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JURIDICAL PROOF AND THE BEST EXPLANATION

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In many areas of life, from hard science to managing one's everyday affairs, explanatory considerations help to guide inference. From the fact that some proposition would explain a given phenomenon we infer that the proposition is true. And when several propositions may explain a given phenomenon we infer the one that best explains it. Quantum mechanics best explains sub-atomic phenomena; evolutionary theory best explains species variations; that George Washington existed best explains the historical record concerning him; and that the Cubs won yesterday best explains why today's newspaper reports that they did. These inferences all share the same structure, typically referred to as ''abduction'' or ''inference to

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the best explanation."[1] Because legal proof falls somewhere between science and managing one's everyday affairs, it should perhaps not be surprising that the juridical proof process involves similar inferential practices.

Although juridical proof involves these inferential practices, much theorizing about the law of evidence and the proof process has focused attention elsewhere, primarily on probability theories in general and Bayesian decision theory in particular.[2] This theorizing has been helpful in understanding the process,

[1] The classic article coining the phrase and explaining the idea is Gilbert Harman, 'The Inference to the Best Explanation,' *Philosophical Review* 74 (1965): 88–95;see also Peter Lipton, *Inference to the Best Explanation* (London: Routledge, 2004); William G. Lycan, *Judgment and Justification* (Cambridge University Press, 1988); Paul R. Thagard, 'Evaluating Explanations in Law, Science, and Everyday Life,' *Current Directions in Psychological Science* 15 (2006): 141–45; Brian Leiter, 'Moral Facts and Best Explanations,' *Social Philosophy & Policy* (2001): 79–101; Timothy Day and Harold Kincaid, 'Putting Inference to the Best Explanation in its Place,' *Synthese* 98 (1994): 271–95; Yemima Ben-Menahem, 'The Inference to the Best Explanation,' *Erkenntnis* 33 (1990): 209–24; Paul R. Thagard, 'The Best Explanation: Criteria for Theory Choice,' *Journal of Philosophy* 75 (1978): 76–92.

[2] For recent examples see Dale A. Nance and Scott B. Morris, 'Juror Understanding of DNA Evidence: An Empirical Assessment of Presentation Formats for Trace Evidence with a Relatively Small Random-Match Probability,' *Journal of Legal Studies* 34 (2005): 395; Michael O. Finkelstein and Bruce Levin, 'On the Probative Value of Evidence from a Screening Search,' *Jurimetrics Journal* 43 (2003): 265–266; Deborah Davis and William C. Follette, 'Toward an Empirical Approach to Evidentiary Ruling,' 27 *Law and Human Behavior* 27 (2003): 661; Richard D. Friedman and Roger C. Park, 'Sometimes What Everybody Thinks They Know is True,' 27 *Law and Human Behavior* 27 (2003): 629; Deborah Davis and William C. Follette, 'Rethinking the Probative Value of Evidence: Base Rates, Intuitive Profiling, and the "Postdiction" of Behavior,' *Law and Human Behavior* 27 (2002): 133, 156; Dale A. Nance and Scott B. Morris, 'An Empirical Assessment of Presentation Formats for Trace Evidence with a Relatively Large and Quantifiable Random Match Probability,' *Jurimetrics Journal* 42 (2002): 403. For earlier examples see John Kaplan, 'Decision Theory and the Factfinding Process,' *Stanford Law Review* 20 (1968): 1065; Michael Finkelstein and William Fairley, 'A Bayesian Approach to Identification Evidence,' *Harvard Law Review* 83 (1970): 489; Richard Lempert, 'Modeling Relevance,' *Michigan Law Review* 75 (1977): 1021; Richard D. Friedman, 'Route Analysis of Credibility and Hearsay,' *Yale Law Journal* 96 (1987): 667; Peter Tillers and David A. Schum, 'Hearsay Logic,' *Minnesota Law Review* 76 (1992): 813.

but the relative neglect of explanation-based reasoning has been a mistake.[3] Or so we contend.[4] In this essay, we attempt to correct this neglect and to demonstrate that the process of inference to the best explanation itself best explains both the macro-structure of proof at trial and the micro-level issues regarding the relevance and value of particular items of evidence. Indeed, as we also attempt to show, the probability-based accounts, rather than being an alternative, are parasitic on the more fundamental explanation-based considerations. To the extent the former take into account and attempt to supplement the latter, they may be helpful; to the extent they ignore such explanatory considerations, they risk mismodeling the process. Even if inference to the best explanation offers a more descriptively accurate account than the probability approach, "too bad for current practices; we are offering normative advice," might be the response from proponents of the probability approach. But, here too, a neglect of explanatory considerations would be a mistake; inferences based on explanatory considerations may be justified as well, indeed more so than the conclusions generated by a probability approach.

This debate over the nature of juridical proof involves significant theoretical implications. But the debate is not merely

[3] The neglect we are referring to do concerns analytical attempts to illuminate the nature of various aspects of the proof process. Empirical studies of jury behavior, by contrast, have focused on explanatory-based reasoning, and they have concluded that jurors do indeed rely primarily on explanatory criteria in deciding cases. See Nancy Pennington and Reid Hastie, 'A Cognitive Model of Juror Decision Making: The Story Model,' *Cardozo Law Review* 13 (1991): 519. Thus our discussion has the salutary effect of bring these two areas closer together. For discussions of abductive reasoning in the law see David A. Schum, 'Species of Abductive Reasoning in Fact Investigation in Law,' *Cardozo Law Review* 22 (2001): 1645; see Kola Abimbola, 'Abductive Reasoning in Law: Taxonomy and Inference to the Best Explanation,' *Cardozo Law Review* 22 (2001): 1683; John R. Josephson, 'On the Proof Dynamics of Inference to the Best Explanation,' *Cardozo Law Review* 22 (2001) 1621.

[4] Limitations on probability-based approaches to explain the probative value of evidence are discussed in Ronald J. Allen and Michael S. Pardo, 'The Problematic Value of Mathematical Models of Evidence,' *Journal of Legal Studies* 36 (2007): 107.

academic. Significant and wide-ranging practical implications and consequences turn on it as well. Conclusions about the nature of legal evidence and the process of proof have implications for virtually every legal issue that requires the evaluation of individual items of evidence, bodies of evidence, or judgments in civil and criminal cases. We demonstrate how explanatory considerations provide a better account of micro-level proof issues regarding the relevance and probative value of evidence. This conclusion, in turn, carries wide-ranging consequences for the admissibility of all types of evidence, from testimony of first-hand observations to complex scientific evidence such as DNA to other kinds of statistical evidence. This conclusion also explains and justifies the open-ended nature of the evidence rules in this area.[5] We also demonstrate how explanatory considerations provide a better account of the burden-of-proof standards employed in civil and criminal trials such as preponderance of the evidence, clear and convincing evidence, and beyond a reasonable doubt. This conclusion, in turn, explains and justifies further aspects of the proof process such as the reliance on jurors and the existence of devices to control judgments based on the sufficiency of the evidence (such as summary judgments,[6] judgments as a matter of law,[7] and new trial motions[8] in civil cases and "sufficiency of the evidence" challenges in criminal cases.[9]) Although the primary focus of our explanation-based account will be descriptive and explanatory, we end our discussion by focusing on ways the account can guide and constrain judicial decision-making regarding admissibility and the evaluation of evidence to support verdicts and judgments and also juror decision-making through instructions.

Part I provides a basic account of the abductive reasoning process of inference to the best explanation, and it then explains

[5] See Fed. R. Evid. 401, 403.

[6] See Fed. R. Civ. P. 56.

[7] See Fed. R. Civ. P. 50.

[8] See Fed. R. Civ. P. 50(b).

[9] See Fed. R. Crim P. 29; see also Jackson v. Virginia, 443 U.S. 307, 324 (1979) (articulating standard as whether "[n]o rational trier of fact could have found proof of guilt beyond a reasonable doubt.")

how the process applies to the legal proof process at both the macro- and micro-levels. Part II considers objections to the account provided in Part I from three different areas: (1) objections to IBE from philosophy of science, which are shown to be inapplicable to the law; (2) general objections to IBE, which are shown to be either irrelevant or mistaken as applied to law; and, most importantly, (3) possible law-specific objections to the IBE from probability approaches, which are also shown to be mistaken, along with additional defects in the probability approaches that the explanation-based account avoids. Part III discusses in detail the theoretical and practical implications outlined in the previous paragraph that flow from our account.

I. INFERENCE TO THE BEST EXPLANATION

Inferences may be deductive or inductive. If the premises of deductive inferences are true, the conclusions are guaranteed to be true as well.[10] Rarely, if ever, however, will the material inferences at trial involve deductive inferences from uncontested premises.[11] Inductive inferences are "non-demonstrative" in the sense that even if the premises are true, the truth of the conclusion is not guaranteed (or cannot be conclusively demonstrated). If the defendant confessed, and if her fingerprints were found at the crime scene, it may make it likely[12] that she committed the crime but it does not guarantee so. It is at least possible that she confessed and was at the scene for other

[10] If all men are mortal, and if Socrates is a man, then Socrates is mortal.

[11] But various aspects of the process may involve deductions once the jury finds certain propositions to be true. For example, if a jury is told that the defendant was negligent if he drove through a red light, and the jury finds that the defendant did indeed drive through a red light, then they will (or ought) to deduce that the defendant was negligent.

[12] The fact that such conclusions are not guaranteed, but may be seen as more or less likely, is what invites probability-based approaches to the legal process, as it does in other areas. See generally *Probability is the Very Guide of Life: The Philosophical Uses of Chance* (Henry E. Kyburg, Jr. and Marian Thalos eds.) (Peru, Ill.: Open Court Press, 2003).

reasons. The juridical proof process primarily involves inductive inferences, in the broad, non-demonstrative sense.

Inductive inferences themselves come in two varieties. First, some inductive inferences may be described as simple or "enumerative" induction. From the fact that each raven one has observed has been black, one infers that the next one will be black as well; from the fact that the sun has come up each day in the past, one infers that it will come up tomorrow. This pattern of inference is what Peter Lipton has called the "more of the same" principle.[13] By contrast, some inferences may be referred to as "abductive." Abduction involves inferring a conclusion that would explain the given premises. The common variety is a causal explanation[14]—one infers from a given effect (the premise) to a causal proposition (the conclusion) that would explain, or best explain, that effect. From the fact that the defendant's DNA was found at the crime scene, one infers that the defendant was there at some time in the past. Like enumerative induction, the conclusion is not guaranteed; even if highly likely, it might be false (someone could have planted the defendant's DNA). The pattern of inference at trial is primarily abductive rather than enumerative.[15] We turn next to a description of the general features of the abductive process of inference to the best explanation (sometimes abbreviated as "IBE"), and then to how this process best explains the proof

[13] Peter Lipton, supra note 1 at 9. Enumerative induction may also involve inferences to general conclusions, e.g., that all or most As are B.

