery, see Liping Liu & Ronald R. Yager, *Classic Works of the Dempster-Shafer Theory of Belief Functions: An Introduction*, in *CLASSIC WORKS OF THE DEMPSTER-SHAFER THEORY OF BELIEF FUNCTIONS* 1, 2–12 (Ronald R. Yager & Liping Liu eds., 2008) (formalizing an image of belief functions); cf. Vilém Novák, *Modeling with Words*, *SCHOLARPEDIA* (2008), http://www.scholarpedia.org/article/Modeling_with_words [<http://perma.cc/2JWY-YLZ8>] (“Mathematical fuzzy logic has two branches: fuzzy logic in narrow sense (FLn) and fuzzy logic in broader sense (FLb). FLn is a formal fuzzy logic which is a special many-valued logic generalizing classical mathematical logic FLb is an extension of FLn which aims at developing a formal theory of human reasoning.”).

theory and human capabilities, but also fairly well how human factfinders *do* act and how the law *does* tell them to act in evaluating the processed evidence.⁶⁶

An initial step backwards might be helpful, so let me say a few more words on bivalent logic versus multivalent logic. Many different systems of logic exist, useful in different settings. Because of the classical logic system's dominance, we tend to forget that it rests on the critical assumption of bivalence: every proposition must either be true or be false, taking a value of 1 or 0. The traditional probability theory built on classical logic rests on the same assumption: probability represents the random uncertainty that the proposition is actually true or false, one or the other. The bivalence assumption pays off in that classical logic turns out to be very useful. But like Euclidean geometry and Newtonian physics, classical logic and traditional probability constitute a very useful oversimplification

⁶⁶ For my purposes, it is important that belief function theory is basically consistent with fuzzy logic, as well as with fuzzy logic's progeny called possibility theory. See Didier Dubois & Henri Prade, *A Set-Theoretic View of Belief Functions: Logical Operations and Approximations by Fuzzy Sets*, in CLASSIC WORKS OF THE DEMPSTER-SHAFFER THEORY OF BELIEF FUNCTIONS, *supra* note 65, at 375, 403 (linking belief functions and fuzzy sets); Huber, *supra* note 53, at 10–15 (linking belief functions and possibility theory); Dale A. Nance, *Formalism and Potential Surprise: Theorizing About Standards of Proof*, 48 SETON HALL L. REV. 1017, 1036–37 (2018) (using possibility theory to untangle the conjunction paradox); Shapira, *supra* note 22, at 1614 (“In the legally relevant literature, it was Professor Glenn Shafer who introduced fuzzy measures as appropriate formalizations of epistemic functions.”); L.A. Zadeh, *Fuzzy Sets as a Basis for a Theory of Possibility*, 1 FUZZY SETS & SYS. 3, 3 (1978) (deriving possibility theory from fuzzy sets); cf. DAVID A. SCHUM, THE EVIDENTIAL FOUNDATIONS OF PROBABILISTIC REASONING 266–69 (1994) (observing that one can fuzzify belief functions); John Yen, *Generalizing the Dempster-Shafer Theory to Fuzzy Sets*, in CLASSIC WORKS OF THE DEMPSTER-SHAFFER THEORY OF BELIEF FUNCTIONS, *supra* note 65, at 529 (showing how to form beliefs about membership in fuzzy sets). In fact, belief functions and fuzzy logic are also compatible with the pathbreaking work done on Baconian probability by COHEN, *supra* note 45, at 121 (terming his approach “inductive probability,” but using imagery that is difficult to grasp). See CLERMONT, *supra* note 4, at 180–81 (bridging to Cohen’s work). All three approaches are nonadditive and reject the product rule, end up equivalent in their essential lessons, and stand together in opposition to traditional probability. See ANDERSON ET AL., *supra* note 22, at 250–61 (sketching intelligently the three approaches in contrast to traditional probability); SCHUM, *supra*, at 200–66 (same in greater detail). Other multivalent approaches end in similar places and reject traditional probability. See, e.g., Amos Tversky & Derek J. Koehler, *Support Theory: A Nonextensional Representation of Subjective Probability*, 101 PSYCH. REV. 547, 547 (1994) (“In contrast to the Bayesian school, which represents degree of belief by an additive probability measure, there are many skeptics who question the possibility and the wisdom of quantifying subjective uncertainty and are reluctant to apply the laws of chance to the analysis of belief.”); *infra* note 162 (discussing ranking theory). Of all the available candidates, I have selected belief functions and fuzzy logic as the multivalent-logical systems whose imagery best reflects and illuminates legal factfinding.

that gives wrong answers around the edges of their assumptions.⁶⁷

The cure lies in deploying a more general logic system. Multivalent logic does not assume bivalence. It allows a proposition to be perceived as true to a degree, taking some value between 1 and 0. Bivalent logic is a special case of multivalent logic, used when values can only be 1 or 0. The easiest examples of the usefulness of multivalent logic come from vague terms like “tall.”⁶⁸ In a bivalent world, a person is either tall or not. With multivalence, we can describe a person as exhibiting a degree of tallness. But multivalent logic is in no way limited to vagueness.⁶⁹ It can handle any sort of variable, from vague concepts all the way to belief in the truth of a past fact. Such past facts otherwise look to be either/or and subject only to random uncertainty. Yet they actually appear to the investigator not as true or false, but instead as something falling between completely true and completely false. In other words, even for a past event, one can express a multivalent belief in truth, just as one can vaguely express tallness.

This situation counsels the use of multivalent logic in legal factfinding. Just as the investigator can express a degree of belief in the fact, all views of triable facts should be expressed as multivalent degrees of belief. The triable fact is not susceptible to being viewed as certainly, or even almost certainly, true or false. There would be no trial of the fact otherwise. Moreover, the factual disputes are “unsettlable,” in that there will be no revelation of truth.⁷⁰ In short, handling found facts is different from placing bets or flipping coins.

Coming back now to belief function theory, after the factfinder processes the evidence, a belief in a fact called *a* can range anywhere between 0 and 1. Likewise, belief in *not-a*, which is disbelief of *a* or, equivalently, an active belief in *a*'s contradiction, falls between 0 and 1. The probative force of the

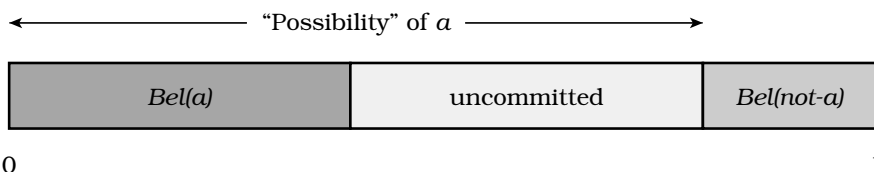
⁶⁷ By the way, Euclidean geometry and Newtonian physics, both based on classical logic, break down in the face of general relativity and quantum mechanics, which take down classical logic's bivalence assumption. See MICHAEL DUMMETT, *Is Logic Empirical?*, in TRUTH AND OTHER ENIGMAS 269 (1978).

⁶⁸ See Roy Sorensen, *Vagueness*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY (Edward N. Zalta ed., 2018), <https://plato.stanford.edu/entries/vagueness/> [<https://perma.cc/J4M6-343Y>] (“[A] term is vague to the extent that it has borderline cases.”).

⁶⁹ See Radim Belohlávek, George J. Klir, Harold W. Lewis III & Eileen Way, *On the Capability of Fuzzy Set Theory to Represent Concepts*, 31 INT'L J. GEN. SYS. 569, 575 (2002) (stressing the reach of fuzzy logic).

⁷⁰ COHEN, *supra* note 45, at 91 (arguing that the law's interest lies in provability, not probability).

parties' presentations, as well as avoidable defects in evidence,⁷¹ will affect the degree of belief in a and in $not-a$. Also, on the basis of incomplete, inconclusive, ambiguous, or dissonant evidence, some of the factfinder's belief should remain undetermined. Thus, in factfinding, we ask how much we believe a to be a real-world truth based on the evidence, as well as how much we believe $not-a$, while remaining conscious of uncertainty and so recognizing that part of our belief will remain uncommitted as a nonbelief.⁷² In other words, a belief and the belief in its contradiction will normally add to less than one.



To illustrate, let a , say, that Katie is dead, be an element of a claim. The zone between $Bel(a)$ and $Bel(not-a)$ represents the uncommitted belief. Indeed, any case starts with the whole range of belief standing as uncommitted. The proper representation of lack of proof is zero belief in the plaintiff's position—but also zero belief in the defendant's position. As the plaintiff introduces proof, some of the factfinder's uncommitted belief should start to convert into a degree of belief in a 's existence, and almost inevitably the plaintiff's proof will also have the inadvertent effect of generating an active belief in at least the slightest possibility of its nonexistence, namely, that Katie is alive. If the defendant next introduces effective proof to reduce the belief in a , whether the proof comes in the form of negation or as part of an alternative and inconsistent account, the degree of active belief in a 's nonexistence would presumably grow. Or the very clash of beliefs could diminish the degrees of belief in both a and $not-a$.

⁷¹ See Kevin M. Clermont, *Standards of Proof Revisited*, 33 VT. L. REV. 469, 480–81 (2009) (“[T]he common-law fact-finder is not supposed to hold an *unavoidable* paucity of evidence against the burdened party, but is instead in such a situation supposed to decide the likelihood based on the evidence.” (emphasis added)).

⁷² See Liu & Yager, *supra* note 65, at 3–4 (describing uncommitted belief); Hans Rott, *Degrees All the Way Down: Beliefs, Non-Beliefs and Disbeliefs*, in DEGREES OF BELIEF, *supra* note 22, at 301, 302 (calling uncommitted belief a nonbelief); Rajendra P. Srivastava & Glenn R. Shafer, *Belief-Function Formulas for Audit Risk*, in CLASSIC WORKS OF THE DEMPSTER-SHAFER THEORY OF BELIEF FUNCTIONS, *supra* note 65, at 577, 581 (“Belief functions . . . permit uncommitted belief . . .”).

When we say after evidence processing that $Bel(a) = 0.40$, we are not saying that $Bel(not-a) = 0.60$. We are saying only that the proof is such that to a degree of 0.60, which could represent uncommitted belief in part or in whole, a has not been proven to be true. Imperfect evidence means that some of the belief will remain uncommitted, with the remaining belief divided between $Bel(a)$ and $Bel(not-a)$. So, the belief in a 's falsity would be smaller than 0.60. In the diagram, $Bel(not-a) = 0.20$. It does not equal $1 - Bel(a)$, a measure that expresses only the maximal "possibility" of $not-a$. Hence, there is a big difference between the complement and the belief in the contradiction, the difference being the uncommitted belief. After all, a lack of belief and a disbelief are entirely different states of mind.

Parenthetically, amidst all these decimals, bear in mind that one need not quantify beliefs in order to work with them, and indeed usually one should not. Because all the factfinder usually needs to do is compare the strengths of belief and disbelief, the factfinder need almost never place the fact on a quantified scale of likelihood.

Even if one desired to quantify a particular proposition, one should express a belief as its degree of membership in the set of fully believed facts. Then, given humans' limited ability to evaluate likelihood, one should express the belief in words drawn from a coarsely gradated scale of likelihood, rather than speaking in misrepresentative terms of decimals. The following diagram gives an appropriately gradated scale that utilizes natural language and captures the fuzzy imprecision of beliefs, whether the burden of persuasion is on plaintiff or defendant: (1) slightest possibility, (2) reasonable possibility, (3) substantial possibility, (4) equipoise, (5) probability, (6) high probability, and (7) almost certainty.⁷³

This rough scale works both for beliefs and for probabilities, although, as I have explained, the degree of belief in a fact will be smaller than the probability of the fact, because of uncommitted belief. This scale shows why, when the factfinder finds $Bel(a) > Bel(not-a)$, it is not drawing a fine line or making a close call, but rather saying that the degree of belief is at least a whole step upward in likelihood from its degree of disbelief.

⁷³ See CLERMONT, *supra* note 4, at 35–36, 166–68 (extricating law's coarsely gradated scale of likelihood).

0 -----> 1

Slightest Possibility	Reasonable Possibility	Substantial Possibility	Equipoise	Probability	High Probability	Near Certainty
Near Certainty	High Probability	Probability	Equipoise	Substantial Possibility	Reasonable Possibility	Slightest Possibility

1 <----- 0

C. How Does the Factfinder Apply the Standards of Proof?

In evaluating the evidence, the factfinder must apply the standard of proof. The standard seems to require some sort of comparison of beliefs, nonbeliefs, and disbeliefs.⁷⁴ A variety of comparisons is conceivable, involving either sizes or ratios.⁷⁵ But a civil case's preponderance standard seems to ask whether the factfinder believes the fact is true more than the factfinder believes that the fact is false.⁷⁶ That is, the factfinder should ask the natural question that the law seems to pose by "more likely than not": do you believe the burdened party's allegation more than you disbelieve it?⁷⁷

More specifically, this believed-more-than-disbelieved standard calls for constructing separate beliefs for *a* and *not-a* while leaving some belief uncommitted, and then comparing the sizes of the beliefs in *a*'s truth and falsity while ignoring the uncommitted belief. A preponderance of the evidence then means that $Bel(a) > Bel(not-a)$, not that $Bel(a) > 0.50$. Indeed, finding an element to exist will sometimes entail a smallish belief found to exceed an even smaller belief in its contradic-

⁷⁴ See Thomas M. Strat, *Decision Analysis Using Belief Functions*, 4 INT'L J. APPROXIMATE REASONING 391, 391–92 (1990) (recognizing the need for some type of transform to proceed from beliefs to decisions).

