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EXPLORING THE PROOF PARADOXES*

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This article explores a long-running debate in evidence theory about the significance of certain puzzling cases where there is reluctance to ascribe liability despite a high probability of liability. It focuses on certain analyses of these puzzles, distinguishing between inferential, moral, and knowledge-based analyses. The article emphasizes the richness and complexity of the puzzle cases and suggests why they are difficult to resolve.

I. INTRODUCTION

A simple way of understanding standards of proof is in terms of degrees of probability. On this account, to prevail in a civil case a claimant need only prove the defendant's liability to a degree above 0.5. For the prosecution to succeed in a criminal case, it needs to prove guilt to a considerably higher degree: 0.95, say (the exact figure is not important; all that matters is that a certain degree of probability by itself suffices). As well as being intuitively attractive, this account is able to draw on the theoretical resources of decision theory, which suggest that the 0.5 standard minimizes expected errors and maximizes expected utility, and that a suitably high standard in criminal cases will also maximize expected utility.[1] The proof paradoxes are a set of examples, well known to evidence lawyers, that are often taken to suggest that there is something wrong with this probabilistic account of standards of proof. One example is Blue Bus: Mrs. Brown is run down by a bus on Orange Street; 60 percent of the buses that travel along this street are owned by the blue bus company, and 40 percent by the red bus company. The only witness is Mrs. Brown, who is color-blind. Mrs. Brown appears to be able to establish a 0.6 probability that she was run down by a blue bus. Yet the overwhelming intuition is that the 60 percent statistic is not sufficient

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1. Good accounts include D.H. Kaye, *Clarifying the Burden of Persuasion: What Bayesian Decision Rules Do and Do Not Do*, 3 EVIDENCE & PROOF 1 (1999); D. Hamer, *Probabilistic Standards of Proof, Their Complements, and the Errors That Are Expected to Flow from Them*, 1 U. N. ENG. L.J. 71 (2004).

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for Mrs. Brown to prove her case in a civil trial. Thus, the argument goes, proof involves something more than just probability.

This article undertakes a detailed examination of this type of "proof paradox." There are other proof paradoxes, such as the conjunction problem, which are also said to raise difficulties for the probabilistic account of proof;[2] they are not discussed here because they are not obviously connected to Blue Bus–type paradoxes which, in any case, are sufficiently complex to call for separate analysis. In the discussion to follow, then, "proof paradox" refers to examples like Blue Bus. Because of the restricted focus, the aim of this article is not to establish whether a probabilistic conception of proof is correct. The aim, rather, is to look in detail at Blue Bus–type examples, to assess the extent to which, by themselves, they support the "not just probability" argument.

Much has been written about the proof paradoxes,[3] and readers familiar with the literature will doubtless be wondering what more there is to say about them. There are two main reasons for embarking on a new assessment. One is that the paradoxes have never received a satisfactory resolution: there is no consensus in the literature on what lessons to draw from examples like Blue Bus. While the current analysis does not claim to offer a definitive solution, it does aim to progress the debate by mapping approaches to the paradoxes and suggesting reasons that consensus has been hard to achieve. A second reason for revisiting the paradoxes is that recent work in epistemology has devoted considerable attention to examples that bear some similarity to the proof paradoxes and so provides new resources with which to explore them.

II. THE EXAMPLES

There are various versions of Blue Bus–type paradoxes. It is worth starting by setting out several of them; the differences between them are important because they give us a broad set of data against which we can test explanations.

- *Blue Bus.* See above.
- *Prisoners.* One hundred prisoners are exercising in the prison yard. Ninety-nine of them suddenly join in a planned attack on a prison guard; the hundredth prisoner plays no part. There is no evidence available to show who joined in and who did not. Is the 0.99 probability that a particular prisoner is guilty enough to prove beyond reasonable doubt that he is guilty? The intuition is that it is not. This does not seem to be explained by the fact that 0.99 is not a high enough

2. *See, e.g.*, L.J. COHEN, THE PROBABLE AND THE PROVABLE (1977), ch. 5; R.J. Allen & S.A. Jehl, *Burdens of Persuasion in Civil Cases: Algorithms v. Explanations*, 4 MICH. ST. L. REV. 893 (2003).

3. An excellent review of the literature is H.L. HO, A PHILOSOPHY OF EVIDENCE LAW: JUSTICE IN THE SEARCH FOR TRUTH (2008), at 135–143.