[14] But it need not be–one may infer, for example, mathematical, definitional, conceptual, or grammatical explanations of given premises.

[15] Inductive inferences may often be recast either as abductive or enumerative. Gilbert Harman has suggested that all inductive inferences involve abduction. Harman, supra note 1 at 88–95. Richard Fumerton, by contrast, has argued that all abduction may be described as an enumerative inference. R. A. Fumerton, 'Induction and Reasoning to the Best Explanation,' *Philosophy of Science* 47 (1980): 589–600. Consider a fact finder's inference from the fact that the defendant confessed to the conclusion that the defendant is guilty. This inference could be explicated as abductive (that the defendant is guilty best explains why he confessed) or as enumerative (most people in the past who have confessed have been guilty; therefore, the defendant is likely guilty as well).

process at trial (both the proof of cases as a whole and the value of particular items of evidence).

A. Explanation as a Guide to Inference

To say that one infers the best explanation of a body of evidence to be true—whether in science, law, or everyday affairs—is not just to say that one infers the likeliest hypothesis or conclusion. This would be an uncontroversial thesis, but it would fail to illuminate the role played by explanations. Rather, explanations occur prior to and guide inference in the sense that explanatory considerations help to determine how likely one judges particular hypotheses or conclusions to be, and "it is for this reason that inference can be a good that explanation delivers."[16]

This process occurs in two steps: generating potential explanations of the evidence and then selecting the best explanation from the list of potential ones as an actual explanation or as the truth. Practical considerations and interests affect both steps. The domain of the inferential task will provide guidance and constraints with regard to what counts as a potential explanation.[17] This is clear in the legal context, where the substantive law determines what conduct triggers liability and hence what potential explanations to look for (e.g., did the defendant cause the plaintiff's injury). In other domains, the

[16] Peter Lipton, 'What Good is an Explanation?,' in *Explanation: Theoretical Approaches and Explanations* 56 (G. Hon and S.S. Rakover eds.) (Norwell, MA and Dordrecht: Kluwer Academic Publishers, 2001); see also Peter Lipton, 'Is Explanation a Guide to Inference?,' in *Explanation: Theoretical Approaches and Explanations* 93 (G. Hon and S.S. Rakover eds.) (Norwell, MA and Dordrecht: Kluwer Academic Publishers, 2001) ("we sometimes decide how likely a hypothesis is to be correct in part by considering how good an explanation it would provide, if it were correct.").

[17] More generally, we do not rely on any precise definition of "explanation." It is a concept of which we assume most readers have at least a basic intuitive grasp. Explanations function by answering questions such as why, what, when, where, how, and so on. For more sophisticated accounts see Peter Achinstein, *The Nature of Explanation* 74–102 (Oxford University Press, 1983); Bas C. van Fraassen, *The Scientific Image* 134–57 (Oxford University Press, 1980).

disciplines themselves may limit what counts as a potential explanation; what counts as potential explanations for the chemist may not count for the sociologist or the literary theorist, and vice versa, even if they are all trying to explain the same phenomenon. Beyond these practical considerations, however, the list of potential explanations is generally (and maybe always) limited only by the creativity of those involved.[18]

The second step, choosing among potential explanations, also varies with context and interests. In general, however, philosophers have identified several criteria that help guide the choice among competing explanations. An explanation is, others things being equal, better to the extent that it is consistent, simpler,[19] explains more and different types of facts (consilience), better accords with background beliefs (coherence), is less ad hoc, and so on; and is worse to extent it betrays these criteria.[20] There is no formula for combining such criteria; rather, each criterion is a standard which must be weighed against the others.[21] Again, practical considerations will drive this process; the scientist may be more concerned with consilience—explaining a large variety of different types of facts, without making assumptions with narrow application

[18] For a discussion of the ways abductive reasoning aids in generating hypotheses see David A. Schum, 'Species of Abductive Reasoning in Fact Investigation in Law,' *Cardozo Law Review* 22 (2001): 1645.

[19] One reason a simpler explanation may be more likely is that more complex explanations involve more auxiliary premises and background assumptions and, therefore, more places to go wrong.

[20] Harman, supra note 1; Paul R. Thagard, 'The Best Explanation: Criteria for Theory Choice,' *Journal of Philosophy* 75 (1978): 76–92.

[21] There are spirited debates among philosophers of science over how precisely to define inference to the best explanation and precisely what its criteria are. Perhaps indicative of the differences between the treatment of IBE by the philosophers and its implications for the legal system, we are largely indifferent to these debates. The philosophers are engaged in conceptual analysis, and thus appropriately (we guess) argue over the "correct" definition of IBE; our concerns are intensely practical, and thus we are interested in what variables seem to matter to human decision makers and how well they work in juridical fact finding.

only—while the historian (and the jury even more so) may be more concerned with explaining a few events.[22]

This process of inferring the best explanation may be further illuminated by focusing on the contrastive nature of the explanations involved. Suppose one wants to explain what caused a certain event to occur—for example, why a man suffered terrible heartburn last night after eating a chili cheeseburger with extra jalapenos.[23] As first-year law students learn in torts and criminal law, events have many, many causes (from the big bang, to the man being born, to eating the chili cheeseburger with extra jalapenos). Where in the causal history of the event to look for an appropriate causal explanation will depend on one's inferential interests. For the man's wife, for instance, the decision to eat spicy food may qualify as a good explanation because the man may suffer heartburn only after eating spicy food. For the man's doctor, however, facts about the man's stomach or esophageal tract may qualify as a good explanation of the event because many of the doctor's other patients may eat spicy food without suffering any heartburn. The difference would have to do with the inferential interests of the wife and the doctor. The wife is interested in explaining why the man suffered heartburn *on this occasion* rather than on other occasions; the doctor is interested in explaining why *this man* suffered heartburn rather than other patients. The explanation in each case worked not just by picking a causal point

[22] See Edward O. Wilson, *Consilience: The Unity of Knowledge* (New York: Random House, 1998); Thagard, supra note 20.

[23] This example is based on one involving Adam, Eve, and an apple in Morton White, *A Philosophy of Culture: The Scope of Holistic Pragmatism* 89–90 (Princeton University Press, 2002), which in turn is based on one in H.L.A. Hart and A.M. Honore, *Causation in the Law* 33–34 (Oxford University Press, 1959).

but by picking one that contrasts it with an alternative possibility.[24] The explanations are good ones because the contrasts identified made a causal difference in the event's occurrence, and did so in a way that facilitated the inferential interests of the two agents.

These points generalize. Explanations do not explain evidence in its entirety; explanations explain aspects of evidence. Explanations rarely explain why A; they explain why A rather than B. The inferential interests at stake pick out the appropriate contrasts (or "foils")—whether we want to explain why A rather than B or why A rather than C (or D, etc.). Consider whether "the maid stole the necklace" provides a good explanation of the fact that the necklace was found in the maid's pocket. It might if the other evidence is clear that someone stole it (rather than, by contrast, it being misplaced, given away, or sold).[25] But suppose the dispute is not over who stole the necklace, but whether the necklace was in fact stolen (or, by contrast, was given as a gift to the maid). Now, "the maid stole the necklace" would no longer be as good of an explanation because it does not mark a difference relevant to the inferential interests at stake ("the maid received it as a gift" also potentially explains why it's in her pocket). The explanation was better, and hence an inference to it more likely, when the

[24] Lipton refers to alternative possibilities as "foils," supra note 1 at 33: "A contrastive phenomenon consists of a fact and a foil, and the same fact may have several different foils. We may not explain why the leaves turn yellow in November *simpliciter*, but only for example why they turn yellow in November rather than in January, or why they turn yellow in November rather than blue." In Lipton's example, the foils would be "leaves turn yellow in January" and "leaves turn blue in November." In the example in the text, foils would include "this man suffered heartburn on other occasions (when he did not)" and "other people suffered heartburn (when they did not)." A contrastive explanation works by identify why the facts occurred and these foils did not. See also id. ("When I ask my, then, 3-year old son why he threw his food on the floor, he told me that he was full. This may explain why he threw it on the floor rather than eating it, but I wanted to know why he threw it rather than leaving it on his plate.").

[25] But it might not if someone else could have easily planted it in the maid's pocket without her realizing it.

contrast was with someone else stealing it rather than with whether it was stolen.[26]

One final point about the basics of how explanation guides inferences: there appears to be a circularity in need of resolution. Explanations are "self-evidencing" in the sense that what is explained (the evidence) provides a reason for believing that the explanation is correct.[27] The circularity is that a hypothesis explains the evidence while the evidence helps to justify the hypothesis. This circularity, however, is not vicious or problematic; rather, it helps to illuminate how explanation can guide inference and is well supported by current scientific and everyday inferential practices.[28] Scientific hypotheses commonly are supported by the same observations they are supposed to explain. The law of gravity explains why everyday objects fall and the speed at which they do so; these observable events justify belief in the accuracy of the theory under ordinary conditions. Likewise, "the burglar broke the window to enter the apartment" may explain the broken window, and the broken window may justify the conclusion that this indeed is how the burglar entered. In guiding inferences, explanations are thus a tool used to acquire true beliefs or conclusions.

B. Explanation as a Guide to Inference at Trial

Here we describe in general how inference to the best explanation applies to the macro- and micro-level issues at trial.

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[26] Identifying an appropriate contrast may also help to locate the meaning of statements. See Fred I. Dretske, 'Contrastive Statements,' *Philosophical Review* 81 (1972): 411–437. "The maid stole the necklace" (rather than the butler) when asked "Who stole the necklace?" means something different than "The maid stole the necklace" (rather than received it as a gift) when asked "Why does the maid have the necklace?" Likewise, identifying appropriate contrasts also helps to locate the reasons that would support a proposition. For example (Dretske's), if one wanted to know why Clyde married Bertha, Clyde's reasons for *marrying* Bertha may not be the same as his reasons for marrying *Bertha*. Id. at 417.

[27] Lipton, *What Good is an Explanation?*, supra note 16 at 44.

[28] Id. at 44 ("Any account of understanding that rules them out is incorrect.").

Later sections consider objections and alternatives to IBE in general and its application to the process of juridical proof in particular.

The general structure of proof at trial instantiates the two-stage explanation-based inferential process discussed above. At the first stage, potential explanations are generated; at the second, an inference is made to one of the potential explanations on explanatory grounds. The work at the first stage is fairly straightforward and is left primarily to the parties (including the government in criminal cases), who must offer competing versions of events that, if true, would explain the evidence presented at trial. Parties with the burdens of proof on claims or defenses offer versions of events that include the formal elements that make up the particular claims or defenses; parties on the other side offer versions of events that fail to include one or more of the formal elements. In addition, parties may, when the law allows,[29] offer alternative versions of events to explain the evidence. Finally, fact-finders are not limited to the potential explanations explicitly put forward by the parties, but may construct their own, either in deliberation by suggesting them to fellow jurors or for themselves in reaching the conclusions they accept.[30]

Issues get more complicated, and controversial, at the second stage. In civil cases where the burden of persuasion is a preponderance of the evidence, proof depends on whether the best

[29] Parties may sometimes be precluded from offering contradictory accounts. See McCormick v. Kopman, 161 N.E. 2d 720 (Ill. App. Ct. 1959).