⁷⁵ See Dale A. Nance, *Belief Functions and Burdens of Proof: Competing Views* 6–8, 15–16, 25–26 (June 28, 2018) (unpublished manuscript) (on file with author) (sketching various comparison possibilities).

⁷⁶ See *Nissho-Iwai Co. v. M/T Stolt Lion*, 719 F.2d 34, 38 (2d Cir. 1983) ("The term 'preponderance' means that 'upon all the evidence . . . the facts asserted by the plaintiff are more probably true than false.'" (quoting *Porter v. Am. Exp. Lines, Inc.*, 387 F.2d 409, 411 (3d Cir. 1968))).

⁷⁷ See Clermont, *Belief Function*, *supra* note 9, at 373–75 (explicating the preponderance standard); J.P. McBaine, *Burden of Proof: Degrees of Belief*, 32 CALIF. L. REV. 242, 248–49 (1944) (examining what level of proof a factfinder needs in order to believe in the burdened party's position).

tion.⁷⁸ To continue my example, the factfinder should find *a* even if $Bel(a) = 0.40$, when $Bel(not-a)$ appears as 0.20 and the uncommitted belief equals 0.40.

Besides preponderance, American law employs the two standards of clear and convincing evidence and beyond a reasonable doubt. These less simple standards need separate explanation, even though my general discussion could focus on preponderance until here. When the cost of a false positive in factfinding considerably exceeds the cost of a false negative, the law tries to minimize error costs by raising the standard of proof. In doing so, it considers not just the costs of erroneous decisions *ex post* but also the benefits of correct decisions in setting *ex ante* incentives.⁷⁹ Here is not the place to reconsider the law's complicated and contentious calculations. On these higher standards, I shall therefore shift from a descriptive and normative approach to trying just to explain in terms of beliefs what the law has decided to do on the basis of policy.

Clear and convincing evidence appears under current law to require that $Bel(a) \gg Bel(not-a)$. This standard is easy to apply because we are used to the idea of being clearly convinced of something, in life and in law.⁸⁰ It means that rela-

⁷⁸ Factfinders disregard the uncommitted belief even when the proof of both the fact's existence and its nonexistence is weak. See Clermont, *Belief Function*, *supra* note 9, at 356, 374, 381–82 (discussing weak-proof cases). If the plaintiff has carried the burden of production and if the plaintiff's proof is perceptibly stronger than the defendant's after taking into account any failure to produce evidence, decision must go for the plaintiff. The court cannot choose not to decide, and a decision for the plaintiff is less likely an error than decision for the defendant would be. See Larry Laudan, *Strange Bedfellows: Inference to the Best Explanation and the Criminal Standard of Proof*, 11 INT'L J. EVIDENCE & PROOF 292, 304–05 (2007) ("The trier of fact cannot say, 'Although plaintiff's case is stronger than defendant's, I will reach no verdict since neither party has a frightfully good story to tell.' Under current rules, if the plaintiff has a better story than the defendant, he must win the suit, even when his theory of the case fails to satisfy the strictures required to qualify his theory as the best explanation.").

⁷⁹ See HILARY EVANS CAMERON, *REFUGEE LAW'S FACT-FINDING CRISIS: TRUTH, RISK, AND THE WRONG MISTAKE* (2018) (applying the factors sensitively in a particular context); CLERMONT, *supra* note 4, at 25–31 (treating the setting of standards as a policy judgment).

⁸⁰ See Clermont, *Belief Function*, *supra* note 9, at 375–76 (explicating the clear-and-convincing standard). A promising alternative that employs a ratio of $Bel(a)$ and $Bel(not-a)$ appears in Nance, *supra* note 75, at 15–16. My formulation of a higher standard is similar, but not equivalent, to Nance's elevated ratio. Although stating the clear-and-convincing standard as, say, $Bel(a) > 2 \bullet Bel(not-a)$ might have some theoretical advantages, the current law does not employ such a standard. That is, although theorists have long spoken of ratios, the law has always resisted their vision. Speaking in terms of ratios does not accord with accepted legal language and sense. See CLERMONT, *supra* note 4, at 30–31 (explaining ratio approach in criminal context). Actually speaking of ratios would necessitate a major shift, and a lot more detail, in the current judicial instruction.

tively close calls go against the proponent. If one wanted a more explicit formulation, one could say that the factfinder needs to be more convinced than merely believing that the likelihood of *a* exceeds the likelihood of *not-a* on the above-diagrammed scale of seven gross categories of likelihood, and instead the factfinder needs to believe that it is at least two categories higher.

It is possible that this intermediate standard of proof could be more demanding, as by imposing a requirement of completeness of evidence. That is, current law could demand that the admitted evidence reduce uncommitted belief below some stated standard. But I nondogmatically doubt it demands this extra. The clear-and-convincing cases are not explicit, but they do seem to speak in terms of the necessary degree of belief being stronger than what preponderance requires, and not in terms of a standard of proof that differs in kind, as by also demanding complete evidence.⁸¹

Proof beyond a reasonable doubt, however, does under current law seem different in kind as to demandingness.⁸² It must require more than $Bel(a) \gg Bel(not-a)$. It might merely require $Bel(a) \gg \gg Bel(not-a)$, as the probabilists would have it. But more realistically and effectively, current law appears to

The explanation would lead to quantification of beliefs and maybe to talk of probabilities. But perhaps the real reason for the law's approach is that a required ratio could not be communicated to, or understood by, factfinders without a terrific risk of wild mistake on their part. *Cf. id.* at 15–16 (recounting the law's rejection of variable standards of proof, even though they might be theoretically desirable).

⁸¹ See *Tauese v. State, Dep't of Labor & Indus. Relations*, 147 P.3d 785, 819–20 (Haw. 2006) (“Under Hawai'i law, ‘clear and convincing’ evidence is ‘defined as an intermediate standard of proof greater than a preponderance of the evidence, but less than proof beyond a reasonable doubt required in criminal cases.’ This standard requires ‘that degree of proof which will produce in the mind of the trier of fact a firm belief or conviction as to the allegations sought to be established, and requires the existence of a fact be highly probable.’” (citations omitted) (quoting *Masaki v. Gen. Motors Corp.*, 780 P.2d 566, 574–75 (Haw. 1989) (observing also, “The law has evolved three standards of levels of proof for different types of cases.”)); *Molyneux v. Twin Falls Canal Co.*, 35 P.2d 651, 655–56 (Idaho 1934) (saying that “clear, positive, and unequivocal” overstates the clear-and-convincing standard); CLERMONT, *supra* note 4, at 23–25, 73–82 (giving background on the clear-and-convincing standard, and arguing that there are and should be only three standards of proof); 2 MCCORMICK ON EVIDENCE, *supra* note 11, § 340 (citing cases on the clear-and-convincing standard). *But see* Hillary Gaston Walsh, *Unequivocally Different: The Third Civil Standard of Proof*, 66 U. KAN. L. REV. 565, 602 (2018) (arguing for a fourth standard of “clear, unequivocal, and convincing” evidence applicable in immigration cases, which would be higher than clear and convincing).

⁸² See CLERMONT, *supra* note 4, at 26–31 (giving background on the criminal standard).

place separate demands on $Bel(a)$ and $Bel(not-a)$, demanding that proof of guilt be strong and that no reasonable doubt persists. Those separate demands of a sizable $Bel(a)$ and a tiny $Bel(not-a)$ will ensure that $Bel(a) \gg \gg Bel(not-a)$, but require more.

Although there are many conceivable approaches to the extra requirement, my conjectured formulation of the current law would require both (i) that the belief in guilt ($Bel(a)$) be strong enough to exceed the so-called maximal possibility of innocence ($1-Bel(a)$), and (ii) that no reasonable possibility of innocence exist, that is, that the factfinder could not reasonably hold that $Bel(not-a)$ exceeds the lowest category of slightest likelihood on the scale of seven gross categories of likelihood.⁸³

The first requirement of strong proof of guilt ensures that the belief in guilt outweighs all alternative possibilities, including fanciful ones. $Bel(a)$ cannot be weak, compared to the maximal possibility of innocence. This part of the standard thus remains comparative. Asking for a belief that guilt is more likely than all alternative possibilities is fairly communicable to and understandable by the factfinder. Moreover, the proof of guilt must be solid enough that the factfinder is not swimming in uncommitted belief. We do not want to convict when, although there is some evidence of guilt, we really do not know what happened. The first requirement thus requires a completeness of evidence not required on the civil side.⁸⁴

The second requirement expresses the accepted idea implicit in the criminal standard that the factfinder cannot retain a reasonable belief in innocence or, equivalently, a reasonable

⁸³ See Clermont, *Belief Function*, *supra* note 9, at 376–77 (explicating the criminal standard).

⁸⁴ Also, the first requirement might mollify those who treat the criminal standard as a unitary but very high probability standard and then argue that the standard is much too demanding to be optimal. *E.g.*, Ronald J. Allen & Larry Laudan, *Deadly Dilemmas*, 41 TEX. TECH. L. REV. 65, 68 (2008) (“While the prospect of convicting or executing a truly innocent person is horrifying, this type of mistake occurs within a highly complicated matrix of relationships where other equally horrifying mistakes go unnoticed in the conventional discourse.”); *cf.* Federico Picinali, *Can the Reasonable Doubt Standard Be Justified?: A Reconstructed Dialogue*, 31 CAN. J. L. & JURISPRUDENCE 365 (2018) (reconciling deontologists’ and consequentialists’ views). Still, given the usual limits on available evidence, achieving such a high degree of belief that $Bel(a) > 1-Bel(a)$ constitutes a demanding standard. Bear in mind that a $Bel(a)$ in excess of $1-Bel(a)$, along with a tiny $Bel(not-a)$, would usually convert by pignistic transform into a very high probability, not far from the probabilities often mentioned in association with beyond a reasonable doubt. See CLERMONT, *supra* note 4, at 108–11 (surveying empirical studies); Lawrence T. White & Michael D. Cicchini, *Is Reasonable Doubt Self-Defining?*, 64 VILL. L. REV. 1 (2019) (describing study that suggested 65 percent threshold).

doubt as to guilt.⁸⁵ The second requirement works to satisfy those who contend that the criminal standard “is intended to make even the juror who thinks that the defendant ‘did it,’ in everyday terms, think twice.”⁸⁶ The second requirement explains why some infamous, celebrity defendants who were “obviously guilty” were nevertheless properly acquitted.

D. How Can the Multivalent-Belief Model Solve Probability’s Difficulties?

One sign that the law should, and actually does, embrace the multivalent-belief model is that this model resolves all those paradoxes, puzzles, and problems that plague the probabilistic position:

1. *Unrealistic factfinding.* Probabilistic thinking, with its usual $p > 50\%$ formulation of preponderance, induces one to speak in quantified terms. Expressing the standard instead as $Bel(a) > Bel(not-a)$ avoids the troublesome task of quantification. Additionally, comparing those two beliefs invokes the factfinders’ considerable powers of relative judgment, rather than humans’ weak powers of absolute judgment required for placement on some scale of likelihood.⁸⁷
2. *Prior probability.* A huge difficulty for traditional probability theory is fixing the starting point for factfinding: many a probabilist is left to assume that when the factfinder knows nothing, the rational starting point is 50%. Under the multivalent-belief model, however, the well-behaved factfinder starts not at 50% but at zero belief. Then, to get $Bel(a)$ to exceed $Bel(not-a)$, the proponent must generate a reasonable possibility, the first degree of belief perceptibly above the zero level of disbelief. This requirement conforms to the law’s dictate that to get past the gatekeeper-judge and reach the factfinder requires more than a feather’s weight of evidence. Moreover, the multivalent-belief standard of proof conforms to the law by saying that the nonburdened party does not need to develop a competing version of the truth, but can succeed as long as the proponent’s case remains relatively weak. These insights make sense of the notion of a bur-

⁸⁵ See CLERMONT, *supra* note 4, at 36–38 (explaining the meaning of equivalent standards when the burden shifts).

⁸⁶ Harold A. Ashford & D. Michael Risinger, *Presumptions, Assumptions, and Due Process in Criminal Cases: A Theoretical Overview*, 79 YALE L.J. 165, 199 (1969); see Pardo, *supra* note 38, at 1829 & n.142 (seeing the beyond-a-reasonable-doubt standard as imposing a double requirement).