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probability to satisfy beyond reasonable doubt: the intuition is still there if we increase the number of prisoners to one thousand.[4]

- *Predicting Violence.* Suppose that reliable studies show that 50 percent of males who are brought up in broken homes, are addicted to drugs, and are unemployed go on to commit serious acts of violence. Can we use that as a basis for giving D, who has these characteristics, a longer-than-normal sentence because he poses a risk to the public? Or could we use these facts at D's trial as supplementary evidence to show that he committed an act of violence? The intuition, particularly on the second of these questions, is that we cannot.[5]
- *Summers and Tice.* S and T are hunting, and both negligently fire their guns into the woods. A pellet from one of the guns hits V. S had 60 pellets in his gun and T had 40. Can V successfully sue S? Again, the intuition is that he cannot.[6]
- *Shonubi.* S is found to have entered the United States with a number of heroin-filled balloons in his stomach. It is known that he has made several other heroin smuggling trips, taking the same Nigeria-U.S. route, but he was not caught on those trips. To sentence him, the court needs to know the total amount of heroin that S has smuggled into the country. To this end, it acquires statistics on other Nigeria-U.S. balloon-swallowing heroin smugglers and uses the average amount smuggled as the basis for a calculation of the total amount smuggled by S. Some people are uneasy about this method of calculating the amount smuggled, and in the actual case the appeal court refused to allow S to be sentenced on this basis.[7]

It is worth making some general comments about these examples before exploring in detail the more promising attempts to resolve them. I suggest above that there are clear intuitions about some of these cases. Certainly, with the key examples of Blue Bus and Prisoners, most people are very troubled by the idea of ascribing liability. Empirical research on Blue Bus demonstrates this clearly: even though subjects agree that the probability that the blue bus company is liable is 0.6, they will not find for Mrs. Brown.[8] When it comes to court decisions, things are not quite so clear-cut, but that is partly because actual cases are rarely as simple as the hypothetical examples.[9] Liability was denied in *Smith v. Rapid Transit, Inc.*,[10] a case reasonably close to Blue Bus. Shonubi is an actual case, and while the trial judge was

4. This example originates in C.R. Nesson, *Reasonable Doubt and Permissive Inferences: The Value of Complexity*, 92 HARV. L. REV. 1187 (1979).

5. The example is taken from R.A. Duff, *Dangerousness and Citizenship*, *in* FUNDAMENTALS OF SENTENCING THEORY: ESSAYS IN HONOUR OF ANDREW VON HIRSCH (A. Ashworth & M. Wasik eds., 1998).

6. A variation on Summers v. Tice, 33 Cal.2d 80, 199 P.2d 1 (1948). In the actual case, the court found both defendants liable. This version is taken from J.J. Thomson, *Liability and Individualized Evidence*, *in* RIGHTS, RESTITUTION AND RISK: ESSAYS IN MORAL THEORY (W.A. Parent ed., 1986).

7. The *Shonubi* case gave rise to a number of different judgments. For an introduction to the litigation, *see* A.J. Izenman, *Introduction to Two Views on the Shonubi Case*, *in* STATISTICAL SCIENCE IN THE COURTROOM (J.L. Gastwirth ed., 2000).

8. G.L. Wells, *Naked Statistical Evidence of Liability: Is Subjective Probability Enough?*, 62 J. PERSONALITY & SOC. PSYCHOL. 739 (1992).

9. A useful review of the case law is J.J. Koehler, *When Do Courts Think Base Rate Statistics Are Relevant?*, 42 JURIMETRICS J. 373 (2002).

10. 371 Mass. 469, 58 N.E.2d 754 (1945).

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happy to sentence Shonubi on the basis of statistics obtained from other smugglers, the court of appeals overturned the sentence, demanding "specific" evidence of the amount smuggled.[11] This decision has drawn both criticism and approval.

One might wonder whether it is simply the quantification of proof that causes problems in these examples. The empirical research suggests that it is not: in a variation of Blue Bus in which a witness identifies the bus as blue but is shown to make mistakes in 40 percent of cases, subjects are happy to find liability.[12] Our experience with DNA cases, too, suggests that courts are reasonably happy to convict on the basis of probabilistic evidence. This hints that it is something to do with the particular type of quantified evidence that is causing problems in the above examples.

As we see above, in *Shonubi* the Court of Appeals tried to articulate the problem with the evidence in terms of its lack of "specificity." The argument that there is something lacking in the evidence in the above examples because it is too general and does not relate specifically to the defendant is initially attractive. But it turns out to be difficult to explain how the generality in these examples differs from that in other examples that do not meet with reluctance to ascribe liability.[13] "Drugs records" was an example given by the *Shonubi* court of evidence that would meet its specific evidence requirement.[14] But even if we discover that Shonubi keeps a notebook recording quantities of drugs smuggled, we are able to draw an inference from this only by making generalizations about the likely veracity of such notes (e.g., "people do not generally record incriminating information unless it is true"), generalizations that will not relate specifically to Shonubi. If there is something to the call for specific evidence, then, it is likely that "specific evidence" is a placeholder for some more complex idea, various possibilities for which emerge in the more detailed analysis to follow.

There are other accounts of the proof paradoxes that are not very satisfying. For example, it has been suggested that we deny liability in Blue Bus for policy reasons, because otherwise the blue bus company would end up paying damages in every case similar to Mrs. Brown's, even though it was responsible for the accident in only 60 percent of them.[15] The empirical research does not support this theory,[16] and in any case, it is doubtful that this rather sophisticated explanation can account for the basic intuition prompted by the scenario. Similarly, the claim that the examples are unrealistic, that there will always be some other evidence available beyond the

11. United States v. Shonubi, 998 F.2d 84 (2d Cir. 1993); *see also* United States v. Shonubi, 103 F.3d 1085 (2d Cir. 1997).