[30] Empirical evidence (and common sense) suggests that juries assume in most cases the parties have put forward the explanation that best helps their case. See Dale A. Nance, 'Naturalized Epistemology and the Critique of Evidence Theory,' *Virginia Law Review* 87 (2001): 1551, 1579 n. 91 (citing Robert H. Klonoff and Paul L. Colby, *Winning Jury Trials: Trial Tactics and Sponsorship Theory* (Lexis-Nexis, 1990)). But that will not always be the case, for example, when parties for personal reasons don't want to reveal what actually happened even when it may offer the best explanation of the evidence and benefit them at trial. For a vivid example, see Steve Bogira, *Courtroom 302: A year Behind the Scenes in an American Criminal Courthouse* 236–59 (New York: Knopf, 2005), recounting a story of a 16-year-old female defendant who never revealed a prior sexual relationship with the victim, a cab driver, whom she was convicted of shooting.

explanation of the evidence favors the plaintiff or the defendant.[31] Fact finders decide based on the relative plausibility of the versions of events put forth by the parties, and possibly additional ones constructed by themselves or fellow jurors.[32] As a general matter, fact finders infer the most plausible explanation as the actual explanation and find for the party that the substantive law supports based on this accepted version.[33] Empirical evidence has confirmed that jurors[34] formulate factual conclusions by constructing narrative versions of events to account for the evidence presented at trial based on criteria such as coherence, completeness, and uniqueness.[35] This process proceeds on explanatory grounds—jurors construct narratives to explain the evidence and choose among alternatives by applying similar criteria to those invoked in the philosophy of science. These narratives function as ''self-evidencing'' explanations: the accepted version of events explains the evidence and the evidence provides reasons justifying acceptance of that version as the correct one.[36] As in science, these explanations thus function as a tool for acquiring true beliefs, and a focus on the role of explanation helps to illuminate the inferential process.

How this process proceeds at trial depends on the inferential interests of the legal system and the fact-finders. Several distinct

[31] See Ronald J. Allen, 'Factual Ambiguity and Theory of Evidence,' *Northwestern University Law Review* 88 (1994): 604; Ronald J. Allen, 'The Nature of Juridical Proof,' *Cardozo Law Review* 13 (1991): 373.

[32] We sometimes use the word ''juror'' or ''jurors'' to mean ''fact finder,'' as is the case in the text at this footnote. It is obvious when we are using the term to refer specifically to jurors as compared to judges engaged in fact finding.

[33] As explained more fully below, this aspect neutralizes a formal conjunction paradox in cases with multiple elements.

[34] Which is simply an instantiation of how virtually everyone reasons about the world at large. See Allen, supra note 31 (discussion of scripts, narratives, etc.).

[35] Pennington and Hastie, supra note 3.

[36] A product of this process hopefully is a reduction or minimization of errors, and thus one can say that, in a sense, the decision goes for the story with the higher probability. However, references to probability in this context are completely epiphenomenal, or at least completely dependent upon IBE and serve no independent value.

narratives (or theories) can be constructed to explain a given body of evidence, all of which are equally plausible. Indeed, as Richard Friedman has pointed out, their number is infinite—did the accident occur at noon or 12:01 or at one of the infinite slices of time in between (which Zeno taught us to notice)?, and so on.[37] In general, how fine grained the explanation must be will depend on the context. ''The accident occurred at 12:00:01'' may be too detailed; ''The accident occurred in the afternoon on June 16'' may be good enough; and ''An accident occurred sometime in the past'' may be not detailed enough. Consider again the man with heartburn. From the wife's perspective, the fact that he ate something spicy may be a good enough explanation because it identifies an appropriate contrast (based on the wife's inferential interests[38]); it does not matter whether the spicy food was a chili cheeseburger with jalapenos (or something else spicy) because any such food would have caused the heartburn. For other contexts or for others with different inferential interests, such as his doctor making a diagnosis, more details and different details will be appropriate.

In the context of juridical proof, two factors set the inferential interests and the appropriate level of detail at which fact finders should focus in evaluating explanations. These factors are the substantive law and the points of contrast between the versions of events offered by the parties (the disputed facts). First, the substantive law will require a sufficiently detailed explanation of the evidence to show the plaintiff is entitled to relief (E.g., explanations such as ''the defendant did something bad'' typically will not be detailed enough.). Sometimes, however, the substantive law allows parties to provide quite broad explanations. For example, the doctrine of res ipsa loquitur allows plaintiffs to recover even by offering explanations such as ''My injuries were caused by *something* done by the

[37] Richard D. Friedman, 'Infinite Strands, Infinitesimally Thin: Storytelling, Bayesianism, Hearsay and other Evidence,' *Cardozo Law Review* 14 (1992): 79.

[38] Assuming her interest is explaining why he suffered heartburn on this occasion. If he hadn't eaten any spicy food on this occasion (at any of its time slices), then he would not have suffered heartburn on this occasion.

defendant'' when such a theory provides the best explanation of the evidence.[39] And second, where the parties choose to disagree focuses attention on the appropriate details for choosing among contrasting explanations. If the defendant contends that he was on vacation somewhere out of state during the car accident, then the appropriate contrast on which to focus is whether he was in state (and driving the car that caused the accident) or out of state, and not on whether he was driving or in the back seat or the trunk or any other place in the universe.[40] Consider further Friedman's hypothetical focusing on whether an accident occurred at noon or some other time. If a defendant tries to defend on the ground that, although the accident occurred around noon, the evidence does not show precisely whether it was at 12:00 or 12:01, the defendant will obviously lose because the substantive law is indifferent to the matter.[41] The IBE process thus accommodates the concern of too many explanations by showing how to aggregate and differentiate among them.

A complementary possible concern is having too few potential explanations. There may be cases where neither party offers a particularly plausible explanation of the evidence, either because neither side can explain key pieces of evidence or because there is such a paucity of evidence that it can be

[39] Richard D. Friedman, "'E'' is for Eclectic: Multiple Perspectives on Evidence,' *Virginia Law Review* 87 (2001): 2029, 2047, suggests that situations allowing for general explanations (like res ipsa loquitur) somehow pose a challenge to the theory that juries decide on the basis of the relative plausibility of competing explanations. But even quite general explanations are still explanations.

[40] Although if a jury thinks that the best explanation of the evidence is that the defendant was in the back seat (and perhaps is covering for the driver), then the proper level of detail would shift and the proper contrast would be on where in the car the defendant was sitting.

[41] As we discuss below, Professor Friedman presents his hypothetical as a criticism of the relative plausibility theory, which in turn rests upon IBE. As one can see, it has no negative implications for either.

explained in multifarious ways none of which are any better (or more likely) explanations than any other. In the first scenario—where each side has problems explaining the same or different critical items of evidence—the key point is the comparative aspect of the process. A verdict will (and should) be rendered for the *better* (or best available) explanation, whether one of the parties' or another constructed by the fact-finder. If the proffered explanations truly are equally bad (or good), including additionally constructed ones, judgment will (and should) go against the party with the burden of persuasion. In the second scenario—too little evidence from which to differentiate among potential explanations—should also end in judgment against the party with the burden of persuasion; they have failed to meet their burden of producing evidence from which a reasonable fact-finder could differentiate among the potential, contrasting explanations. Through burdens of proof, the structure of civil trials thus assuages concerns associated with too few potential explanations.[42]

The discussion so far has concerned proof in civil cases with a preponderance proof standard. This situation provides a direct fit with the process of IBE. The proof process alters in criminal cases, with a proof standard of beyond a reasonable doubt, and in cases with an intermediate proof standard of "clear and convincing" evidence.[43] In criminal cases, rather than inferring the *best* explanation from the potential ones, fact-finders infer (and should infer) the defendant's innocence whenever there is a sufficiently plausible explanation of the evidence consistent with innocence (and ought to convict when there is no plausible explanation consistent with innocence,

[42] Devices like summary judgment and judgments as a matter of law implement the general way burdens of proof accommodate these concerns.

[43] Both Richard Friedman and Dale Nance have criticized the theory of relative plausibility by suggesting that it cannot account for intermediate standards such as "clear and convincing" evidence. Friedman, *Eclectic*, supra note 39 at 2047; Nance, supra note 30 at 1591–1592.

assuming there is a plausible explanation consistent with guilt[44]). When there is a plausible explanation of the evidence consistent with innocence, then there is a concomitant likelihood that this explanation is correct (the actual explanation) and thus that the defendant is innocent, which in turn creates a reasonable doubt (and thus should prevent the fact-finder from inferring guilt).[45]

Similar alterations apply to the clear-and-convincing-evidence standard. Rather than inferring the *best* explanation from the available potential ones, fact-finders should infer a conclusion for the party with the burden of persuasion when there is an explanation that is sufficiently more plausible than those that favor the other side (not just when the party with the burden has offered a better one). How sufficiently more plausible must the explanation be to meet the standard? The explanation must be plausible

[44] If both the prosecution and the defense offer implausible explanations of the evidence, the jury ought to acquit. Suggesting something quite similar to Ronald J. Allen, 'Rationality, Algorithms and Juridical Proof: A Preliminary Inquiry' *International Journal of Evidence and Proof* 1 (1997): 254, 273, Professor Josephson has proposed a definition of the reasonable-doubt standard that turns on whether there is an explanation that represents a ''real possibility'' of innocence. See John R. Josephson, 'On the Proof Dynamics of Inference to the best Explanation,' *Cardozo Law Review* 22 (2001): 1621, 1642 (''A real possibility does not suppose the violation of any known law of nature, nor does it suppose any behavior that is completely unique or unprecedented, nor any extremely improbable chain of coincidences.'').

[45] Larry Laudan has argued (correctly) that this is no longer a process of inference to the *best* explanation and is rather an example of the kinds of decisions IBE was meant to avoid in the first place (i.e., inferring conclusions that are not the best explanations because they are less likely to be true). See Larry Laudan, 'Strange Bedfellows: Inference to the Best Explanation and the Criminal Standard of Proof,' (forthcoming in *International Journal of Evidence and Proof*). This is a necessary feature of the reasonable-doubt standard, however, and not a criticism of an explanatory account. IBE is, at root, based on the notion that explanatory success tracks likelihood of truth—the better the explanation, the more likely true. Because the criminal standard distributes errors unevenly (in favor of the defendant), it should not be surprising that the quality of the explanation needed for a pro-defendant verdict should therefore be lower.

enough that is it clearly and convincingly more plausible than those favoring the other side.[46] For example, the standard applies in defamation cases where the plaintiff must prove the defendant acted with "actual malice" in publishing a defamatory statement.[47] In such cases, for a plaintiff to succeed there must be a theory that explains the evidence, which incorporates actual malice by the defendant, and which is not only the best explanation but is clearly and convincingly a better explanation than those that do not include actual malice.