⁸⁷ See CLERMONT, *supra* note 4, at 62–66 (discussing human limitations on nonrelative judgment).

den of production. That burden is not some additional requirement arbitrarily introduced to supplement my model, but instead flows naturally from requiring that a reasonable factfinder could find that $Bel(a)$ perceptibly exceeds $Bel(not-a)$.⁸⁸

3. *Infinite alternatives.* Under the traditional probability model, the infinite range of possibilities alternative to the proponent's allegations appears to make the burden of persuasion very heavy. By contrast, the multivalent-belief model clarifies that the proponent need not dispel all possible alternatives. The model does not require the completeness of proof that would be necessary for the burdened party to get belief to some level above 50%, but instead is willing to follow the law by resting decisions on the evidence presented. Furthermore, the burdened party need not fight imaginary fights, trying to disprove every alternative possibility, but instead can focus on elevating a and depressing $not-a$. All those possible states of the world that create neither a belief in a nor a belief in $not-a$ remain in the uncommitted belief.⁸⁹
4. *Element-by-element factfinding.* Speaking in terms of probability brings into play the product rule, which says that the probability of a conjunction of independent elements is the product of their probabilities and thus leads to the aforementioned paradox: it seems that each element's being more likely than not is no guarantee that the elements' conjunction will be more likely than not. But the mathematics of traditional probability is not applicable to combining beliefs. The highly developed and widely accepted mathematics for combining beliefs instead instructs that the conjunction has a degree of belief equal to the weakest of the conjoined beliefs, in accordance with the so-called MIN rule. The paradox, as well as the criticality of the size of elements, vaporizes: if each element is more likely than not, then the elements' conjunction must be more likely than not.⁹⁰

⁸⁸ See Clermont, *Belief Function*, *supra* note 9, at 377–82 (explicating the burden of production).

⁸⁹ See *id.* at 369–77 (explicating the burden of persuasion).

⁹⁰ Philosophers and logicians agree with the law's approach. See COHEN, *supra* note 45, at 89–91, 265–67 (arguing that the conjunction of two or more propositions has the same inductive probability as the least likely conjunct); RUSSELL, *supra* note 59, at 359–61 (arguing comparably that his “degrees of credibility” do not follow the product rule of traditional probability); Dubois & Prade, *supra* note 66, at 403 (rejecting the application of “arguments deriving from the study of statistical experiments”); Susan Haack, *The Embedded Epistemologist: Dispatches from the Legal Front*, 25 *RATIO JURIS* 206, 217–18 (2012) (arguing comparably that her “degrees of warrant” do not follow the product rule of traditional probability); John MacFarlane, *Fuzzy Epistemicism*, in *CUTS AND CLOUDS*,

5. *Standards' purposes.* Most importantly, traditional probability does not deliver the message that standards of proof should convey. The law is looking for some sort of conviction on the part of its factfinders, not a probability. The multivalent-belief model not only better communicates the standards' message, but also better serves the law's other purposes.⁹¹ For example, the reformulated preponderance standard achieves the goal of minimizing error costs in civil cases. The mathematics of beliefs, by the so-called MAX rule, instructs that a disjunction has a degree of belief equal to the strongest of the disjoined beliefs. It further instructs that if each belief is stronger than its disbelief, the conjunction of the beliefs is stronger than the disjunction of disbeliefs, that is, the conjoined story is stronger than all other possible stories combined.⁹²

Let me expand on the last two points. We can better understand them if we follow the law's lead in using a different imagery for verbalizing and combining beliefs, once the beliefs are formulated and evaluated. Law and lawyers tend at this point to shift unconsciously from a style of thinking that conforms with belief functions (used by factfinders when applying the standard of proof, with acute awareness of uncommitted belief) to a form of speech that conforms with fuzzy logic (used by lawyers, when discussing the output of evidence evaluation after disregarding the uncommitted belief, as "more probable than not" or whatever).⁹³ Fortunately, belief functions and fuzzy logic are compatible, being alternative representations of multivalence.⁹⁴ This switch in imagery is not necessary, but

supra note 58, at 438 (arguing against the product rule and in favor of the MIN rule).

⁹¹ See Edward K. Cheng & Michael S. Pardo, *Accuracy, Optimality and the Preponderance Standard*, 14 LAW, PROBABILITY & RISK 193 (2015) (considering various purposes, but prioritizing accuracy).

⁹² See Clermont, *Fuzzy Logic*, *supra* note 16, at 64–66 (making the efficiency argument). On the normalization step implied here, see *infra* text accompanying notes 94–107.

⁹³ See HAACK, *supra* note 56, at 57 (illustrating the legal system's usages).

⁹⁴ For a mathematical defense of a switch from belief functions to fuzzy logic, and for the simplifying assumptions on which the switch rests, see Didier Dubois & Henri Prade, *Consonant Approximations of Belief Functions*, 4 INT'L J. APPROXIMATE REASONING 419, 419 (1990) ("Viewing a fuzzy set as a consonant random set, it is shown how to construct fuzzy sets that may act as approximations of belief functions."); Rott, *supra* note 72, at 304, 311 (assuming that if *b* is less likely than *a*, then *not-a* should be less likely than *not-b*). The law apparently makes those simplifying assumptions in the pursuit of simple rules' workability.

the switch both conforms to the law's imagery and makes it simpler and easier to picture and discuss what is going on.⁹⁵

Now let me explain the new imagery. Fuzzy logic derives from the brilliant pioneering work of Berkeley Professor Lotfi Zadeh dating from 1965.⁹⁶ Fuzzy logic measures a multivalued variable, or a degree of membership in some fuzzy set.⁹⁷ The degree may take any value throughout the interval [0,1], rather than just the value of 0 or 1 as in classical logic. So, think of the set of facts fully believed to be true, where membership measures the degree of believed truth of a statement of fact. Because the statement can be believed as true to some degree, we call the degree a fuzzy belief.⁹⁸

Both fuzzy logic and belief functions employ MIN and MAX rules.⁹⁹ These operators apply in most multivalent systems (such as fuzzy logic and belief functions), while some variation of the product rule governs in most bivalent systems (such as frequentist events and betting odds with fully committed belief).¹⁰⁰ Fuzzy beliefs differ from belief functions in their treat-

⁹⁵ See MIRCEA REGHIS & EUGENE ROVENTA, CLASSICAL AND FUZZY CONCEPTS IN MATHEMATICAL LOGIC AND APPLICATIONS 354 (1998) (referencing belief functions and fuzzy logic, and observing: "In order to treat different aspects of the same problems, we must therefore apply various theories related to the imprecision of knowledge."); SCHUM, *supra* note 66, at 41, 200–01 (disbelieving that it is "possible to capture all of this behavioral richness within the confines of any single formal system of probabilities").

⁹⁶ L.A. Zadeh, *Fuzzy Sets*, 8 INFO. & CONTROL 338 (1965). See generally BART KOSKO, FUZZY THINKING: THE NEW SCIENCE OF FUZZY LOGIC (1993) (giving a popularized view of fuzzy logic); Petr Cintula, Christian G. Fermüller & Carles Noguera, *Fuzzy Logic*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY (Edward N. Zalta ed., 2017), <https://plato.stanford.edu/entries/logic-fuzzy/> [<https://perma.cc/5DSZ-XDBU>]. For the historical background of the theory, see Didier Dubois, Francesc Esteva, Lluís Godó & Henri Prade, *Fuzzy-Set Based Logics—An History-Oriented Presentation of Their Main Developments*, in 8 HANDBOOK OF THE HISTORY OF LOGIC 325, 432 (2007).

⁹⁷ Fuzzy set theory is a common, but not necessary, way to represent and work with fuzzy logic. See THEODORE SIDER, LOGIC FOR PHILOSOPHY 12–23 (2010) (introducing set theory); Ross & Parkinson, *supra* note 22, at 33 (linking fuzzy logic and fuzzy set theory).

⁹⁸ I am treating beliefs in truth as fuzzy, for purposes of decisionmaking. I do not view truth itself as fuzzy for pure facts. A lively debate exists as to whether I could do so, with some contemplating the existence of such vagueness. See Gareth Evans, *Can There Be Vague Objects?*, 38 ANALYSIS 208 (1978); Michael Morreau, *What Vague Objects Are Like*, 99 J. PHIL. 333, 334–35 (2002); Sorensen, *supra* note 68, § 8. In any event, I am not treating factual truth itself as fuzzy, and I do not need to do so for present purposes.

⁹⁹ See Clermont, *Belief Function*, *supra* note 9, at 385–89 (applying MIN and MAX rules to belief functions).

¹⁰⁰ The product rule derives from the givens of traditional probability, which are the bivalence assumption and Kolmogorov's three axioms, and so it is inoperative when those conditions do not hold. See Brian R. Gaines, *Fuzzy and Probability Uncertainty Logics*, 38 INFO. & CONTROL 154, 157 (1978) ("[B]oth multi-

ment of uncertainty, however. Belief functions treat all uncertainty front and center in terms of uncommitted belief, while fuzzy set theory moves any second-order uncertainty, that is, uncertainty about the estimate of degree of membership, into the additional dimension of a so-called ultra-fuzzy set. It is fuzzy logic's separation of first-order imprecision from second-order uncertainty that makes the operation of its MIN rule simpler and easier.¹⁰¹

Fuzzy imagery allows us to speak of beliefs in terms of a likelihood that a fact is true and a complementary likelihood that it is not proven.¹⁰² To get there, we recognize the disregard of uncommitted belief, in application of the standard of proof, by normalizing the belief functions $Bel(a)$ and $Bel(not-a)$. That is, we scale them up proportionately so that together they equal 1, thereby moving the uncommitted belief back into another dimension. The degrees of beliefs then appear as normalized fuzzy beliefs. Normalizing $Bel(a) = 0.40$ and $Bel(not-a) = 0.20$ would yield a fuzzy belief in a equal to 0.67, and a fuzzy belief in a 's not being proven equal to 0.33. Although these numbers look like odds, they are not odds. They retain the relative relation of $Bel(a)$ and $Bel(not-a)$, but 0.67 is just the best first-order estimate of the provability of a . To get odds, one would instead have to perform a pignistic transform by consciously allocating all belief between true and false, thereby eliminating all partial truths.¹⁰³

plication/addition, and max/min, connectives may be seen to arise from constraints on an underlying probability logic."). The product rule does not apply in systems that reject the law of the excluded middle. See *id.* at 155-59, 161 (showing that the MIN rule of fuzzy logic reduces to the product rule for independent events in a bivalent world, but that only the MIN rule applies in a fuzzy world). In sum, the law of the excluded middle dictates additivity, which dictates the proper conjunction operator. See *supra* notes 20-22 (discussing excluded middle and additivity).

¹⁰¹ See Clermont, *Common Sense*, *supra* note 23, at 1065, 1075-76 (explaining how the different treatments of uncertainty counsel the switch in images).

¹⁰² See CLERMONT, *supra* note 4, at 187 (showing that fuzzy logic remains nonadditive); Clermont, *Fuzzy Logic*, *supra* note 16, at 60-64 (showing how complementarity is not contradiction in fuzzy logic); Ross & Parkinson, *supra* note 22, at 33 (same).

¹⁰³ Many readers get confused here. They view *probabilities* of truth and *beliefs* in truth as fundamentally equivalent concepts, both being multivalent measures on a range from 0 to 1. But the two concepts are built on different logics. Traditional probability represents the random uncertainty that a proposition is actually true or false and so rests on classical logic, with its excluded middle and its additivity consequence. Beliefs in truth, as discussed herein, employ multivalent logic (such as belief functions or fuzzy logic), which does not assume an excluded middle and hence does not exhibit additivity. The law's choice between logics turns on whether factfinding should focus on bivalent truths that come only as 0 or 1 or on multivalent beliefs that can take on all values from no belief to full

<i>FuzzyBel(a)</i>	<i>FuzzyBel(not-a)</i>
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0

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Once this far in fuzzy imagery, we can utilize the well-established logical operators of fuzzy logic. Its conjunction operator, a more general replacement for the product rule, is the so-called MIN rule for combining fuzzy beliefs in proposition *a* and proposition *b*:

$$FuzzyBel(a \text{ AND } b) = \text{minimum}(FuzzyBel(a), FuzzyBel(b))$$

If after proof *FuzzyBel(a)* is 0.67 and *FuzzyBel(b)* is 0.60, then by fuzzy logic their conjunction is 0.60.¹⁰⁴

On the one hand, the probabilistic odds of *a* dictate under bivalence the odds of *not-a*, and so the conjunction of *a* and *b* means mounting odds of *not-a* or *not-b*.¹⁰⁵ That is, the complement of the probabilistic chance of *a*'s being revealed as true is the chance of *a*'s being revealed as false. The chance of *a*'s being revealed as false interacts with the chance of *b*'s being revealed as false, so that the chance of *a* or *b* being revealed as false goes up, and the chance of *a* and *b* being true goes down, by a multiplicative amount in accordance with the product rule.