We acknowledge there is vagueness in how "sufficiently plausible" an explanation must be in order to satisfy either the beyond-a-reasonable-doubt or the clear-convincing-evidence standard, but this vagueness inheres in the standards themselves.[48] Lack of precision may thus be a critique of the standards, but it is not a critique of an explanation-based account. Even if the strength of a party's total evidence could be quantified,[49] the vagueness remains for such a probability approach

[46] As we discussed, we are not offering circular definitions. We are illuminating how explanatory factors guide the inferential processes at trial, and how the structure of the system is designed to control and foster those practices. If there is vagueness here, it inheres in the concept of "clear and convincing" evidence. How ever one wants to define that concept, it is met when an explanation is good enough to cause and justify the desired inference.

[47] See New York Times v. Sullivan, 376 U.S. 254 (1964).

[48] With "beyond a reasonable doubt," the system accommodates this vagueness by leaving it to juries to determine whether the standard has been met without requiring further elaboration. See Victor v. Nebraska, 511 U.S. 1, 5 (1994) ("the Constitution neither prohibits trial courts from defining reasonable doubt nor requires them to do so as a matter of course. Indeed, so long as the court instructs the jury on the necessity that the defendant's guilt be proved beyond a reasonable doubt, the Constitution does not require that any particular form of words be used in advising the jury of the government's burden of proof.") (citations omitted). For a recent critique of the Court's jurisprudence in this area see Larry Laudan, *Truth, Error, and Criminal Law: An Essay in Legal Epistemology* (Cambridge University Press, 2006).

[49] For reasons why it cannot be see Allen and Pardo, supra note 4, and the discussion below.

as well. Is 58% likelihood clear and convincing? Is 65%? Is 72%?[50]Is 85% beyond a reasonable doubt? Is 90%? Is 95%?[51] Moreover, simply defining the standards as a certain percentage does not explain them; it changes them by fiat.[52] We are not offering new standards; we are illuminating how explanatory factors guide the inferential processes at trial, and how the structure of the system is designed to control and foster those practices. However the current standards are defined, they are met when explanations are plausible enough to cause and justify the desired inferences. Either that one explanation is clearly and convincingly more plausible, under one standard, or that there is a plausible explanation consistent with a criminal defendant's guilt and no plausible explanation consistent with innocence, under the other.

This concludes our general discussion of how IBE illuminates the process of juridical proof at the macro level. Before considering possible objections and alternatives, we next illustrate how IBE clarifies the relevance and probative value of individual items of evidence. The concepts of both ''relevance'' and ''probative value'' may be clarified by focusing on the relationship between explanations and items of evidence. Recall the ''self-evidencing'' nature of explanations: a hypothesis or conclusion explains evidence and the evidence in turn justifies the belief that the hypothesis or conclusion is true. An item of evidence is thus relevant if it is explained by the particular explanation offered by the party offering the evidence, which in turn justifies that explanation as correct, assuming the

[50] For an example of the vagueness see Federal Civil Jury Instructions of the Seventh Circuit 35 (available at www.ca7.uscourts.gov) (defining the ''clear and convincing'' standard as ''highly probable that it is true'').

[51] See United States v. Fatico, 458 F. Supp. 388, 410 (E.D. N.Y. 1978) (providing a survey of district judges on the probability they associated with various standards of persuasion—judges differed); see also Simon and Mahan, 'Quantifying Burdens of Proof: A View from the Bench, the Jury, and the Classroom,' *Law and Society Review*, 5 (1971): 319.

[52] Thus, Professor Nance's lament, supra note 30 at 1593, is equally applicable to his own probabilistic account: ''there is no clue how, even in principle, one can determine how probable the defendant's story must be in order to be plausible or in what other way a jury is to decide whether a story is plausible.''

explanation concerns a fact that matters to the substantive law.[53] Probative value refers to the strength of the explanation[54]; the more the evidence is explained by, and hence justifies, the party's explanation of the evidence, the greater the probative value and hence the stronger the inference to the truth of that explanation. The strength of that inference will depend contextually on the other evidence, and the presence of other, contrary explanations.[55] Consider again the example of the necklace found in the maid's pocket. Suppose the owner testifies that she found the necklace in the maid's pocket. This testimony is relevant because the fact that the maid stole the necklace explains the testimony.[56] But the strength of the inference to the truth of the explanation will depend on the other available evidence. If there is other evidence that someone stole the necklace, then the testimony has greater probative value; if there is other evidence that the owner gave the maid the necklace as a gift, then the testimony has less probative value.

II. OBJECTIONS AND THE BAYESIAN APPROACH

We turn now to objections to the use of IBE in explaining the nature of juridical proof, and explain where and how our account contrasts with the dominant probability-centered accounts in the legal literature. We first discuss why some general objections to IBE in the area of philosophy of science do not carry over as legitimate objections in the legal context.

[53] Federal Rule of Evidence 401 defines "relevant evidence" as "having any tendency to make the existence of any fact of consequence to the determination of the action more probable or less probable than it would be without the evidence." Explanatory considerations establish the "any tendency" aspect of evidence (the logical relevance); the substantive law determines which facts are of consequence. Parties must therefore construct explanations that include (or fail to include, if on the other side) these facts of consequence.

[54] See Michael S. Pardo, 'The Field of Evidence and the Field of Knowledge,' *Law & Philosophy* 24 (2005): 321, 374–83.

[55] See Allen, *Factual Ambiguity*, supra note 31.

[56] Impeachment evidence, therefore, weakens the explanatory connection by offering contrary explanations for the testimony.

Next, we discuss objections to IBE as a general inferential strategy. Finally, we focus on possible objections raised by probability approaches and discuss the relationship between our views and those approaches.

A. Objections to IBE in the Philosophy of Science

In a recent debate regarding the use of statistical evidence during sentencing, the commentators (while disagreeing with each other) agreed in questioning the applicability of IBE as an approach to legal proof.[57] Their questioning of IBE was based on citations to philosophy-of-science literature questioning IBE; however, the debates in the philosophy of science are focused on narrow issues that do not apply in the legal context. The main objection to IBE in the philosophy of science concerns whether it provides an adequate defense of the position of scientific realism, that is, whether non-observable, theoretical entities and theoretical laws actually exist (or are really "real"). The use of IBE in this context is straightforward: the existence of these entities and laws best explains the observable phenomena experienced by scientists.

A strong objection to such a view comes from Bas van Fraassen.[58] His challenge is based on the idea that adequate scientific theories need only explain ("account for" or "save") the observable phenomena that scientists experience; in other words, that the theories need only be "empirically adequate."[59] So long as they do this, no further inference to the existence of these entities is necessary, or is warranted. He readily concedes, however, that IBE is a perfectly appropriate strategy for

[57] See Peter Tillers, 'If Wishes Were Horses: Discursive Comments on Attempts to Prevent Individuals from Being Unfairly Burdened by their Reference Classes,' *Law, Probability and Risk* 4 (2005): 33–49; Mark Colyvan, Helen M. Regan, and Scott Ferson, 'Is it a Crime to belong to a Reference Class?' *Journal of Political Philosophy* 9 (2001): 168–81. We discuss this debate in more detail in Allen and Pardo, supra note 4.

[58] van Fraassen, supra note 17. The IBE defense of scientific realism is also challenged in Arthur Fine, *The Shaky Game: Einstein Realism and the Quantum Theory* (Chicago University Press, 1996).

[59] van Fraassen, supra note 17 at 20.

justifying conclusions about the nature and behavior of everyday objects. He provides the example of inferring that a mouse is in one's house: this best explains the scratching in the wall, the droppings, and the missing cheese.[60] Unlike the scientific practices being discussed, we do not infer just that a mouse "saves the phenomena" or it is "as if" there is a mouse or that "these apparent signs of mousely presence will continue"—for the conclusion that there is a real mouse in the house amounts to the very same thing as it being "as if" there is a mouse (we can observe mice).[61] Nancy Cartwright offers similar arguments, but she suggests that van Fraassen's arguments go too far; for her, IBE does indeed justify the existence of unobservable entities, just not theoretical laws.[62] Her argument is based on the idea that positing an entity to explain certain results commits one to a causal claim whenever one has posited that the unobservable entity caused the observable results. She points out that the abductive inference from effect to cause in such cases is legitimate and hence that such causal claims have truth "built into them"—"existence is internal to causal claims. There is nothing similar for theoretical laws."[63] Now, these objections pose little if any threat to an explanation-based account of juridical proof. Trials involve disputes over everyday objects such as people and property and contracts; rarely, if ever, will there be a litigated dispute over

[60] Id. at 19.

[61] Id. at 19–20.

[62] Nancy Cartwright, *How the Laws of Physics Lie* (Oxford University Press, 1983).

[63] Id. at 91. Likewise, Larry Laudan has argued that IBE has a poor track record because several theories once accepted due to their being the best available explanation have been falsified (he gives several examples such as the humoral theory of medicine, the theory of electromagnetic aether, and the phlogiston theory of chemistry). See Larry Laudan, 'A Confutation of Convergent Realism,' *Philosophy of Science* 48 (1981): 19, 33. But, again, he is discussing the existence of scientifically posited entities: "A theory's success is no warrant for the claim that all or most of its central terms refer." Id. at 47. Whatever else is going on in litigation, it is typically the case that most of its terms refer to verifiable entities.

whether certain theoretically posited entities or theoretical laws actually exist or are only empirically adequate.[64]

B. General Objections to IBE

The objections in the next category are general and may be launched at the use of IBE in any context. First, one might suggest that IBE is not a good strategy because what counts as the *best* explanation will be too subjective to guide inference in a manner that is truth conducive. This objection, however, mischaracterizes the process. Although inferences will be relative to interests and other contextual factors, once these are fixed there are indeed objective criteria for evaluating explanations. For example, of two explanations, other things being equal, the one that explains more of the evidence will be better than the one that explains less; the one that is more in accord with what else we know will be better than the one that isn't; and so on. Consider again the man with heartburn. For the wife, the fact that he ate spicy food is a better (objectively better) explanation than that he drank water that day because he very often drinks water and does not get heartburn. What is more, these ubiquitous practices of inference based on explanatory considerations have likely evolved and remained around precisely because of their success in navigating our environments.[65] In other words, their success best explains their ubiquity.

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[64] Perhaps litigation over the nature of evolution and "intelligent design" is an exception. We do not mean to suggest that IBE is problematic in science only in cases involving unobservable entities and laws, but this is the context in which it appears to have been most notoriously challenged. Rather, our point is that the failure of IBE in some scientific contexts does not necessarily mean that it is ill-suited to explain legal phenomena.

[65] Lipton, supra note 1 at 209; Ilkka Niiniluoto, 'Defending Abduction,' *Philosophy of Science* 66 (1999): S436. Empirical evidence suggests that jurors do quite well employing this strategy at trial, see Pennington and Hastie, supra note 3, even in cases involving scientific evidence. See Neil Vidmar, 'The Performance of the American Civil Jury: An Empirical Perspective,' *Arizona Law Review* 40 (1998): 894, 898 ("Juries in medical malpractice trials, frequent targets of critics, tend to render decisions that are consistent with independent assessments of health care providers.").

Second, one may object that even though an explanation appears to be the best (based on objective criteria), this is still no guarantee that it will be true or is even likely to be true. This objection, however, is aimed not at IBE but against any form of inductive inference. The evidence will always underdetermine the conclusions of inductive inferences: this level of Humean skepticism does not single out IBE as inferior to any other inductive strategies (including Bayesian).[66]

Finally, one may object that, even if an explanation appears to be the best available, its truth should not be inferred unless it has been adequately tested, a view most often associated with the work of Karl Popper within the philosophy of science[67] but that may apply generally. In the legal context, parties' explanations or theories must first pass the test of explaining the key, contested items of evidence in a given case. And parties are then given the responsibility of further probing the other side's explanation, either through cross-examination or by offering rebuttal evidence. During this process, the evidence may fail to adequately probe either explanation sufficiently, but the structure of proof accommodates such deficiencies. In civil cases, if the plaintiff's explanation appears no more likely than the defendant's, judgment should be for the defendant. And even if the plaintiff's explanation appears better than the defendant's but is so poorly probed by the evidence that the jury concludes many other explanations (favoring the defendant) are equally or more plausible, then judgment again should go for the defendant. This is so because the plaintiff has failed to produce

[66] See Lipton, supra note 1 at 142–63.

[67] See Karl Popper, *Realism and the Aim of Science* (1983); Deborah G. Mayo, 'Evidence as Passing Severe Tests: Highly Probable vs. Highly Probed Hypotheses,' in *Scientific Evidence: Philosophical Theories and Applications* 95–127 (Peter Achinstein ed.) (Baltimore: The Johns Hopkins University Press, 2005).

sufficient evidence from which a reasonable factfinder could differentiate among the potential, contrasting explanations.[68]

C. Probability-Based Objections and the Bayesian Alternative

The strongest law-specific objections to the explanation-based account we have provided will arise from probability-based accounts of the process. Such probability accounts share some common features.[69] They attempt to assign a cardinal probability of between 0 and 1 to account for both the strength of individual items of evidence and the strength of a party's case as a whole.[70] The strength of the evidence may then be compared with standards of persuasion, which are also interpreted in terms of cardinal probabilities (e.g., preponderance = .5; clear and convincing = .60–.70; beyond a reasonable doubt = .9,

[68] Similar analysis should apply in the criminal context, with a standard of beyond a reasonable doubt, and in civil cases with a "clear and convincing evidence" standard. In criminal cases, the government's explanation must be sufficiently probed such that the plausible explanations consistent with innocence have been refuted. Likewise, in cases requiring clear and convincing evidence, a plaintiff's explanation must be sufficiently probed that it weakened the potential, plausible explanations favoring the defendant such that the plaintiff's explanation is sufficiently more plausible than those favoring the defendant.

[69] See, e.g., the articles cited in supra note 2.

[70] A common approach to assigning probabilities to individual items of evidence is through the notion of a "likelihood ratio," that is, the probability of evidence (e.g., a confession) given a hypothesis (e.g., the defendant is guilty) divided by the probability of that evidence given the negation of the hypothesis. See Nance and Morris, supra note 2; Finkelstein and Levin, supra note 2; David H. Kaye and Jonathan Koehler, 'The Misquantification of Probative Value,' *Law and Human Behavior* 27 (2003): 645. For critiques of the likelihood-ratio approach see Pardo, supra, supra note 54; Allen and Pardo, supra note 4.

or something similar).[71]The accounts typically employ Bayes' Theorem as a way to guide, measure, or critique combinations of evidence in general and to compare in particular the strength of evidence once a new item is introduced as compared with the strength of the evidence without that item.[72] The primary divergence in these various approaches is where the numbers come from[73]: some rely on "objective" data such as known base rates for the evidence and the disputed facts[74] while others rely on "subjective" assessments of the factfinder.[75] Because such decision procedures are rarely if ever followed at trial, the primary motivation of such projects is to illuminate how an ideal rational fact-finder would behave, and perhaps to offer normative advice on how that ideal may be closer realized or how the law ought to be changed.

Even if the trial is structured around explanatory considerations, a formalized Bayesian approach may suggest objections to these current practices. Indeed, such objections have been

[71] Interpreting standards of persuasion in terms of cardinal probabilities also accords with how some judges think of them. See United States v. Shonubi, 895 F. Supp. 460, 471 (E.D. N.Y. 1995), reversed on other grounds, 103 F.3d 1085 (2d Cir. 1997) ("Judges–who deal with burdens of proof on a daily basis–are inclined to think of those burdens in probabilistic terms. A survey of judges in the Eastern District of New York found general agreement that 'a preponderance of the evidence' translates into 50+ percent probability. Eight judges estimated 'clear and convincing' as between 60 and 70 percent probable (while two found this standard unquantifiable). Estimates for 'beyond a reasonable doubt' ranged from 76 to 90 percent, with 85 percent the modal response.").

[72] See, e.g., Nance and Morris, supra note 2; Davis and Follette, supra note 2.

[73] The approaches also diverge on how they define probative value, either as the likelihood ratio or as the difference between prior and posterior probabilities. Compare Nance and Morris, supra note 2 with Davis and Follette, supra note 2.

[74] Nance and Morris, supra note 2 (DNA random-match evidence); Finkelstein and Levin, supra note 2 (match of carpet fibers); Davis and Follette, supra note 2 (infidelity as evidence of spousal murder). We critique each of these attempts in Allen and Pardo, supra note 4.

[75] See, e.g., Richard D. Friedman, 'Character Impeachment Evidence: Psycho-Bayesian [!?] Analysis and a Proposed Overhaul,' *UCLA Law Review* 38 (1991): 637.

launched at the general theory that fact-finders decide based on the relative plausibility of the parties' theories as a whole.[76] We consider here how an IBE approach stands up to these objections and compare the two approaches.[77]

Both Richard Friedman and Dale Nance have raised objections to the relative plausibility of competing explanations as a macro-level theory of the proof process, each preferring Bayesian approaches. Their objections focus on perceived problems and ambiguities involved in aggregating the various theories and stories that may support each side. Instead, they propose articulating both the strength of a party's case and the burden of persuasion in terms of cardinal probabilities: "the claimant (plaintiff or prosecutor) should prevail if the probability that the claimant has a valid claim is greater than the standard of persuasion."[78] Nance defines the preponderance standard in a civil case with two elements, A and B, as whether A X B > .5.[79]

Under their approaches, fact-finders must aggregate the probabilities of all the possible stories that support each side. Thus, if the jury believes that two mutually incompatible stories favor a party, the party gets the benefit of the disjunction of their probabilities. They both read an approach based on the

[76] Friedman, *Infinite*, supra note 37; Friedman, *Eclectic*, supra note 39; Nance, supra note 30.

[77] Two possible objections to an account based on the relative plausibility of explanations have already been discussed. These are that there may be too many or too few explanations. But as explained above, an explanation-based approach can adequately respond to these situations. Wesley Salmon has raised Bayesian challenges to IBE in the domain of science, but he recognized a legitimate domain for IBE in explaining everyday affairs such as explaining intentional behavior, where IBE does quite well and where the situation is too complex, ambiguous, and based on subtle linguistic cues to be reduced to a formalized process. (In other words, the kinds of situations that give rise to litigation.) See Wesley Salmon, 'Explanation and Confirmation: A Bayesian Critique of Inference to the Best Explanation,' and 'Reflections of a Bashful Bayesian: A Reply to Peter Lipton,' in *Explanation: Theoretical Approaches and Explanations* 61–91, 121–36 (G. Hon and S.S. Rakover eds.) (Norwell, MA and Dordrecht: Kluwer Academic Publishers, 2001).

[78] Friedman, *Eclectic*, supra note 39 at 2045.

[79] Nance, supra note 30 at 1568.

relative plausibility of the potential explanations as prohibiting aggregation,[80] or at least as not specifying how it is to be done,[81] and thus as leading to counterintuitive conclusions.[82] The problem with relative plausibility, as they see it, is that by ordinally ranking fully detailed versions of reality, each narrative (or theory or explanation) must then stand or fall on its own as compared to every other fully detailed narrative, even if nearly all of those narratives favor one side (This could be particularly devastating because of the fact that there are an infinite number of potential stories that may explain the evidence; thus, the cardinal probability of each one being true may be quite small.). The Bayesian approach, by contrast, can aggregate the probabilities that support each side; therefore, when one reduces the probability of any individual story by offering a more fine-grained account one does not lower the probability for either side.[83]

Nance illustrates this critique with an illuminating example[84] that usefully teases out the supposed aggregation problem by vividly raising a third possibility in addition to the two theories offered by the parties.[85] Suppose a negligence case involving a car accident reduces to what color the light was when the defendant drove through the intersection. Under the substantive law of the jurisdiction, the defendant is negligent if it was red, but not if it was green or yellow. At trial, the plaintiff contends that it was red; the defendant contends that it was green. At the close of trial, the jury concludes that the

[80] See Nance supra note 30 at 1575–84; Friedman, *Eclectic* supra note 39; Friedman, *Infinite* supra note 37.

[81] Friedman, *Infinite* 37 at 93–94 n. 40.

[82] Nance, supra note 30 at 1575–84; Friedman, *Eclectic* supra note 39; Friedman, *Infinite* supra note 37 at 93–94 n. 40.

[83] See Friedman, *Eclectic* supra note 39; Friedman, *Infinite* supra note 37 at 93–94 n. 40. Specifying more detailed stories means more stories with lower individual probabilities; less detailed stories means fewer stories with higher individual probabilities—but the aggregate for both would remain the same.

[84] Nance, supra note 30 at 1578.