On the other hand, under multivalent logic, if one believes *a* and one believes *b*, then by the principle of conjunctive closure one believes *a* and *b* together, although of course not more than one believes *a* or *b* separately.¹⁰⁶ A belief is an evidence-based measure of sureness about the real world. The comple-

belief. What this whole article is about, then, is which is a more realistic and effective representation of a found fact: either additive odds of bivalent truth or partial belief and disbelief that do not add to one? The law's choice between logics thus means choosing between different variables, either bivalent truths or multivalent beliefs. I think a focus on bivalent truth would produce all sorts of logical and practical problems; and I observe that existing law in many respects, such as its element-by-element factfinding, already rejects a focus on bivalent truth.

¹⁰⁴ Much of my prior writing on standards of proof treated this conjunction operator in detail, as well as the MAX operator for fuzzy disjunction. I am trying to be nontechnical in this Article, so here I shall only cite ALIEV, *supra* note 22, at 1, 6 (stating formally the MIN operator); Richard Bellman & Magnus Giertz, *On the Analytic Formalism of the Theory of Fuzzy Sets*, 5 INFO. SCI. 149, 151-52 (1973) (defending the MIN rule for use in conjoining the truth values of multiple propositions); Ronald R. Yager, *Connectives and Quantifiers in Fuzzy Sets*, 40 FUZZY SETS & SYS. 39 (1991) (giving a more technically complete defense).

¹⁰⁵ See CLERMONT, *supra* note 4, at 173, 194 (explaining the product rule for bivalent systems).

¹⁰⁶ See Simon J. Evnine, *Believing Conjunctions*, 118 SYNTHESE 201, 201, 214, 222 (1999) (stating the principle as “[i]f S is rational, then if S believes A and S

ment of a belief is not a disbelief, but is instead the degree to which the belief was not proven. As the factfinder shifts from evidence of *a* to evidence of *b*, the sureness as to *a* does not slip. The degree of *a*'s not being proven does not have any effect on or interaction with the degree of *b*'s not being proven. In other words, figuring joint odds is fundamentally different from conjoining beliefs.¹⁰⁷

The MIN rule can be derived by formal proof.¹⁰⁸ But formal proofs seem not to convince lawyers. The MIN rule can also be intuited. The product rule would start producing obvious nonsense for law cases as the number of elements starts increasing. By contrast, a legal case should be seen as a story consisting of proven elements, which can be strung element-by-element as links in a chain whose strength is the strength of its weakest link.¹⁰⁹

Imagine ten or more facts from history each believed by a historian to 0.90, which link together as the necessary elements to form a historical story. Should the historian accept that story? Yes, even though the product rule would put the probability at 35% or less. Rejecting that path, and instead accepting the product rule, would lead to such idiocies as Holocaust denial: the denier would wonder how anyone could think that so many events conjoined to produce the Holocaust. Every story from a historian consists of linked, not multiplied, beliefs.¹¹⁰

Try this thought experiment. You just discovered that your credit card is gone, and you must decide whether to cancel the

believes *B*, then *S* believes *A and B*," and defending the principle as generally valid); *supra* note 94 (praising simpler rules).

¹⁰⁷ See Huber, *supra* note 53, at 10 (stating "that fair betting ratios should indeed obey the probability calculus, but that degrees of belief, being different from fair betting ratios, need not").

¹⁰⁸ See Clermont, *Fuzzy Logic*, *supra* note 16, at 51 n.32, 67–68 (providing that proof).

¹⁰⁹ See *Branion v. Gramly*, 855 F.2d 1256, 1264 (7th Cir. 1988) (rejecting multiplication of odds in a legal case by saying: "Every event, if specified in detail, is extremely improbable; indeed, with *enough* detail it is unique in the history of the universe. It is always possible to take some probabilities, small to start with, and multiply them for effect.").

¹¹⁰ See Michael Salter, *Countering Holocaust Denial in Relation to the Nuremberg Trials*, in *HOLOCAUST AND GENOCIDE DENIAL: A CONTEXTUAL PERSPECTIVE* 21, 22 (Paul Behrens et al. eds., 2017) (treating Holocaust history); cf. Giorgio Resta & Vincenzo Zeno-Zencovich, *Judicial "Truth" and Historical "Truth": The Case of the Ardeatine Caves Massacre*, 31 *LAW & HIST. REV.* 843 (2013) (considering the treatment of history in the courtroom). See generally *EVIDENCE AND INFERENCE IN HISTORY AND LAW: INTERDISCIPLINARY DIALOGUES* 2–62 (William Twining & Iain Hampsher-Monk eds., 2003) (comparing historical inquiry and legal proof); TWINING, *supra* note 26, at 352–53 (same).

card and change all its automatic payments. You check around without finding it. You then try to reconstruct your recent past. You think about when you last saw the card. You believe that a purchase of a shirt prompted the last time you used it. You believe that the clerk returned the card to you, and that you put it back in your wallet. You think about who would have had access to your wallet. You believe that your daughter’s boyfriend is a possible suspect. Of course, you may have just misplaced the card, temporarily or permanently. Consider whether, during this introspection into the course of weighing evidence to find facts in real life, you were working with odds or instead with beliefs, disbeliefs, and uncommitted beliefs in the face of uncertainty. Consider further whether you were tempted, when combining a series of events, to multiply the likelihoods of your suspicions. When I do the experiment, I find myself finding the facts that I believe more than disbelieve, and then moving on to the next fact without carryover—much as the law focuses on finding each element that is henceforth treated as judicial truth.¹¹¹

Another way to see the difference between the product rule for odds and the MIN rule for beliefs is to think first of the 1/4 odds of flipping two coins as two heads:



The product rule critically utilizes the idea that if a coin is not heads, it is tails. Now imagine that you have eyewitnesses who testify to fairly fleeting views of each of the coins landing as heads. The coins are now gone. You form a belief of 0.60 in heads for the first coin, and the same belief for the second coin, as represented thus:¹¹²



Now, is your belief in two heads having come up 25%? Or 0.36? The MIN rule of belief function theory says 0.60. Why? You started at zero beliefs. The base rate of 50/50 drops out of

¹¹¹ Empirical testing is sketchy. See Rami Zwick, David V. Budescu & Thomas S. Wallsten, *An Empirical Study of the Interpretation of Linguistic Probabilities*, in *FUZZY SETS IN PSYCHOLOGY* 91, 114–16 (Tamás Zétényi ed., 1988) (indicating experimentally that people do not naturally use the product rule for degrees of belief).
¹¹² See KOSKO, *supra* note 96, at 15 (“You paint one picture of the world if you say there is a 50% chance that an apple sits in the refrigerator. You paint a different picture if you say half an apple sits in the refrigerator.”).

further consideration.¹¹³ The testimony of the eyewitnesses was pretty good, making your beliefs in heads pretty strong. Some of your belief remains uncommitted. No witness is saying there were tails. Your beliefs in tails remain low. So, when you conjoin the beliefs in heads, you are not working with a 40% chance of tails, the product rule is inapplicable, and the MIN rule applies. The point is that the belief in the coins' having been two heads, expressed as a degree of full knowledge, is different from the odds of two heads in future flips, the difference deriving from the presence or absence of the uncommitted belief that defeats bivalence. (If, instead of working with beliefs, you wanted to bet on whether there had been two heads, and there was a way eventually to find out, you would go through some pignistic transform that makes the odds of each coin being heads fall between *Bel(heads)* and *Bel(tails)*, say, 75:25, so that the probability of two heads would be 56% by the product rule. Note that the conjoined probability (56%) is not wildly different from the conjoined belief (0.60), because probabilities of facts are, before application of the product rule, bigger than the corresponding degrees of belief in the facts.)

The more general point is that uncertainties fall mainly into one of two piles: one of bivalent measures for which the product rule suffices, and another of multivalent measures to which the more general MIN rule applies.¹¹⁴ The probability of truth, with all views committed between true and false, falls into the first pile. The belief in truth, as opposed to nonbelief and disbelief, goes into the second pile. The law could choose to put legal factfinding in either pile. The choice turns on policy.¹¹⁵ There is little doubt, based on extant doctrine expressed in judicial instructions, that the law has cast legal factfinding

¹¹³ For consideration of statistical evidence and its ultimately nonparadoxical nature, see FIELD ET AL., *supra* note 24, at 1512–16 (explaining how a factfinder converts statistical evidence into what I am now calling a belief: “After all, rationally converting the statistical evidence into a [belief] represents a substantial task, at least in all but the most fanciful cases. The evidence may have to be connected up with the issue in the individualized case by a series of permissible but uncertain inferences; also, the evidence may have to be discounted for defects in credibility; the probability may have to be adjusted in light of the probative value of the absence of other proof, an effect most often cutting against the proponent.”). For what turns out to be the doable task of combining statistical and nonstatistical evidence, see Clermont, *Fuzzy Logic*, *supra* note 16, at 46–48. But there is a rule that certain kinds of evidence—statistics, the opponent’s failure to testify, and disbelief and demeanor of the opponent’s evidence—will not satisfy the initial burden of production, a special rule that acts to ensure a certain completeness of evidence requirement. See CLERMONT, *supra* note 4, at 206–07.

¹¹⁴ See *supra* note 103 (refining the distinction).

¹¹⁵ See *supra* text accompanying note 59 (framing the policy choice).

into the second pile. I contend that this choice is the wise one. The law has no cogent interest in the odds for betting on unattainable truth. Choosing the second pile avoids the many difficulties of dealing in probabilities. Therefore, the law should seek the measure of the factfinder's belief, based on the imperfect evidence presented.

First, of three closing observations that raise additional advantages of multivalent beliefs over traditional probability, a neat consequence of the MIN rule is that it makes irrelevant whether the evidence processing stage proceeded holistically or atomistically, or whether it ended in a stab at forming a belief or in something more rigorous. Nothing turns, in the evidence evaluating stage, on the route taken to the factfinder's measure of processed strength. If the measure of strength is meticulously calculated element-by-element, and each element of the proponent's case is found more likely than not, then the conjunction of elements will be more likely than not by the MIN rule. If instead the factfinder makes a stab at the proponent's whole story, and finds it more likely than not, then each of the elements is necessarily fixed at more likely than not.

Second, conjunction is a matter of immense theoretical importance.¹¹⁶ Lest you think this conjunctive musing is all a fine, even if significant, theoretical point that seldom arises in actual practice,¹¹⁷ however, I would point out that combining

¹¹⁶ See Michael S. Pardo, *The Paradoxes of Legal Proof: A Critical Guide*, 99 B.U. L. REV. 233, 280–82, 288–89 (2019) (arguing that paradoxes force one to grapple with the fundamental issues). The product rule would lead to other silliness, such as the aggregation paradox. See Alon Harel & Ariel Porat, *Aggregating Probabilities Across Cases: Criminal Responsibility for Unspecified Offenses*, 94 MINN. L. REV., 261, 261 (2009) (building on the aggregation paradox); Ariel Porat & Eric A. Posner, *Aggregation and Law*, 122 YALE L.J. 2, 4 (2012) (same). These theorists would have us convict defendants on the basis of a series of almost-proven crimes. *But see* Kevin M. Clermont, *Aggregation of Probabilities and Illogic*, 47 GA. L. REV. 165, 166 (2012) (resolving the aggregation paradox).

¹¹⁷ Many dismiss the conjunction paradox as a mere theoretical wrinkle without practical worry, arguing that most cases involve a single disputed issue and that multiple issues are seldom independent. *E.g.*, Lempert, *supra* note 8, at 452 (“One might, for example, argue that the probabilities favoring the existence of the different elements of a plaintiff's case are generally highly dependent, and that successful plaintiffs generally prove the separate elements of their cases by far more than a mere preponderance of the evidence.”). More desperately, others argue that the lamentable distortion caused by ignoring conjunction is offset by other features of the trial process. *E.g.*, Saul Levmore, *Conjunction and Aggregation*, 99 MICH. L. REV. 723, 734 (2001) (invoking the Condorcet Jury Theorem to argue that supermajority rules offset the failure to require jurors to conjoin probabilities). *But see* Allen & Jehl, *supra* note 1, at 914–18 (critiquing the supermajority theory of Levmore); Paul H. Edelman, *On Legal Interpretations of the Condorcet Jury Theorem*, 31 J. LEGAL STUD. 327, 343–48 (2002) (critiquing the Condorcet theorizing by Levmore); *cf.* CLERMONT, *supra* note 4, at 128, 186 n.542

found facts is a universal and constant task in factfinding. The same MIN rule applies whether the elements are independent or interdependent, unlike the product rule. Moreover, the task is by no means limited to combining elements. The MIN rule works in the same way on facts within elements as it does between elements, making any particular division of a claim or defense into elements nondeterminative.¹¹⁸ Also, as the factfinder induces up toward the element to be proved,¹¹⁹ the

(discussing group decisionmaking); EYAL ZAMIR & DORON TEICHMAN, *BEHAVIORAL LAW AND ECONOMICS* 120–24, 559–61 (2018) (same). Still others contend that because factfinders proceed holistically anyway (or the judge might not clearly state, or the jury might not fully understand, the element-by-element approach to the standard of proof), we can rest content in the thought that the right standard is being applied to the conjunction, as long as we do not force the factfinder into a corner by some device like a special verdict. *E.g.*, Ronald J. Allen & Michael S. Pardo, *Relative Plausibility and Its Critics*, 23 *INT'L J. EVIDENCE & PROOF* 5, 29–30 (2019) (asserting that comparing whole stories somehow avoids the conjunction paradox); *cf.* Elizabeth G. Thornburg, *The Power and the Process: Instructions and the Civil Jury*, 66 *FORDHAM L. REV.* 1837, 1857–63 (1998) (questioning whether a special verdict actually changes the jury's decision-making practice).