[85] See id. (''this 'third story' possibility is the most serious problem for the relative plausibility theory, one that needs to be addressed adequately before it is embraced.'').

probability that the light was—red = .42; green = .30; yellow = .28.[86] Assuming a preponderance standard of .5, the probability approach dictates that the defendant should win, while relative plausibility, Nance contends, dictates that the plaintiff should win because the plaintiff's explanation is the most likely one.[87] Thus the probability approach leads to intuitively more plausible results because it appears to maximize expected utilities.[88]

But nothing in examining the relative plausibility of competing explanations prevents aggregation. As explained in our basic account above, both the substantive law and the contrasting nature of the parties' explicit theories at trial help to sort potential explanations in a way that is useful based on the decision-maker's inferential interests.[89] Sometimes an explanation as general as "the defendant did something that caused the accident" is good enough (in cases involving res ipsa loquitur) even when that something could be several things, and sometimes, *pace* Friedman, it does not matter at which of the infinite time slices between 12:00 and one second later the event occurred. Friedman's criticism of IBE is based

[86] N.B., they would have relied on explanatory criteria to get these numbers.

[87] Nance, supra note 30 at 1580–81.

[88] Nance and Friedman both contend that relative plausibility must collapse into a Bayesian approach if it concludes that the defendant should win. Nance, supra note 30; Friedman, *Eclectic*, supra note 39. We respectfully disagree. First, there is nothing problematic about a disjunctive explanation; and second, nothing about a disjunctive explanation suggests that it necessarily must be Bayesian. It, of course, might be, but this is not a challenge to relative plausibility. This seems to be similar to the fact that inductive inferences can often be re-cast as either abductive or enumerative. See infra note 15.

[89] We thus concur with Friedman's statement that, "the observer's understanding of the world and of the issues at stake will usually provide considerable guidance on how to aggregate possibilities in a sensible way." Friedman, *Eclectic*, supra note 39 at 2042. As we discussed above, both the observer's understanding of the world and the issues and stake help to guide inferences based on explanatory criteria.

on a misconstruction of the substantive law.[90] But sometimes a very detailed story (explanation) will be necessary based on the appropriate contrast—for example, whether the fire occurred the day before or the day after the insurance policy expired or whether the driver's blood alcohol level was .07 or .08. These factors control how to aggregate stories under an explanation-based account. Based on the substantive law in the street-light example, it's perfectly appropriate for the jury to contrast the explanation "The light was red" against the explanation "The light was green or yellow."[91] Thus an explanation-based account also supports the conclusion that the defendant should win.[92] Likewise, if a man gets heartburn only after he eats either chili cheeseburgers or spicy Thai food, and he now has heartburn, it is a perfectly good explanation that "he must have eaten a chili cheeseburger or spicy Thai food," even though the two may be incompatible, if, of course, the appropriate contrast is why he now has heartburn rather than not now having heartburn.[93]

Just like a Bayesian approach, an explanation-based approach can account for aggregation of potential stories or theories and explain how and why it should proceed in the way

[90] This criticism of Friedman's of explanation-based accounts of juridical proof, see supra note 37 and accompanying text, like most of the criticisms from the probabilists, is equally applicable to their own account. If the law requires that the precise time (whatever that might mean given the infinite series between any two points on a time line) be established, under a probabilist's account it would have to be established by a preponderance of the evidence (in civil cases) or (beyond reasonable doubt) in criminal cases. How that could be done is a mystery. We are fairly certain that the probabilists would view this as an unfair criticism of their approach for precisely the same reasons that we do: i.e., it involves a misconstruction of the law and amounts to criticizing an approach for being unable to do what the law does not demand and that no other approach could accomplish either.

[91] Therefore, Nance, supra note 30, is incorrect to assert that if relative plausibility is allowed to aggregate potential explanations, it must aggregate all of them, which leads to a probability of 1. This ignores the contrastive nature of explanations.

[92] Without reducing to the Bayesian account.

[93] In a context, however, where the appropriate contrast is "what caused the heartburn: cheeseburgers or Thai food?" this is no longer a good explanation (and an inappropriate aggregation).

that it does This issue thus scores no additional points for the Bayesian, but the connection between the two is closer, and deeper. Indeed, explanatory considerations drive key aspects the Bayesian process. The Bayesian approach, for example, cannot offer advice on how to generate potential theories; explanatory considerations guide this process. As Nance notes explicitly: "students familiar with Bayesian thinking naturally pose the question of what circumstances or events, consistent with innocence, would *explain* the report of a match, and then inquire how likely such circumstances or events are as compared to the report of a match for an accused who is guilty [emphasis added]."[94] Moreover, as we have attempted to show throughout this article, explanatory considerations drive inferences as to the likelihood of various potential explanations. Indeed, there is no reason to see explanatory and Bayesian approaches as necessarily incompatible.[95] Explanatory considerations, however, are inherent and fundamental; to the extent Bayesian perspectives can clarify and approve on those considerations, they prove their worth. To the extent they do not, they do not.

By contrast with aggregation, the explanation-based account does much better than the Bayesian in taming the conjunction paradox.[96] As noted above, the Bayesian approach requires that the probability of the claimants' claim must exceed the probability of the standard of persuasion. Some Bayesian theorists have reconstructed this to mean that, under a preponderance standard of .5 for a claim with two elements, A and B, the probability of A X B exceeds .5 (and for a three-element claim A X B X C must exceed .5, and so on). This would mean that as the number of elements increases, the probability needed for each

[94] Nance, supra note 30 at 1609.

[95] See Lipton, supra note 1 at 103–20.

[96] On the paradox see Ronald J. Allen and Sarah A. Jehl, 'Burdens of Proof in Civil Cases: Algorithms vs. Explanations,' *Mich. St. DCL L. Rev.* (2003): 893; Alex Stein, 'Of Two Wrongs that Make a Right: Two Paradoxes of the Law of Evidence and their Combined Justification,' *Texas Law Review* 79 (2001) 1199; Saul Levmore, 'Conjunction and Aggregation,' *Michigan Law Review* (2001): 723.

element would increase as well[97] (For two elements the average probability for each element must be approximately .707; for three elements: .794; for four elements .841.).[98] One problem with this model is that this is not how the law defines the burden of persuasion or how it instructs jurors: it does so by requiring that claimants prove *each element* to the requisite standard of persuasion.[99] A probability approach based on the proof of discrete elements to the standard of persuasion does not distribute errors evenly among parties and therefore is unlikely to increase the accuracy of outcomes.[100] Rather, it leads to paradoxical conclusions such as the following: the plaintiff in a two-element claim wins when proving each element to .6 (despite a likelihood of .36) and loses when proving one element to .9 and the other to .5 (and having a likelihood of .45).

The Bayesian response is to declare that current practices are wrong and should be changed.[101]But this creates its own

[97] This assumes that the elements are independent from one another (viz., that the likelihood on one element being true does not affect the likelihood of any other element being true), which often will not be the case in the law. Dependence makes things even more complicated for the Bayesian approach because one needs to know not only the probabilities of each element but how they interact. We put this additional problem for the Bayesian approach to the side. But we note that the explanation-based approach avoids this problem because the accepted explanation must incorporate each of the elements.

[98] Friedman, *Infinite*, supra note 37 at 98.

[99] Allen and Jehl, supra note 95.

[100] Id. at 929–36. The preponderance rule is based on the assumptions that the parties should be treated roughly equally (and hence errors distributed roughly evenly among them) and that the evidence will generally favor the side that deserves to win (hence minimizing the total number of errors). For more detailed discussions of standards of proof with regard to error distribution see Laudan, supra note 48 at 63–88; Richard S. Bell, 'Decision Theory and Due Process: A Critique of the Supreme Court's Law Making for Burdens of Proof,' *Journal of Criminal Law and Criminology* 78 (1987): 557.

[101] See Friedman, Infinite, supra note 37 at 97 n. 48 (offering an alternative instruction that requires that the conjunction of elements be more likely than not true); See also Dale A. Nance, 'A Comment of the Supposed Paradoxes of a Mathematical Interpretation of the Logic of Trials,' 66 *Boston University Law Review* 66 (1986): 947 (suggesting that each element individually plus their conjunction must meet the standard).

problem. Plaintiffs' likelihood of success will depend on how the claim is defined; more elements means that they have the burden not only of proving the additional elements, but also that their burden goes up even with regard to the other (possibly independent) elements. For example, suppose a plaintiff has to prove injury and one other independent element—they would have to show the probability of injury was around .707. But suppose two additional elements are added in that have nothing to do with whether the plaintiff suffered an injury. The plaintiff's burden with regard to injury now shoots up on average to around .841. Of course, this may turn out to be less of a problem in the rare case that the additional elements merely divide up, and hence logically entail, a more general element. Friedman gives such an example—one element of whether a car had four hubcaps being divided into four separate elements based on whether each wheel had a hubcap.[102] But this is a rare case that proves the general point.[103] The typical case—in which individual elements are not entailed by a more general one—leads to counterintuitive results. Such counterintuitive results pose a serious challenge to the Bayesian approach. By contrast, an explanatory approach based on relative plausibility avoids the formal paradox. In civil cases, fact finders infer the best explanation of the evidence as a whole; in doing so they now have an accepted explanation that

[102] Friedman, *Infinite*, supra note 37 at 98 n. 50.

[103] Even in such cases, instructing the jury to treat them as separate elements may increase the risk of error.

may or may not instantiate all of the formal elements of the claim.[104] If it is does, then the claimant ought to win; if not, not.[105] In doing so, the formal paradox is effectively neutralized.

The Bayesian approach also suffers from a disabling defect that the explanatory approach avoids. It essentially assumes that all the possible explanatory hypotheses will be before the court, and thus collectively add up to a probability of 1.0. At trial, however, parties often pick the best of the explanations rather than a series, in part because the presentation of a series may itself communicate to the fact finder that none of the series is to be believed. Thus, although perfectly allowable, one never sees at trial the defense, ''I didn't do it. But if I did, it was in self-defense. And if it wasn't in self-defense, I was coerced to do it. But if I wasn't coerced, I was entrapped. And if I wasn't entrapped, I was insane.'' Thus, there is good reason to believe the standard problem of trials is not to accumulate all the stories for the parties and see which collectively adds up to great than .5. Rather, the standard problem may be something more like the probability of the plaintiff's case being .4, and the respective probabilities of the two defenses each being .1. In such a case, the Bayesian approach would result in a defense verdict (plaintiff has not satisfied its burden of persuasion), yet that is perverse from the point of view of reducing errors. By contrast, an explanatory account avoids this perverse result by focusing on the relative plausibility of the parties' explanations.

[104] The same applies, with the necessary adjustments, for criminal cases and ''clear and convincing'' cases.

[105] Juries are not explicitly instructed to do this, but it is plausible to suppose that they do so because explanatory criteria are used to infer holistic narratives of events before receiving jury instructions. See Pennington and Hastie, supra note 3; Shari Seidman Diamond, Mary R. Rose, and Beth Murphy, 'Revisiting the Unanimity Requirement: The Behavior of the Non-Unanimous Civil Jury,' 100 *Northwestern University Law Review* (2006): 201, 212 (''The deliberations of these 50 cases revealed that jurors actively engaged in debate as they discussed the evidence and arrived at their verdicts. Consistent with the widely accepted 'story model,' the jurors attempted to construct plausible accounts of the events that led to the plaintiff's suit. They evaluated competing accounts and considered alternative explanations for outcomes.'').

Relative plausibility provides an easy, non-perverse answer: plaintiff wins.[106]

Although the Bayesian objections do not threaten explanation-based approaches at the macro-level, the Bayesian may also object at the micro-level.[107] Several recent attempts have been made to model the probative value[108] of particular items of evidence in supporting particular factual conclusion. They work by employing likelihood ratios and Bayes' Theorem to attempt to fix numerically the value of evidence.[109] Such models have been used to model the value of evidence as diverse as "random match" DNA samples,[110] infidelity,[111] and carpet fibers.[112] If successful, these models present clear advantages over, and objections to, explanation-based approaches. The formal probability models appear to provide more precision, which would thus make them particularly useful in deciding issues like the admissibility of evidence[113] and whether evidence

[106] Schum, supra note 3 at 1655, has criticized IBE on a similar ground: "If we say we have the 'best' explanation . . . we must also be assured we have canvassed all possibilities." The legal system, however, addresses this concern by allowing parties to present the explanations they believe to be most favorable. There are an infinite number of possible explanations; it would, of course, be nonsensical to construct a decision procedure requiring that they all be canvassed. The explanatory account handles this situation through a comparative approach; a probability account that must aggregate all possibilities falls prey to it.

[107] Friedman has thus posed the following challenge: I cannot recall the Bayesioskeptics ever offering any criticism about particular uses of probabilistic methods as a tool for analyzing evidentiary questions; the challenges always seem to be at the general level, concerning the value of the enterprise itself or the overall standard of persuasion. Richard D. Friedman, 'Answering the Bayesioskeptical Challenge,' *International Journal of Evidence and Proof* 1 (1997): 276, 290 (1997). We offer criticism of the use of such methods at the micro-level in Allen and Pardo, supra note 4.

[108] Fed. R. Evid. 403.

[109] For examples see the articles cited in note 2.

[110] Nance and Morris, supra note 2.

[111] Davis and Follette, supra note 2.

[112] Finkelstein and Levin, supra note 2.

[113] As mentioned earlier, the probative value could be defined as either the likelihood ratio, see Nance and Morris, supra note 2, or as the difference between the prior probability without the evidence and the posterior probability with it, Davis and Follette, supra note 2.

is sufficient to meet a standard of persuasion. They also pose a challenge to an apparently less formal and less precise explanation-based account—because the probability model may have fixed the value based on "objective" data (typically base rates), explanatory conclusions will err to the extent that they deviate from the results dictated by the probability model.[114]

The explication of probative value, rather than providing a telling critique of explanatory approaches, demonstrates that probability models have it backwards, for these models do not capture the objective value of legal evidence. Instead, they err to the extent they deviate from the results generated by explanatory criteria and are useful to the extent they respect and supplement those results. This may be illustrated with an example from Tversky and Kahneman:

> A cab was involved in a hit and run accident at night. Two cab companies, the Green and the Blue, operate in the city. You are given the following data:(a) 85% of the cabs in the city are Green and 15% are Blue.(b) a witness identified the cab as Blue. The court tested the reliability under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time.What is the probability that the cab involved in the accident was Blue rather than Green?[115]

Employing this data and Bayes' Theorem, the authors conclude that the correct result should be .41.[116] And thus that, despite the witness's report, the cab involved is more likely to be Green. Test subjects given this information frequently ignored the base-rate data and the median answer was that the probability of it being Blue was .80. By contrast, when subjects were given the following data instead—"Although the two

[114] See Nance and Morris, supra note 2, who construct a "Bayesian norm" to measure juror performance in assessing DNA evidence. Jurors are considered correct or rational to the extent their assessments match the "Bayesian norm" and incorrect to the extent to which they deviate from it. We critique these studies in Allen and Pardo, supra note 4.

[115] Amos Tversky and Daniel Kahneman, 'Evidential Impact of Base Rates,' in *Judgement Under Uncertainty: Heuristics and Biases* (Kahneman, Paul Slovic and Tversky eds.) (Cambridge University Press, 1982).

[116] Id. at 157. The probability that the cab was blue given the testimony is calculated via Bayes' Theorem as $.80 \times .15/(.80 \times .15) + (.20 \times .85) = .12/.12 + .17 = .41$.

companies are roughly equal in size, 85% of cab accidents in the city involve Green cabs and 15% involve Blue cabs''—the median answer dropped to .60.[117] Their article suggests that this is a mistake; the answer should have remained the same under both scenarios (.41).[118]

We respectfully disagree. The authors point out the key difference that there is a causal component in the second scenario: ''the difference in rates of accidents between companies of equal size readily elicits the inference that the drivers of the Green cabs are more reckless and/ or less competent that the drivers of the Blue cabs.''[119] The difference, in other words, is explanatory. A causal explanation explains why more Green cabs are involved in accidents and also why the one involved in this crash is more likely to be Green—namely, that Green cabs are driven by bad drivers. This conclusion explains the evidence and thus is inferred to be more likely on that basis. By contrast, no such explanatory connection exists in the first scenario—the fact that a Green cab caused the accident simply does not explain why they own 85% of the cabs in town, nor is another explanation readily apparent that would explain both pieces of data.

Moreover, the data in the both scenarios are subject to a reference class problem,[120] which undermines the conclusion that the correct answer is .41. A Green cab either was involved or it was not, meaning the probability is 0 or 1. Base-rate data regarding the prevalence of Green cabs in town is just one of the infinite number of classes of which the event may be an instantiation. For example, how many Green cabs travel on the particular street (suppose it's 85% Blue, now the conclusion switches); how many on the street at that time of day (suppose

[117] Id.

[118] Id. at 156 (''From a normative standpoint, however, the causal and the incidental base rates in these examples should have roughly comparable effects.'').

[119] Id. at 158–59. They continue: ''This inference accounts for the differential base rates of accidents and implies that any Green cab is more likely to be involved in an accident that any Blue cab'') Id. at 159.

[120] The reference-class problem and its limitations for mathematical models of evidence is discussed in more detail in Allen and Pardo, supra note 4.

it's 85% Green, it now switches back); and so on. We can continue to specify more and more detailed classes, but eventually we will arrive at the event itself, again with a probability or 0 or 1. The incidental base rates, thus, are subject to a particular reference class and without some guarantee that there is some degree of homogeneity within the class (e.g., are Green cabs 85% more prevalent everywhere in town?), the data may not be very useful in telling us about the particular event.[121]

Compare the explanation-based approach. Explanations help to form the needed connections. An explanation that Green drivers are indeed bad potentially explains both the class data and the particular event under discussion, thereby also suggesting the needed relative homogeneity.[122] Now, of course, there are reference-class concerns here as well.[123] Perhaps the particular Green drivers out that night have pristine driving records. But if such evidence is introduced, the original explanation ceases to best explain the evidence regarding the event and hence becomes less likely. But given the stronger explanatory connection in scenario two, we think the subjects were justified in employing the strategy of inferring that a certain conclusion was more likely when there is a stronger explanation linking the evidence and the event at issue.[124] Probability-based approaches must respect how explanatory considerations guide inference and likelihood assessments[125]; they risk rendering erroneous conclusions when they do not.[126]

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[121] See Allen and Pardo, supra note 4.

[122] Inferential interests pick out which variables are relevant.

[123] Indeed, this may best explain why the median in the second scenario was .60 (rather than, say, .85 or .41).

[124] The authors' ultimate conclusion is the following: "The major conclusion of this research is that the use or neglect of consensus information in individual prediction depends critically on the interpretation of that information." Tversky and Kahneman, supra note 114 at 160. To that we would add that it will be explanatory considerations driving that interpretive process. And rightly so.

[125] The best way to do so appears to be to allow for subjective assessments based on explanatory criteria. For an example see Friedman, supra note 75.

[126] For examples see Allen and Pardo, supra note 4.

When it comes, therefore, to assessing the probative value of items of evidence, one must focus on explanatory criteria. The probative value of evidence is the extent to which it supports an inference in a particular context.[127] The strength of this inference will depend on how well it explains the evidence, and this in turn will be determined by the inferential interests of the decision-maker and the contrasting explanations at issue in the case (recall the maid example). We suspect that those who favor the probability approaches will dislike the lack of formality and precision in this answer, but these features are part of the world, not defects in the explanation-based approach.

III. IMPLICATIONS OF THE DEBATE

Neglect of explanatory considerations, and focus instead on probability models, has obscured aspects of the proof process and offered misleading advice to guide and constrain legal decision-makers. We now discuss in more detail the implications and benefits that flow from recognizing the explanation-based nature of juridical proof. The implications are descriptive, explanatory, and normative, and the benefits include greater understanding of various aspects of the proof process as well as help in guiding and constraining judicial and juror decision-making.

The explanation-based account better explained the proof process at both the micro- and macro-levels than did the probability account. At the micro-level, we demonstrated that the relevance and probative value of evidence depends on the explanatory relationships between evidence and facts of consequence in particular cases. At the macro-level, we demonstrated that standards of persuasion are better understood in terms of explanations (rather than in terms of cardinal probabilities). Understanding the standards in terms of competing explanations more accurately describes what occurs at trial, is consistent with the our best understanding of the reasoning processes of jurors, avoids the formal conjunction paradox, and allows the standards to fulfill their function of distributing

[127] See Pardo, supra note 54.

errors among the parties and ultimately increasing the accuracy of outcomes.

These conclusions, in turn, explain further aspects of the proof process. If the probability account were true at the micro-level, and the value of evidence could be quantified, then the law could create more-detailed evidence rules specifying admissibility criteria, or lists of admissible evidence, based upon its quantified value.[128] The Federal Rules of Evidence reject this approach, and instead employ an open-ended system.[129] The explanatory nature of the process explains why. If the value of evidence depends on how it supports the relative plausibility of the competing explanations the parties offer, as determined by jurors based on the background knowledge they each bring to court, then it would be impossible to specify detailed rules for determining such value in advance.

And at the macro-level, the explanation-based account better explains reliance on jurors in the first place and the existence of devices such as summary judgment, judgment as a matter of law, and motions for a new trial.[130] If the probability account were true, then the sum total of the moving party's evidence could be quantified and compared with a similarly quantified standard of persuasion. If this could be done, then the jury (and *a fortiori* the above-mentioned devices) would become superfluous. By contrast, under the explanation-based account, jurors are necessary to provide the background knowledge to make contextual judgments about the strength of competing explanations and to suggest new ones—the confluence between this process and everyday judgments based on similar explanatory considerations is precisely what explains and justifies its use. Devices like summary judgment—including all measures of the sufficiency of the evidence to support judgments or verdicts—are necessary to ensure that the moving party has provided enough evidence to the jury such that they could reasonably infer the explanation that the moving party has

[128] See Allen, supra note 31 at 630–31.