¹¹⁸ Consequently, “element” should mean a finding necessary for a claim or defense to succeed under the substantive law. Within elements, the factfinder uses the usual intuitive techniques for finding facts in a nonquantitative and approximate fashion. If an element is said to entail separate facts, the process of combining facts is the same as the proof process between elements. To conjoin the separate facts (as opposed to the treatment of reinforcing or weakening evidence), the factfinder uses the same MIN operator for conjunction. *See* CLERMONT, *supra* note 4, at 158–59, 191–92 (discussing proof of facts within elements). The apparent criticality of the number of elements thus melts away.

Nevertheless, the law does split cases into parts that it calls elements and tells its factfinders to proceed element-by-element, but it does so only to make the factfinders' path to decision more comprehensible and careful. Also, the element-by-element instruction avoids the need to instruct on using the MIN rule and against using the product rule. Therefore, the judges' practice of stressing the element-by-element instruction is an excellent practice.

¹¹⁹ On the inductive process in finding facts, see generally ANDERSON ET AL., *supra* note 22, chs. 3–4 (treating “principles of proof” and “methods of analysis”). Inferences are the mental steps in connecting a piece of evidence to the element to be proved, or the “probandum.” Many inferences may lie between evidence and probandum. *See* Morgan, *supra* note 26, at 943–45. Each inference allows progress toward the probandum by invoking a generalization, an inductive if-then statement that is often probabilistic in nature and always subject to some question as to its soundness. Those generalizations can be entered in evidence, or judicially noticed, to the limits of the rules of evidence; but most generalizations are implicit, with the factfinder permitted to use common knowledge but not personal knowledge. The factfinder then uses deductive reasoning on the generalization to infer from the prior belief in the chain of reasoning to a posterior belief. But that step is only as strong as the generalization.

On combining catenate inferences, see ANDERSON ET AL., *supra* note 22, at 107–08. The process is conjunction, as each step must be accepted in a chain. The evidence's probative force must account for any lack in the credibility of the piece of evidence or any ancillary evidence undercutting the strength of the inferential generalizations. Nothing in practice suggests that the product rule applies in this inferential reasoning. Instead, theory holds that the MIN rule applies,

MIN rule must be used again and again on the task of combining beliefs.¹²⁰ Finally, the task of combination extends well beyond trial, into pretrial devices and other legal-factfinding settings inside and outside courts, as well as into settlement negotiations and other law-office applications of law that depend on expected factfinding.¹²¹ And, as I have repeatedly suggested, we all intuitively combine facts by the MIN rule in countless settings of daily life. In short, the use of the MIN rule is almost ubiquitous. We must get conjunction right. Accuracy is essential not only for efficiency, but also for fairness, as I shall show.¹²²

Third, the multivalent-belief model does not differ revolutionarily from the traditional concept of standards of proof. It is not telling the factfinder to think a new way or to apply Bayesian mathematics. It instead is trying to represent how a factfinder actually thinks, while urging that this is a good way to think. The major contributions of belief functions and fuzzy logic are to provide a way to represent the evidential uncertainty that prevails in the real world and, thereby, instruct how to handle that uncertainty.

because the process involves conjoining multivalent beliefs. So, when an inference rests on an inference from the piece of evidence, multivalent logic says that the conjoined strength of belief drops to the likelihood of the least likely step.

¹²⁰ There are three steps in factfinding: (1) connecting a piece of evidence to the element to be proved, a process treated in the preceding footnote; (2) combining pieces of evidence that all bear on one element to form a belief; and (3) conjoining the series of beliefs on each element to reach a decision, which was the subject of this subpart D. The MIN rule applies to the first and third steps. But step #2 is a different process, one that does not centrally involve conjunction.

The combined probative force of the pieces of evidence on an element can nudge up (as by convergence or corroboration) or down (as by conflict or contradiction) with a new piece of evidence. See *Al-Adahi v. Obama*, 613 F.3d 1102, 1105 (D.C. Cir. 2010) (“Those who do not take into account conditional probability are prone to making mistakes in judging evidence. They may think that if a particular fact does not itself prove the ultimate proposition (e.g., whether the detainee was part of al-Qaida), the fact may be tossed aside and the next fact may be evaluated as if the first did not exist.”). The combination calculation should proceed, as a theoretical matter, in accordance with one of the multivalent generalizations of Bayes’ theorem. See, e.g., CLERMONT, *supra* note 4, at 157.

¹²¹ Settlement on the basis of expected judgment is a two-step process that involves (i) establishment of paths of decision in favor of each side based on beliefs, to which the textual discussion is relevant, and then (ii) calculation of the odds of the decisionmaker’s taking each path. See *supra* note 61 (discussing odds of future events). Similarly, application of other standards of decision will often involve (i) retracing decisions based on beliefs and then (ii) calculating the probability of correctness. See *supra* note 33 and accompanying text (discussing standards other than the standard of proof, such as the standard of review).

¹²² See *infra* Part III (discussing apparent asymmetries).

II RADICAL MODELS

Most, but not all,¹²³ people who think seriously about this topic realize that traditional probability conflicts with the standards of proof.¹²⁴ Accordingly, many have proposed a rethinking of the topic that would allow us to live with the accepted paradoxes, puzzles, and problems that accompany traditional probability.¹²⁵ They try to circumvent the difficulties through heightened sophistication. Consequently, their competing models are radical reconceptions.

Take the much-condemned conjunction paradox as an example again.¹²⁶ Analysis of it has prompted some to abandon truth as an aim of trial and to embrace acceptability of result instead.¹²⁷ Radical reconception calls for radical reform. For acceptability, it should not matter whether the plaintiff's conjoined story is more likely than not, as long as the plaintiff's story is more likely than any other single story.¹²⁸ Others argue

¹²³ E.g., Mark Spottswood, *On the Limitations of a Unitary Model of the Proof Process*, 23 INT'L J. EVIDENCE & PROOF 75 (2019) (defending probabilism in models of legal decisionmaking against common critiques).

¹²⁴ Indeed, a recent article grandly insists that we live in the time of a "paradigm shift" in evidence theory away from probabilism. Allen & Pardo, *supra* note 117, at 5.

¹²⁵ E.g., Ho, *supra* note 35, at 127, 155–56, 171 (arguing that finding a fact in a criminal or civil case requires a categorical belief in the fact, that is, a judging that the fact is actually true); ALEX STEIN, FOUNDATIONS OF EVIDENCE LAW 133–40 (2005) (arguing for viewing standards of proof in terms of allocation of risk); Christoph Engel, *Preponderance of the Evidence Versus Intime Conviction: A Behavioral Perspective on a Conflict Between American and Continental European Law*, 33 VT. L. REV. 435 (2009) (arguing for a standard based on psychological confidence); Luke Meier, *Probability, Confidence, and the "Reasonable Jury" Standard*, 84 MISS. L.J. 747 (2015) (arguing for a standard based on statistical confidence); Nesson, *supra* note 15 (arguing that the process of proof aims at generating acceptable statements about past events and thus at projecting behavioral norms to the public); D. Michael Risinger, *Leveraging Surprise: What Standards of Proof Imply That We Want from Jurors, and What We Should Say to Them to Get It*, 48 SETON HALL L. REV. 965 (2018) (arguing for a standard based on the degree of the surprise that the factfinder would feel if the found fact hypothetically were revealed to be false); Vern R. Walker, *Preponderance, Probability and Warranted Factfinding*, 62 BROOK. L. REV. 1075, 1136 (1996) (arguing that preponderance means "being warranted by the evidence").

¹²⁶ Scholars reflexively invoke the paradox as a criticism of current law. E.g., Allen & Jehl, *supra* note 1; Cheng, *supra* note 3; Jason Iuliano, *Jury Voting Paradoxes*, 113 MICH. L. REV. 405 (2014); David Kaye, *The Laws of Probability and the Law of the Land*, 47 U. CHI. L. REV. 34, 38–41 (1979); Jonathan J. Koehler & John B. Meixner, *Decision Making and the Law: Truth Barriers*, in 2 THE WILEY-BLACKWELL HANDBOOK OF JUDGMENT AND DECISION MAKING 749, 752 (Gideon Keren & George Wu eds., 2015); Pardo, *supra* note 38.

¹²⁷ E.g., Nesson, *supra* note 15, at 1366–68.

¹²⁸ See *id.* at 1389–90 ("Application of the more-probable-than-not test to each element produces the most acceptable conclusion as to that element. The con-

more directly for changing the standard of proof.¹²⁹ We might raise the standard for the elements to ensure that their conjunction meets the current standard of proof.¹³⁰

The amazing result is that, even at this late date, there is no consensus on what the standards of proof require or should require. It is a theoretical jungle out there. My Article is merely the latest in a vibrant, contentious, and extensive literature.

A. Inference to the Best Explanation

The most invoked of the various temptations out there is inference to the best explanation (IBE). This method involves consideration and analysis of alternative conjectures to get the one that best explains the evidence.

IBE was built on abductive reasoning, a way of thinking first segregated by the early American logician Charles Sanders Peirce (1839–1914).¹³¹ Abduction is a creative process of fallible and defeasible insight. It uses data to generate hypotheses that are possibly true, which need to be inductively and deduc-

junction of these conclusions constitutes a story that is more probable than any other story about the same elements. Suppose, for example, that the elements of a story are *A* and *B*, and *A* (70%) is more probable than not-*A* (30%), and *B* (60%) is more probable than not-*B* (40%). The conjunction (*A* & *B*) (42%) may not be more probable than its negation (not-*(A* & *B)*) (58%). But the conjunction (*A* & *B*) (42%) is more probable than any other version: (*A* & (not-*B*)) (28%), ((not-*A*) & *B*) (18%), or ((not-*A*) & (not-*B*)) (12%). The application of the more-probable-than-not standard of proof on an element-by-element basis will produce the single most probable story.” (footnotes omitted).

¹²⁹ The two most recent forays argue at length that the conjunction paradox is real and that therefore the law should change to conform to the product rule. David S. Schwartz & Elliott R. Sober, *The Conjunction Problem and the Logic of Jury Findings*, 59 WM. & MARY L. REV. 619 (2017); Mark Spottswood, *Unraveling the Conjunction Paradox*, 15 LAW, PROBABILITY & RISK 259 (2016).

¹³⁰ E.g., A.P. Dawid, *The Difficulty About Conjunction*, 36 STATISTICIAN 91, 95–97 (1987) (suggesting a cure of raising the standard of proof on each of the elements, so as to satisfy preponderance for the whole claim or defense).

¹³¹ See 5 CHARLES SANDERS PEIRCE, COLLECTED PAPERS OF CHARLES SANDERS PEIRCE: PRAGMATISM AND PRAGMATICISM 106 (Charles Hartshorne & Paul Weiss eds., 3d ed. 1934) (“Abduction is the process of forming an explanatory hypothesis.”). Sherlock Holmes, championed for his (allegedly) deductive logic, was actually using (very lucky) abductive reasoning—which is not that surprising considering that his stories were written by Arthur Conan Doyle and inspired by Joseph Bell, both medical doctors. See ANDERSON ET AL., *supra* note 22, at 8–10, 58–59 (“There is no evidence that Peirce and Conan Doyle each knew of the other’s work.”); MARGALIT FOX, CONAN DOYLE FOR THE DEFENSE xix–xx, 42, 70–77 (2018) (documenting Bell’s influence). “When Holmes says, as he does in his debut appearance, ‘In solving a problem of this sort, the grand thing is to be able to reason backward,’ he is singing the praises of abduction.” *Id.* at 81; see *id.* at 79 n.* (“Conan Doyle, per common parlance, tended to use ‘deduction’ as a general rubric denoting any type of logical inference.”).

tively tested and then refined. A line of argument that captures abduction is this:

A surprising event, *a*, has occurred.
 If a hypothesis, *H*, were true, then *a* would follow.
 Thus, reason exists to believe *H* might be true.¹³²

Logicians later came to formalize abduction as a problem-solving method.¹³³ As such, IBE involves generating and testing hypotheses like *H*, then falsifying some and eventually settling on the best one as the explanation. It dominates the scientific method's production of explanations of generic events,¹³⁴ having produced such fruits as Darwin's theories of evolution¹³⁵ but also such clunkers as Ptolemaic astronomy.¹³⁶ It alters the line of argument thus:

A surprising event, *a*, has occurred.
 If a hypothesis, *H*, were true, then *a* would follow.
 No competing hypothesis explains *a* as well.
 Thus, reason exists to believe *H* probably is true.¹³⁷

IBE depends on a good-faith and thorough search for a pool of decent explanations. Here arises the strongest criticism of IBE, namely, the "argument from a bad lot."¹³⁸ All that IBE can deliver is the best explanation from the explanations considered. This best explanation could be merely the best of a bad lot. One could never know if it is true. One could not know it is

¹³² See ANDERSON ET AL., *supra* note 22, at 56–58 (formulating such a line of argument).