[129] See Fed. R. Evid. 401, 403. The additional federal rules regulating relevance do so for the most part for policy reasons beyond the logical relevance or probative value of the evidence. See Fed. R. Evid. 404–15.

[130] Id. at 632.

provided (i.e., that in the civil context the moving party's explanation could be the better explanation or that in the criminal context the prosecution's explanation could be the only plausible explanation).[131]

In addition to providing a more accurate description of the proof process and a better explanation of its features, the explanation-based account also helps to guide and constrain legal decision-making. This guidance and constraint is broad and significant—applying to the admissibility of every kind of evidence, to the assessments of judgments in both civil and criminal cases, and to jury instructions.

First, the admissibility of all evidence depends on judgments about its relevance and probative value. To make these judgments, trial judges (and reviewing appellate judges) ought to consider the quality of competing explanations in the context of the case, rather than simply consulting known objective data or their own subjective probability assessments. This is true regardless of whether one is considering testimony regarding first-hand observations,[132] scientific evidence such as DNA or fingerprints,[133] or any other kind of overtly statistical evidence.[134] In every case, the probative value of evidence will be determined by what best explains it. Thus, judges assessing the value of evidence ought to consider how strongly a reasonable jury could find that the explanation provided by the proffering party explains the evidence. This is its probative value. If either

[131] Such devices may be justified on grounds of both efficiency and to ensure the reliability or social plausibility of judgments. See id. at 632.

[132] The assessment of all testimony requires an abductive inference about what best explains why the witness is making the assertions. See Thagard, supra note 2; Jonathan E. Aldler, 'Testimony, Trust, Knowing,' *Journal of Philosophy* 71 (1994): 264, 274–75.

[133] Even though DNA evidence may be presented as a "random match" probability, this number is not its probative value. See Allen and Pardo, supra note 4 (discussing Nance and Morris, supra note 2). Fact-finders must still make inferential judgment about what explains the result, taking account of such possibilities as whether lab error occurred, whether the evidence could have been planted, and whether other suspects may share similar DNA (with mitochondrial DNA, for example, whether the suspects share the same mother).

[134] See, for example, the Blue-cab example discussed above.

the party's explanation is not relevant to a fact of consequence in the case or a reasonable jury could not find that the explanation proffered explains the evidence, then the evidence is irrelevant.[135]

Second, because standards of persuasion turn on explanatory criteria, the criteria ought to guide and constrain judicial decisions. In civil cases, the standard for both summary judgments and judgments as a matter of law turns on whether any reasonable jury must find for one side over the other.[136] Scholars have lamented the lack of clarity with regard to this standard.[137] But a focus on competing explanations helps to explain and clarify it. In explanatory terms, it means that a judge ought to grant such a motion only if a jury would have to

[135] That judges ought, and do, engage in more contextual judgments further vindicates the explanation-based account as descriptively accurate. See Old Chief v. United States, 519 U.S. 172 (1997); Anderson v. Griffin, 397 F.3d 515 (7th Cir. 2005) (''Events that have a very low antecedent probability of occurring do sometimes occur ... and if in a particular case all the alternatives are ruled out, we can be confident that the case presents one of those instances in which the rare event did occur.'') And, as the Blue-cab example illustrated, this practice is also epistemically sound.

[136] See Anderson v. Liberty Lobby, Inc. 477 U.S. 242, 250–57 (1986).

[137] See, e.g., Arthur R. Miller, 'The Pretrial Rush to Judgment: Are the ''Litigation Explosion,'' ''Liability Crisis,'' and Efficiency Cliches Eroding our Day in Court and Jury Trial Commitments?,' *N.Y.U. Law Review* 78 (2003): 982; James Joseph Duane, 'The Four Greatest Myths about Summary Judgment,' *Washington & Lee Law Review* 52 (1996): 1523, 1554–62.

find one side's explanation more plausible than the other side's explanation.[138] Trial judges (and reviewing appellate courts) can thus implement the standard by explaining why one side's explanation must be inferred by every reasonable jury or why the other side's explanation must be rejected by every reasonable jury. In criminal cases, defendants may challenge a criminal conviction when, based on the evidence presented, no reasonable jury could find them guilty beyond a reasonable doubt.[139] In explanatory terms, this means that no reasonable jury could find his explanation to be implausible or that all of the plausible explanations imply his guilt. Trial judges (and reviewing appellate courts) can implement this standard by considering whether a reasonable jury must accept the defendant's explanation of the evidence as plausible or whether a reasonable jury could accept the prosecution's explanation as

[138] The Supreme Court employed an explanatory approach in a summary-judgment case in City of Los Angeles v. Alameda Books, Inc., 535 U.S. 425, 437 (2002) (''Neither the Court of Appeals, nor the respondents, nor the dissent provides any reason to question the city's theory. In particular, they do not offer a competing theory, let alone data, that explains why the elevated crime rates in neighborhoods with a concentration of adult establishments can be attributed entirely to the presence of walls between, and separate entrances to, each individual adult operation.'') In the antitrust context, the Court's opinion in Matsushita Elec. Indus. Co. v. Zenith Radio Corp., 475 U.S. 574, 587 (1986), created some confusion by its phrasing: ''if the factual context renders respondents' claim implausible–if the claim is one that simply makes no economic sense–respondents must come forward with more persuasive evidence to support their claim than would otherwise be necessary.'' But as the phase ''no economic sense'' suggests, the standard is not whether the court thinks an explanation is implausible, it is whether any reasonable jury could find it to be plausible. The Court later clarified that the standard is the latter. See Eastman Kodak Co. v. Image Tech. Serv. Inc., 504 U.S. 451, 468–69 (1992).

[139] Jackson v. Virginia, 443 U.S. 307, 324 (1979) (articulating standard as whether ''[n]o rational trier of fact could have found proof of guilt beyond a reasonable doubt.'') Defendants may also file ''motions for acquittal'' at trial based on the same sufficiency standard. See Fed. R. Crim. P. 29.

the only plausible one (or that all the plausible explanations imply guilt).[140]

Finally, in addition to providing guidance to judges (and to lawyers who must construct arguments), the explanatory criteria could be made more explicit to the jurors themselves and emphasized to the judges when sitting as fact finders, the decision-makers charged with the task of evaluating explanations. In civil cases, instructions on the preponderance standard are generally "unhappily pegged to a theory of subjective probability estimates."[141] For example, a typical jury instruction defines "preponderance of the evidence" as "When you have considered all the evidence in the case, you must be persuaded that it is more probably true than not true."[142] Jurors, however, are not generally given any further guidance in how to implement the standard. Jurors are already assessing the relative plausibility of competing explanations. Their task could be further clarified by explicitly instructing them to implement the standard with these explanatory considerations. For example, they could be told to select the best explanation of the evidence (or the most plausible version of the litigated events) and that

[140] For examples employing these considerations, see United States v. Beard, 354 F.3d 691, 693 (7th Cir. 2004) ("Relative to the alternatives, the government's case was more powerful than it would have seemed in the abstract."); United States v. Newell, 239 F.3d 917, 920 (7th Cir. 2001). When the defendant does not offer a particular explanation of the evidence, but instead attempts only to poke holes in the prosecution's theory, the *Jackson* standard may still be met by showing that the prosecution's theory is implausible. In such a case, the reasonable inference is not that there is a plausible explanation which implies innocence, but rather that the prosecution has not met its burden of providing a plausible explanation.

[141] Laudan, supra note 45.

[142] Federal Civil Jury Instructions of the Seventh Circuit 34 (available at www.ca7.uscourts.gov). The instructions define the "clear and convincing" standard as "you are convinced that it is highly probable that it is true." Id. at 35.

something has been proven by a preponderance of the evidence if it is part of their selected explanation or version of events.

In criminal cases jurors typically are given even less guidance in implementing the "beyond a reasonable doubt" standard. Extant instructions vary between providing no guidance at all[143] and unhelpful platitudes.[144] As Larry Laudan has recently argued, much of the confusion surrounding the standard arises because instructions focus more on the subjective mental state the jurors ought to have rather than on providing them with guidance in how to draw conclusions from the evidence (other than consulting their subjective mental states).[145] Making the explanatory task explicit provides this missing guidance. It may not be necessary, or helpful, to *define* "reasonable doubt" in terms of explanations, but instructing the jury to consider, for example, "whether there is a plausible explanation or version of events consistent with innocence" or "whether the prosecution's explanation or version of events is the only plausible one" or "whether all plausible explanations or versions imply guilt" may provide much needed guidance and clarity to this area.

IV. CONCLUSION

We have attempted to demonstrate how the process of inference to the best explanation illuminates the nature of juridical proof. Explanatory considerations guide the inferential processes at trial, and the trial's structural features may be explained in terms of these considerations. The strengths and weaknesses of competing explanations illuminate micro-level issues regarding relevance and probative value, and the explanation-based account of these phenomena explains the evidence

[143] Some states and federal circuits either require judges not to define the standard or do not require a definition. The Supreme Court has concluded that a definition is not required. Victor v. Nebraska, 511 U.S. 1, 5 (1994) ("the Constitution neither prohibits trial courts from defining reasonable doubt nor requires them to do so as a matter of course.").

[144] In *Victor*, for example, the Court discussed whether definitions of the standard that use the phrase "to a moral certainty" were problematic.

[145] Laudan, supra note 48 at 51–62.

law regulating these issues, in particular the open-ended rules regarding admissibility. The strengths and weaknesses of competing explanations also illuminate macro-level issues regarding standards of persuasions in both civil and criminal cases, and the explanation-based account of these phenomena accords with the our best understanding of the reasoning processes of jurors, avoids the formal conjunction paradox, and allows the standards to distribute errors among the parties. In addition, it explains the law's reliance on jurors and the existence of devices such as summary judgments, judgments as a matter of law, and other "sufficiency of the evidence" standards. Although our primary focus has been descriptive and explanatory, we have also pointed out ways that the system could be brought into further accord with the explanatory nature of the proof process: these included the explicit use of explanatory criteria to guide and constrain judicial decisions regarding admissibility and judgments and to instruct jurors.

Ultimately, this article is an example of the very process it has attempted to vindicate. We have attempted to provide a better explanation of the legal proof process and its features than current extant explanations, which rely on concepts from probability theory. We have done this by providing a more accurate description, explaining more of the phenomena, and demonstrating the epistemically justified implications that flow from this account. We thus hope that the reader infers our account as "fact" to the "foil" of the probability account. If so, we will have provided not only the best explanation in terms of content but vindicated the methodology of IBE as well.

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