¹³³ See Gilbert H. Harman, *The Inference to the Best Explanation*, 74 PHIL. REV. 88, 88 (1965) (developing "inference to the best explanation" from abductive reasoning); Giovanni Tuzet, *Abduction, IBE and Standards of Proof*, 23 INT'L J. EVIDENCE & PROOF 114, 115–17 (2019) (delineating the relationship of IBE to abduction).

¹³⁴ See generally PETER LIPTON, *INFERENCE TO THE BEST EXPLANATION* (2d ed. 2004) (providing the classic treatment of the use of IBE in science).

¹³⁵ See Amalia Amaya, *Inference to the Best Legal Explanation*, in LEGAL EVIDENCE AND PROOF, *supra* note 29, at 135, 137 (giving examples). Science's so-called weight of the evidence methodology is such an approach. See *Milward v. Acuity Specialty Prods. Grp., Inc.*, 639 F.3d 11, 18 (1st Cir. 2011) (admitting expert evidence based on the weight of the evidence approach: "The scientist must (1) identify an association between an exposure and a disease, (2) consider a range of plausible explanations for the association, (3) rank the rival explanations according to their plausibility, (4) seek additional evidence to separate the more plausible from the less plausible explanations, (5) consider all of the relevant available evidence, and (6) integrate the evidence using professional judgment to come to a conclusion about the best explanation.").

¹³⁶ See Laudan, *supra* note 78, at 293 (observing that IBE "routinely warrants the acceptance of scientific theories and hypotheses that subsequent empirical research has repeatedly revealed to be false").

¹³⁷ See Amaya, *supra* note 135, at 136 (formulating such a line of argument).

¹³⁸ See BAS C. VAN FRAASSEN, *LAWS AND SYMMETRY* 143 (1989) (developing the criticism); Amaya, *supra* note 135, at 152–53 (recounting the criticism).

even probably true unless one actually knows that the true explanation was probably included among the explanations considered.

Nonetheless, medical diagnosis obviously employs IBE in trying to explain unique events.¹³⁹ Medicine's so-called differential diagnosis approach successively eliminates possible causes of a medical condition to reveal the best explanation of the conceivable alternatives.¹⁴⁰ Here, IBE appears to be a proper mode of analysis, correct and useful. But is it extendable to law? Quite simply, diagnosis does not involve applying a standard of proof, such as more likely than not. Incidentally, it proceeds without a whiff of multivalence.

In sum, IBE works for only certain kinds of problems and can take us only so far. Medical diagnosis is a very different task from legal factfinding. Diagnosis seeks by a process of elimination the best of all explanations one can imagine, and then uses it to guide treatment. The law is asking whether the proponent's version of the facts meets the standard of proof, say, that it is more likely true than false. Applying IBE to law cannot therefore be direct.¹⁴¹

B. Relative Plausibility

Still, some have tried to twist IBE to the legal task.¹⁴² Some of these theorists, realizing that IBE does not really fit, have invented a new approach that merely uses the verbiage of

¹³⁹ See L. Jonathan Cohen, *Bayesianism Versus Baconianism in the Evaluation of Medical Diagnoses*, 31 BRIT. J. PHIL. SCI. 45, 58–59 (1980) (developing the benefits of IBE over traditional probability, while likening IBE to the nonadditive logic of Baconian probability).

¹⁴⁰ See *Hall v. Conoco Inc.*, 886 F.3d 1308, 1314 (10th Cir. 2018) (rejecting expert evidence based on differential diagnosis because of an inadequate pool of possible causes, and observing: “An expert need not consider and rule out every conceivable cause. But the expert must still consider all plausible causes and rule out the less plausible ones until only the most likely cause remains.” (citations omitted)); *Westberry v. Gislaved Gummi AB*, 178 F.3d 257, 262–63 (4th Cir. 1999) (admitting expert evidence based on differential diagnosis).

¹⁴¹ See Laudan, *supra* note 78, at 303 (“IBE cannot function as a standard of proof . . .”).

¹⁴² E.g., Ronald J. Allen & Alex Stein, *Evidence, Probability, and the Burden of Proof*, 55 ARIZ. L. REV. 557, 567–70 (2013) (discussing adjudicative factfinding as IBE); Michael S. Pardo & Ronald J. Allen, *Judicial Proof and the Best Explanation*, 27 LAW & PHIL. 223, 227–42 (2008) (discussing how IBE explains judicial proof); cf. Amalia Amaya, *The Explanationist Revolution in Evidence Law*, 23 INT'L J. EVIDENCE & PROOF 60, 65 (2019) (arguing for evidentialist and coherentist versions of explanationism); Sean P. Sullivan, *A Likelihood Story: The Theory of Legal Fact-Finding*, 90 U. COLO. L. REV. 1, 19–34 (2019) (taking important steps toward formalizing the approach as “likelihood theory,” which nonetheless is subject to much of the same rebuttal as relative plausibility).

IBE.¹⁴³ They call their creation the relative plausibility theory (RP), or explanationism in the most recent reworking.¹⁴⁴

RP posits that the factfinder constructs (i) the overall story (or explanation, in the latest preferred terminology¹⁴⁵) that the plaintiff is spinning and (ii) another story (or stories, in some variants of the theory¹⁴⁶) that the defendant is or could be spinning. The factfinder then compares the two stories and gives victory to the plaintiff if the plaintiff's version is *more plausible* than the defendant's. This choice between alternative competing narratives is largely an ordinal process rather than a cardinal one.¹⁴⁷

No doubt, RP has some advantages, which explains why it is pushed. It does echo the way lawyers talk about their cases. It embraces the use of humans' strong capacity for relative judgment rather than absolute judgment. It strikes the tone of psychology's holistic models, while echoing the words of abduction and IBE.

¹⁴³ See Allen & Jehl, *supra* note 1, at 929–43 (explaining the origin of the new approach).

¹⁴⁴ See Allen & Pardo, *supra* note 117, at 6 n.1 (updating name of theory).

¹⁴⁵ See *id.* at 7 n.7, 17 n.86, 31 (distinguishing “story”); *supra* note 30 (discussing the story model).

¹⁴⁶ Compare Reid Hastie, *What's the Story? Explanations and Narratives in Civil Jury Decisions*, in CIVIL JURIES AND CIVIL JUSTICE 23, 31–32 (Brian H. Bornstein et al. eds., 2008) (expanding the theory to allow for a party's multiple stories), with Michael S. Pardo, *The Nature and Purpose of Evidence Theory*, 66 VAND. L. REV. 547, 598–99 (2013) (discussing the theory's difficulties in handling multiple stories). In my view, this supposed problem of “story” or “stories” disappears if one takes the plaintiff's story (or the defendant's story on an affirmative defense) to be one that encompasses all parts of the claim that the plaintiff must prove. The defendant's story then includes all versions that negate one of those parts. The parties do not have to formulate these stories expressly, as long as the factfinder can construct the story out of the allegations and the evidence. See Allen & Pardo, *supra* note 117, at 24–26 (accepting this approach to alternative explanations, and repudiating the earlier approach set out in, e.g., Ronald J. Allen, *The Nature of Juridical Proof*, 13 CARDOZO L. REV. 373, 409 (1991) (“The defendant could be required to plead and prove an episode that excludes the possibility of instantiating the formal elements of the substantive law, which simply means that if the defendant's claim is accepted, it falsifies at least one formal element.”)). Thus, when I refer to a party's “story,” I am invoking this broad notion of the party's best explanation unless otherwise stated. Note, however, that a broad notion of “story” gives the defendant the benefit of disjunctive proof, while the plaintiff remains saddled with conjunction, a situation that causes RP to unravel completely. See *infra* text accompanying note 154 (discussing survival of the conjunction paradox); *cf. infra* text accompanying note 162 (showing that considering all the defendant's stories is equivalent, under MIN and MAX rules, to considering the defendant's single best story).

¹⁴⁷ See Allen & Jehl, *supra* note 1, at 938 (“[P]roof is largely comparative or ordinal rather than cardinal.”).

Yet, RP has no theoretical underpinning, so nothing explains why RP's path is the right path to follow. First, RP rests on an assumption that factfinders proceed holistically, but RP does not and cannot maintain that holism is normatively sound.¹⁴⁸ Second, despite claims to the contrary, abduction does not justify RP, as abduction is a way for the investigator creatively to imagine possible explanations for later testing, rather than a way to reason to a conclusion.¹⁴⁹ Third, verbiage aside, RP is not a version of IBE, so its bow to IBE adds no support.¹⁵⁰

Instead, RP primarily looks to the parties in an adversary system to select the story candidates. It does not consider all possible explanations or even demand a decent pool of explanations, but by the theorists' fiat it limits consideration to two contesting explanations, which are each party's position on the allegations and evidence. This fiat makes life simpler, but sends the "argument from a bad lot" right through the roof.¹⁵¹ There is no way to justify RP's narrow focus, other than an appeal to adversariness as implying a law of the jungle: "You put up your best story, and you, defendant, do the same. We'll pick the better one."

The lack of theory permeates RP. First, by another fiat, this time in defiance of the law, it repeals the requirement of a standard of proof, at least in any traditional sense. No longer must the case be, say, more likely than not. The plaintiff's story need only be the better of two. That is, RP does not try to explain what the law meant when it articulated a standard of proof; RP is preaching that we should ignore what the law says and instead apply an invented test that gives good results.

¹⁴⁸ See Allen & Pardo, *supra* note 117, at 30–31 (asserting holism is the prevailing practice); Simon, *Thin Empirics*, *supra* note 30, at 86–87 (giving three reasons to beware of holistic factfinding).

¹⁴⁹ See Allen & Pardo, *supra* note 117, at 6 n.1 (claiming that abduction provides the theory's "epistemological foundation"). Those authors simply declare: "Abduction, in other words, is the process by which legal fact-finders arrive at probabilistic—i.e., inductive, non-demonstrative—conclusions." *Id.* at 20–21. That formulation of abduction has no support in the literature. It seems instead to refer to abductive validation, that is, some technique like IBE, to select among the explanations that abduction has yielded. So, RP's reliance on abduction adds nothing beyond its relying on IBE.

¹⁵⁰ See Ronald J. Allen & Michael S. Pardo, *Probability, Explanation and Inference: A Reply*, 11 INT'L J. EVIDENCE & PROOF 307, 314–17 (2007) (defending their IBE approach in a way that pares it back into a form consistent with bare RP); Laudan, *supra* note 78, at 297–305 (demonstrating that, in any event, IBE holds little promise of explaining or illuminating the standards of proof).

¹⁵¹ See Dale A. Nance, *Naturalized Epistemology and the Critique of Evidence Theory*, 87 VA. L. REV. 1551, 1575 (2001) (criticizing that "the relative plausibility theory is stated in terms of *stories advanced by the parties*").

Second, a final fiat dictates that factfinders should simply ignore probabilities. RP does nothing about the paradoxes or puzzles of traditional probability, like conjunction. RP accepts them as facts of life¹⁵² and then sweeps them under the rug.¹⁵³ True, if the factfinder just compares stories, any oddity concerning the necessary likelihood of the elements disappears, but only from view.¹⁵⁴

Beyond a lack of theory that necessitates resort to fiat, RP presents a host of related practical problems.¹⁵⁵ Most seriously, it contradicts the law in a couple of ways. First, it ignores the law stated in judicial instructions. It does not contemplate going element-by-element. It tells the factfinder to create holistic stories and compare them.¹⁵⁶ Second, it might force the defendant to be much more active than the law requires. It appears to compel the defendant, at least as a practical matter, to formulate a competing version of the truth. The defendant seemingly loses the legal right to stand mute and still prevail.¹⁵⁷

¹⁵² See Ronald J. Allen, *The Declining Utility of Analyzing Burdens of Persuasion*, 48 SETON HALL L. REV. 995, 996, 997, 1004 (2018) (calling the paradox “a feature of the world”); Allen & Pardo, *supra* note 117, at 35 n.221, 39, 52 (same); Ronald J. Allen & Michael S. Pardo, *Clarifying Relative Plausibility: A Rejoinder*, 23 INT’L J. EVIDENCE & PROOF 205, 212, 213 n.26 (2019) (same).

¹⁵³ See Allen & Pardo, *supra* note 117, at 17–18 (“Rather than assessing A and B serially and attaching a probability to each, fact-finders evaluate whether the plaintiff’s explanation (which will include or entail A & B) is better than the defendant’s explanation (which will omit A or B, or both).”).

¹⁵⁴ See *id.* at 29 (“Under our account, however, the conjunction problem is avoided because the standard of proof applies to the case as a whole in evaluating explanations and is distributed to both parties.”). RP theorists think that they can avoid the paradox by simply comparing two whole stories. Yet, given their view of the product rule as a feature of life, and given the economic aim that conjunctive liability be more likely in fact than disjunctive nonliability, the plaintiff’s elements individually must have satisfied a much higher standard of proof for his conjoined story to satisfy the law’s standard of proof. Meanwhile, the defendant can aggregate the probabilities of all her alternative versions. That is, the defendant would enjoy the advantage of disjunctive proof, while the plaintiff would remain saddled with conjunction. RP’s refusing to ask for element-by-element likelihoods does not make the paradox disappear. That is just sticking one’s head in the sand.

¹⁵⁵ See Richard D. Friedman, “E” Is for Eclectic: Multiple Perspectives on Evidence, 87 VA. L. REV. 2046–47 (2001) (noting problems with RP).

¹⁵⁶ See Ronald J. Allen, *Standards of Proof and the Limits of Legal Analysis* 14 (Northwestern University School of Law, Public Law and Legal Theory Research Paper Series, May 3, 2011), <http://ssrn.com/abstract=1830344> [<http://perma.cc/AAR6-5X5W>] (acknowledging the inconsistencies between jury instructions and RP).

¹⁵⁷ See 2 MCCORMICK ON EVIDENCE, *supra* note 11, § 339, at 660–61 (explaining that because juries bring their own experiences, it is possible for a verdict to find for a defendant who offers nothing in opposition to the plaintiff’s evidence). Admittedly, RP’s burden on the defendant could conform to the law if RP allows that the defendant’s story could come solely from the factfinder’s forming its own disbelief

Moreover, it is not a flexible method, as also shown in a couple of ways. First, it comes with a fair amount of baggage.¹⁵⁸ It accepts the holistic processing of evidence, rather than formulating a standard of proof that can handle any view of the evidence regardless of the factfinder's processing method. Second, by calling for a head-to-head ordinal comparison of two stories, it has encountered minor difficulties with handling standards other than preponderance.¹⁵⁹

Finally, even after countless articles, it is an underexplained method. It gives little guidance as to how to choose which story is better. IBE at least confronts this problem, albeit with no definite conclusion.¹⁶⁰ RP instead depends on the unfortunate word "plausible." Is plausibility all that the law should ask for? Even accepting "more plausible" as the test, what does it mean? How does it work when, say, the plaintiff's story is strong on all but one element? Resorting to probabilities just for illustration, imagine the plaintiff's story is 51%, 51%, 51%, and 40% on four elements, and the defendant's

of the plaintiff's story. See Allen & Pardo, *supra* note 117, at 21–24 (arguing, in their latest version, that the defendant's burden is no more burdensome than this).

¹⁵⁸ See Craig R. Callen, Commentary, *Kicking Rocks with Dr. Johnson: A Comment on Professor Allen's Theory*, 13 CARDOZO L. REV. 423, 432–39 (1991) (discussing some problems with RP).

¹⁵⁹ See Friedman, *supra* note 155, at 2047 ("Therefore, Allen has previously recognized that the concept of cardinality must come into play."); Laudan, *supra* note 78, at 303 ("Why IBE will not work as a standard of proof is that it aims to be a universal standard of credibility and not a context-specific measure of degree of proof."); cf. Allen, *supra* note 146, at 413 (attempting to explain the beyond-a-reasonable-doubt standard as not being satisfied if the factfinder "concludes that there is a plausible scenario consistent with innocence," while admitting that the clear-and-convincing standard is "troublesome" under his theory because it seems cardinal); Allen & Leiter, *supra* note 46, at 1528 (saying that the prosecution must "show that there is no plausible account of innocence"); Pardo, *supra* note 38, at 1829 (attempting to explain the clear-and-convincing standard as requiring that "the plaintiff's explanation must be clearly and convincingly better than the defendant's explanation"). For their latest iteration, see Allen & Pardo, *supra* note 117, at 16–17, 26–29.

¹⁶⁰ See Laudan, *supra* note 78, at 296 & n.13 (listing the variety of tests that theorists have forwarded); David A. Schum, *Species of Abductive Reasoning in Fact Investigation in Law*, 22 CARDOZO L. REV. 1645, 1659 (2001) ("[W]e may not have any settled criterion for saying what is the 'best' explanation."); cf. Amaya, *supra* note 135, at 138–46 (using a coherentist approach to evaluate the story); Floris Bex, *Analysing Stories Using Schemes*, in LEGAL EVIDENCE AND PROOF, *supra* note 29, at 93 (judging plausibility by how well the story fits a specific description of typical event structures). Lately, and not too helpfully, RP theorists have turned toward this inconclusive literature to suggest: "In general, explanations are evaluated based on criteria such as consistency, coverage, simplicity, coherence, consistency, and fit with background knowledge." Allen & Pardo, *supra* note 117, at 7 n.7; see *id.* at 16, 19 (admitting that there is no general recipe for ranking explanations).

story is 49%, 49%, 49%, and 60%. When the factfinder goes to compare the whole stories, which is more plausible?

C. Reconciliation of Models

Ironically, a theory to support RP does exist, and it resolves those problems of impracticality, inflexibility, and impenetrability. The solution lies in the multivalent-belief model. Unknowingly, RP theorists have formulated a fuzzy technique for dealing with more likely than not. RP thereby ends up as an overly specific statement of multivalent-belief theory. I can demonstrate this near equivalence either by showing how the multivalent-belief model can produce the more dialectical RP model or by showing how RP can generalize into multivalent beliefs.

First, consider how the multivalent-belief model works, using a civil case as the example. If the factfinder goes element-by-element, a plaintiff's win means that each element in the claim is more likely than not, in the sense that the fuzzy belief in the element exceeds the fuzzy disbelief. By the MIN rule, the conjunction of elements is also more likely than not. By the MAX rule for disjunction, the likelihood of any of all the contesting stories being true is the likelihood of the strongest disbelief of any one element. But we already know that for a victorious plaintiff, each and every element is more likely than not. Accordingly, the plaintiff's conjoined story is more likely than the disjunction of all the contesting stories. And if that is so, the plaintiff's conjoined story is more likely than the defendant's best story. Therefore, if the plaintiff prevails under the multivalent-belief model, it prevails under RP.

Second, going the other way is a little tougher, because RP is bereft of theory. Assume that the best story constructible for the plaintiff is "better" than the best story constructible for the defendant, whether the latter is a single story or embodies alternative versions. The most sensible meaning of "better," I posit, is that the degree of belief in the conjoined elements of the plaintiff's best story exceeds the degree of belief in the disjoined denials by the defendant. By the MIN and MAX rules, this inequality means that the weakest element of the plaintiff's story is more likely than the strongest element of any contesting story. If that is so, then every element of the plaintiff's story is more likely than the corresponding element of any contesting story. Therefore, if the plaintiff prevails under RP, it prevails under the multivalent-belief model.

In other words, RP requires the plaintiff to formulate his best explanation, which is as likely as its weakest link. The defendant can offer her best explanation, or just rely on denial of some or all elements, with her best explanation being as likely as its strongest link. RP theorists provide no justification for comparing just the two, but instead unknowingly rely on the MIN and MAX rules of fuzzy logic.¹⁶¹ If the fuzzy belief in the plaintiff's version is greater than the fuzzy belief in her position, then it does make sense to call it better. Indeed, by the MIN and MAX rules, the plaintiff's story is superior to all competing accounts. So, one does not have to consider all competing accounts, but can decide that the plaintiff's story is better after focusing on only the defendant's single best version.¹⁶²

In sum, asking whether the degree of belief in each element of the plaintiff's claim exceeds the corresponding degree of disbelief is equivalent in effect to comparing the plaintiff's and the defendant's single best stories constructible out of the allegations and the evidence. The latter approach is cheered by RP theorists because of its practical advantages, such as conforming to how adversarial lawyers talk about their cases. But the convergence of the two methods means that the multivalent-belief model can likewise claim all those practical advantages, as it too can speak in terms of comparing best stories. The difference is that only the multivalent-belief model has a firm theoretical foundation.¹⁶³

¹⁶¹ The closest they get to acknowledging this reliance is their confusingly, and I think wrongly, noting that, "of course, the most probable explanation supporting each side will be the disjunction of all possible explanations supporting that side (it will be at least as probable as any single disjunct or subset)." Allen & Pardo, *supra* note 117, at 26. In fact, they full-throatedly criticize the multivalent-belief model. See Allen, *supra* note 152, at 1003–14; Allen & Pardo, *supra* note 117, at 49–58; Pardo, *supra* note 116, at 275–78. *But see* Clermont, *Common Sense*, *supra* note 23, at 1074 n.43 (rebuttal); Kevin M. Clermont, *The Silliness of Magical Realism*, 23 INT'L J. EVIDENCE & PROOF 147 (2019) (same).

¹⁶² Another route exists to justify looking at only the defendant's single best version. Under "ranking theory," looking at defendant's single best version allows ignoring all other defendant versions. But accepting ranking theory works out to be the equivalent of accepting multivalent beliefs. See Huber, *supra* note 53, at 16–20 (comparing belief function theory and ranking theory); Wolfgang Spohn, *A Survey of Ranking Theory*, in DEGREES OF BELIEF, *supra* note 22, at 185 (giving a good general treatment of ranking theory).

¹⁶³ Another radical reconception that ends up very near to the multivalent-belief model emerges from DALE A. NANCE, *THE BURDENS OF PROOF* 1–14 (2016) (arguing for adding a measure of Keynesian weight, which turns on the completeness of evidence, to the usual standards of proof that look to the discriminatory power of the evidence). His book speaks in terms of probabilities and accepts the conjunction paradox as a problem. See *id.* at 74–78. But since then Professor Nance has taken to speaking in terms of belief functions rather than probabilities. See Nance, *supra* note 75, at 30 ("It is understandable for legal theorists to

III

PLAINTIFF/DEFENDANT ASYMMETRIES

I cannot conclude that radical reconception and reform of the standards of proof are unnecessary simply because the multivalent-belief model avoids the difficulties of traditional probability theory in producing accurate results. Other theorists attack the law's standards on the grounds of fundamental fairness as a process value. They argue that the playing field is not level. Plaintiffs have to prove a string of elements, while defendants can succeed by disproving only one, so creating an asymmetry. Even if criminal cases are supposed to be uneven contests, this asymmetry seems unfair in civil cases.¹⁶⁴

The key to meeting this argument is to accept the just-developed idea that the multivalent-belief model requires that plaintiff's best story be more likely than the defendant's best story constructible out of the allegations and the evidence. From this vantage point, one can see that the plaintiff and the defendant are on a level playing field after all.

A. Three Supposed Asymmetries

Even putting accuracy problems aside, plaintiff/defendant asymmetries appear to undermine fairness. Basically, defendants seem much better positioned than plaintiffs. Some might

attempt to make use of Shafer's theory and its willingness to embrace non-Bayesian belief functions."). And he has lately used fuzzy logic's progeny in the form of possibility theory to resolve the conjunction paradox. *See* Nance, *supra* note 66, at 1036 ("If one thinks of *A* and *B* as the elements of the claim, *C*, then [possibility theory's MIN rule] provides a potential solution to the so-called conjunction paradox [W]hether that standard [of proof] has been met as to the claim, *C*, can be determined entirely by assessing whether it has been met as to each of *A* and *B*."). The minor remaining difference from my theoretical outlook lies in his distaste for my formulations of the higher standards of proof, which he would define in terms of ratios of *Bel(a)* to *Bel(not-a)*. *See* Nance, *supra* note 75, at 15–20, 28–29; *cf.* *supra* note 80 (rejecting ratios as standards of proof). (His radical reform further invents a separate role for the judicial gatekeeper, who would stop a case from going to factfinding unless, foggily, the completeness of evidence "has been practically optimized by the parties' presentation." Nance, *supra* note 75, at 28. I would deal with that concern, as the law does, by the factfinder's taking any evidential inadequacies into account in forming beliefs and disbeliefs and by the judge's applying the usual tests for judgment as a matter of law, judicial notice, and like procedures. *See supra* text accompanying notes 12, 71 & 113 (discussing reasonable-possibility threshold, evidential defects, and initial burden of production, respectively).)

¹⁶⁴ On the importance of equality to procedural justice, see Mike Redmayne, *Standards of Proof in Civil Litigation*, 62 MOD. L. REV. 167, 171–74 (1999); Lawrence B. Solum, *Procedural Justice*, 78 S. CAL. L. REV. 181, 286–89 (2004).

argue that this is how things should be.¹⁶⁵ But approving a pronounced bias should await proving that the bias even exists.

First among the asymmetries, there is the philosopher's version of probability's problem of infinite alternatives. I have already alluded to Hume's problem with induction.¹⁶⁶ Accumulating observations can fortify a hypothesis, but fortification can never arrive at the point of proven certainty; meanwhile, a single observation can effectively falsify the hypothesis.¹⁶⁷ This situation seems to create an asymmetry between proof and disproof. The plaintiff faces a Sisyphean task, while the defendant goes for a walk in the park.

Second, the logician's version of conjunction paradox arises from the realization that the plaintiff must prove each of several elements, while the defendant need disprove only one. If the plaintiff fails to show any one element, he loses. If the defendant can succeed on any one element, she wins. Thus, the defendant can push many different possibilities, while the plaintiff is less likely to succeed in backing a consistent story that embraces all the elements.

Third, the related lawyer's idea, developed elegantly in a recent article, holds that any rate of adjudicative error, even if random and unbiased, will hurt plaintiffs and help defendants.¹⁶⁸ "As a result, the plaintiff's chances of losing the case undeservedly are much higher than the defendant's."¹⁶⁹ The authors contend that because a single denial (or a single affirmative defense) will defeat the plaintiff who must prove a

¹⁶⁵ See Levmore, *supra* note 117, at 733 ("[S]ome observers (and perhaps jurors and judges) will be comfortable with a decision in favor of liability because of the intuition that making negligent parties pay 'too much' is harmless or even healthy."); Alex Stein, *Of Two Wrongs That Make a Right: Two Paradoxes of the Evidence Law and Their Combined Economic Justification*, 79 TEX. L. REV. 1199, 1199–234 (2001) (justifying the suppression of the product rule on deterrence grounds).

¹⁶⁶ See *supra* text accompanying note 44 (discussing the "problem with induction").

¹⁶⁷ See 7 ALBERT EINSTEIN, *Induction and Deduction in Physics*, in THE COLLECTED PAPERS OF ALBERT EINSTEIN 108, 109 (2002) ("Thus, a theory can very well be found to be incorrect . . . if a fact is not in consonance with one of its conclusions. But *the truth* of a theory can never be proven."). A related idea here, but one not pertinent to standards of proof, is Karl Popper's falsifiability: a statement, hypothesis, or theory has falsifiability (or refutability or testability) only if showing it to be false by observation is conceivable. See Stephen Thornton, *Karl Popper*, in STANFORD ENCYCLOPEDIA OF PHILOSOPHY § 2 (Edward N. Zalta ed., 2016), <https://plato.stanford.edu/entries/popper/> [<https://perma.cc/2BNZ-HW8U>] (situating falsifiability in Popper's thought).

¹⁶⁸ Jef De Mot & Alex Stein, *Talking Points*, 2015 U. ILL. L. REV. 1259, 1261.

¹⁶⁹ *Id.*

string of elements, one unfavorable mistake in factfinding will be fatal to the deserving plaintiff but not to the deserving defendant. The defendant can exploit this asymmetrical risk of error by forcing the plaintiff to settle below true value. The authors propose three shocking reforms to level the playing field: limiting defendants to a single defense for each cause of action; introducing a damage multiplier for plaintiffs who prevail at trial; or fixing all tort and contract damages at a fraction corresponding to the party's comparative fault.¹⁷⁰ To me, the extremist nature of their proposed cures imply error in their diagnosis of disease.

B. Resolution of Asymmetries

The three asymmetries stem from quite similar roots. One observation resolves all three: the plaintiff need show only that his theory of the case is better than the defendant's single best theory. When the factfinder compares best stories, it is looking at all the elements of the defendant's best story, just as it is looking at all the elements of the plaintiff's best story. Therefore, the plaintiff and the defendant remain on a level playing field.

This resolution of asymmetries should not be surprising. An uneven playing field would result in serious bias as well as inefficiency. It is hard to imagine that our legal system could have survived for hundreds of years if it produced skewed results with consistency. The law should have evolved, and it did, toward producing optimal results.¹⁷¹ Likewise astounding, why would commentators and parties have waited centuries to notice such stark injustices?¹⁷² In fact, the commentators today cannot even agree on who has the advantage. Some stress the load on the plaintiff to prove a string of elements.¹⁷³ But others

¹⁷⁰ See *id.* at 1276–85 (sketching proposed reforms).

¹⁷¹ Cf. THOMAS J. MICELI, CONTEMPORARY ISSUES IN LAW AND ECONOMICS 21–27 (2018) (discussing the theory of the common law's efficiency); RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW § 21.7 (8th ed. 2011) (similar).

¹⁷² The earliest known observation of the conjunction paradox lies in the innovative JEROME MICHAEL & MORTIMER J. ADLER, THE NATURE OF JUDICIAL PROOF 140–43 (1931). The supposed disparate effect of error lay undiscovered until 2015's De Mot & Stein, *supra* note 168, at 1263 (saying that their article “is the first to identify this bias”).

¹⁷³ See David A. Moran, *Jury Uncertainty, Elemental Independence and the Conjunction Paradox: A Response to Allen and Jehl*, 2003 MICH. ST. L. REV. 945, 946–47, 950 (“Anyone who has ever litigated a real case knows the exact opposite of the conjunction paradox is true: the more disputed elements the plaintiff has to prove, the less likely the plaintiff is to prevail . . . [because] the jury will find at least one element to be less likely than not.”).

say the proponent benefits from how the ancients (and moderns) divided our causes of action (and defenses) into elements: the more subdivisions, the lower the conjunctive probability that suffices for victory.¹⁷⁴

First, considering the three asymmetries, the standard of proof puts an equal burden on plaintiff and defendant, if one puts the burden of persuasion aside. The plaintiff need not deliver certain truth, so Hume's problem with induction is no problem for legal trials.¹⁷⁵ The defendant faces a task similar to the plaintiff's. Each has the task of comparatively winning the factfinder's belief.

Second, because the standard of proof is equivalent to comparing the parties' best stories, the criticality of the elements disappears.¹⁷⁶ The plaintiff must show that his story is more likely than not, and the defendant depends on that story not being more likely. Their tasks are comparable.

Third, there is no disparate risk of error in the battle of best stories. An error in favor of the plaintiff while judging the plaintiff's whole story is as likely as an error in favor of the defendant, so that the error could defeat the defendant as easily as it could defeat the plaintiff. Thus, I can put my argument simply: Once one perceives that the trial process asks whom the factfinder believes more, rather than asking for the multiplicative odds of a hypothetical revelation of truth, one can sense that the playing field has leveled out.

The factfinder can, but need not, go element-by-element, deciding whether the defendant wins on this point and, if not, whether the defendant wins on the next point, and so on through all the points. But by operation of the MIN and MAX rules, the fight between the plaintiff's position and all the defendant's possible positions, however fought, comes down to a single question: is the plaintiff's weakest link stronger than the defendant's showing on that element? The field of engagement at any one time will be on one element. An error could affect that element. The error might weaken the defendant's showing on the element or, just as easily, might weaken the plaintiff's showing. The playing field is level.

¹⁷⁴ See James A. Henderson, Jr., Fred Bertram & Michael J. Töke, *Optimal Issue Separation in Modern Products Liability Litigation*, 73 TEX. L. REV. 1653, 1655–59, 1667–75 (1995) (discussing “substantive issue separation” and its procedural treatment).

¹⁷⁵ See *supra* text accompanying note 45 (“Yet this situation causes the law no worry because the law does not seek or demand complete truth or knowledge.”).

¹⁷⁶ See *supra* note 118 (discussing “element”).

The usual comeback to my view is that adopting a fuzzy logic outlook cannot change the world. Because fuzzy logic is just another language for talking about likelihood, it can never change the reality it describes. For example, in the third asymmetry, the argument would be that a compound gamble (where the defendant has multiple grounds on which to win) is riskier for the plaintiff than a single-event gamble, and switching to fuzzy logic will not change those betting odds.¹⁷⁷ Of course I agree. The reality is the same, and the betting odds remain the same.

Within that reality, however, one can look at different aspects of reality. The law is looking at a different aspect of reality than is the bettor. The law looks at which side's position is more believable, rather than at the compound betting odds on a string of guesses for each of which all views were committed fully between true and false. The reason the law looks at comparative beliefs, not compound bets, is that it wants factfinders to hold all the different kinds of uncertainty in mind when combining their findings. Traditional probability ignores epistemic ignorance resulting from imperfect evidence and ignores epistemic indeterminacy resulting from vagueness, but multivalent beliefs retain a measure for epistemic uncertainties in the form of uncommitted belief. The law will therefore dictate looking at multivalent beliefs whenever, for the sake of accuracy, a decisionmaker needs to keep track of epistemic uncertainties in addition to any aleatory uncertainty.

To sum up, let me return to my early contention that the two measures of degree of belief and probability of truth really do differ.¹⁷⁸ First, as to the mere existence of differences, based

¹⁷⁷ See E-mail from Alex Stein, Professor of Law, Brooklyn Law School, to author (June 23, 2018, 17:49 EST) (on file with author) (“[W]ith everything else being equal, a compound gamble is always riskier than a single-event gamble, and stating those gambles as fuzzy probabilities won’t change anything. Looking into current sporting events, I surely have a better chance to be right in predicting that the German soccer team will beat South Korea on Wednesday than in saying this, plus, that Mexico and Sweden will draw. How can any fuzzy or other conceptualization of probability make it different? And if I am right here, then I don’t see how the plaintiff’s compound gamble in my article differs from this one. You can use the fuzzy sets theory to reason about probabilities, but it can’t change the underlying reality”); cf. Allen & Pardo, *supra* note 117, at 51 (“There are four major problems with Clermont’s application of fuzzy set theory to juridical proof. The first is that changing one’s theory of probability does not change the world or one’s knowledge of the world.”). *But see The Affair: 406* (Showtime television broadcast July 22, 2018) (Helen explaining to Alison that Californians believe that “you can manifest your reality,” the idea being that “if there’s something in your life you want to change, you just need to think differently and it will change”).

¹⁷⁸ See *supra* text accompanying note 62 (introducing that contention).

on the allocation of uncertainty, there can be little logical dispute by now. Second, there is no mathematical doubt that if the factfinder is thinking in terms of degrees of belief, or fuzzy beliefs, then rules like MIN and MAX govern how to combine beliefs. Third, thinking in those terms and applying those rules clarify how the standards of proof should operate and so bring along many practical benefits, such as avoiding the logical difficulties of probabilities and quashing misguided “reforms” of asymmetry. Although it would be conceivable for the law to ask its factfinders to judge the probability of truth, asking them that question would be very undesirable as a policy matter. The law has been wise to ask its factfinders to adjudge their degrees of belief instead. That, then, is my message: the law has followed good policy in asking factfinders for beliefs rather than for odds.¹⁷⁹

CONCLUSION

The pieces have fallen into place. The traditional probability model raises all sorts of difficulties. The difficulties are so many, indeed, that one should wonder why the whole supposedly skewed proof process has not collapsed of its own weight. Yet from the vantage of multivalent belief, the difficulties all vanish. They turn out to be illusions produced by the academics’ faulty probabilistic premises.

The Article’s first part explained that the standard of proof calls for the factfinder to evaluate the evidence by comparing its degree of belief in the proponent’s position with its degree of contradictory disbelief. The factfinder should disregard its uncommitted belief, except under the criminal standard of proof beyond a reasonable doubt. Under preponderance, the proponent prevails if $Bel(a) > Bel(not-a)$, with no need to show that $Bel(a) > 0.50$. This multivalent-belief model does not encounter those paradoxes, puzzles, and problems that plague the traditional probability model.

The second part argued that without the prod of the traditional probability model’s deficiencies, no radical reconception or reform of the standards of proof is necessary. In particular, the method of inference to the best explanation is inapplicable to legal factfinding. And its offshoot of relative plausibility turns out to be an obscurely rewritten version of the multivalent-belief model shorn of theoretical justification.

¹⁷⁹ See *supra* text accompanying note 114 (developing that policy argument).

The third part demonstrated that viewing the standard of proof as a comparison of belief and disbelief puts the plaintiff and defendant on a level playing field. That the plaintiff must prove a whole series of elements, while the defendant needs to disprove only one, is not actually an asymmetry. While the plaintiff must prove that the degree of belief in its story meets the standard of proof, the defendant prevails if the degree of disbelief in that story is sufficiently strong. The standard of proof puts an equal burden on plaintiff and defendant.

Why is all this important? This Article has shown that the standards of proof, properly understood without a probabilistic overlay, present no critical theoretical problems and produce desirable results. The multivalent-belief model clarifies that the standards of proof involve comparing degrees of belief in the truth, and not calculating the odds of a truth to be miraculously revealed. However the human factfinder processes the evidence, whether element-by-element or by the story method, the standards of proof will then logically work toward error-cost minimization and fairness. None of this is to say that one must carry all this multivalent theory around in one's head. To apply the standards, the factfinder need only listen to the judicial instructions. In a reassuring conclusion on factfinding, the common law has evolved over the centuries toward wisdom.