12. Wells, *supra* note 8.

13. *See, generally*, F. SCHAUER, PROFILES, PROBABILITIES, AND STEREOTYPES (2003), ch. 3.

14. *See Shonubi*, 998 F.2d at 89.

15. *See, e.g.*, R.A. Posner, *An Economic Approach to the Law of Evidence*, 51 STAN. L. REV. 1477 (1999), at 1509.

16. *See* Wells, *supra* note 8.

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"naked statistic,"[17] does not explain the actual decision in *Shonubi* nor what seems to be the reluctance to allow the evidence to play even a supporting role in Predicting Violence.

In what follows, analyses of the proof paradoxes are divided into three groups. The first involves criticisms of the inference drawn in the examples: it may be argued that in Blue Bus we simply should not conclude that the probability of liability is 60 percent or that there is something qualitatively problematic about this conclusion. The second type of analysis involves the claim that the problem in these examples is moral rather than epistemic. The third type of account, which I refer to as knowledge-based, bears some similarity to the first, but rather than concentrating on inference, it emphasizes parallels with various problem cases in the analysis of knowledge.

III. INFERENTIAL ACCOUNTS

Because the gist of the inferential accounts is that there is a problem in the assumption that the relevant probability—for example, the 0.6 in Blue Bus—is well founded, it is worth saying something about the notion of probability relied on here. If we focus on Blue Bus, it is tempting to say that the 0.6 probability of liability is an objective probability, one that is correct and leaves no scope for disagreement. There are, however, well-known difficulties with objective accounts of probability.[18] It is, then, tempting to say that the probability is subjective, but we need to be careful here. "Subjective probability" is often taken to refer to an account of probability where there are no constraints on probability assignments other than coherence.[19] On this view, you would be free to assign a probability as high as 0.99 to a proposition as unlikely as "the moon is made of cheese," as long as your other probability assignments do not conflict with this.[20] That is not an attractive view.[21] The notion of probability underlying the discussion here lies somewhere between these two extremes. The way to understand claims such as "the probability that the blue bus company is liable is 0.6" is not that this is an objective, unarguable fact about the world, nor that it is a mere statement of personal opinion. The idea, rather, is that while "0.6" is subjective, or personal, insofar as it expresses a degree of confidence, it can be given some degree of justification, or rational defense. This view is fleshed out below.

17. *See, e.g.*, Posner, *supra* note 15, at 1510.

18. For an overview, *see* M. Redmayne, *Objective Probability and the Law of Evidence*, 2 LAW, PROBABILITY & RISK 275 (2003).

19. *See, e.g.*, B. de Finetti, *Probabilism: A Critical Essay on the Theory of Probability and on the Value of Science*, 31 ERKENNTNIS 169 (1989).

20. Thus you could not also assign P (0.8) to "the moon is not made of cheese" or to "no large objects are made of cheese."

21. *See* M. KAPLAN, DECISION THEORY AS PHILOSOPHY (1996), at 85–88.

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Reference Classes

The reference-class problem is a well-known problem in the theory of probability.[22] A typical example of the problem goes as follows: suppose we want to know the probability that forty-year-old John Smith will live to age sixty. We might have a statistic that, say, 95 percent of forty-year-old men live to age sixty, and draw a conclusion about Smith on that basis. But suppose that Smith is a smoker who eats well and exercises regularly and whose hobby is skydiving. We might know that only 90 percent of smokers live to sixty; we might also have different statistics for each of the other factors that we know relate to Smith. Relative to each reference class—the reference class of smokers, of healthy eaters, and so on—we would have a different probability of Smith's living to age sixty. What, then, is *the* probability that Smith will live to sixty? It seems that there is no such thing, especially when we realize that there may be many relevant factors about Smith—his family history, for example—about which we have no information. Stated generally, then, the reference-class problem is that when we use a frequency to calculate a probability, the choice of reference class affects the probability, and there may be no obvious way of choosing the "right" reference class.[23]

Allen and Pardo, as well as Colyvan, Regan, and Ferson, have suggested that the reference-class problem plays a role in some of the proof paradoxes.[24] Both sets of authors employ counterintuitive examples to illustrate the issues. In Blue Bus we know the proportion of blue buses that use the relevant street, and that is used as the basis for the probability of liability. Allen and Pardo suggest, however, that there may be different proportions of red and blue buses in the town as a whole, or right across the county, and these town or county reference classes would give us different probabilities of liability.[25] In *Shonubi*, the court used statistics from other drug smugglers to calculate the amount Shonubi smuggled. Shonubi worked as a toll collector on the George Washington Bridge. Why not, Colyvan et al. ask, use the toll collectors as the reference class, the presumption being that, again, this would lead us to a different conclusion about the amount smuggled?[26]

The obvious response to these arguments is that these references classes are intuitively not the most appropriate ones: Nigerian drug smugglers are more relevant to the inferential process than are toll collectors, and buses

22. *See, e.g.*, D. GILLIES, PHILOSOPHICAL THEORIES OF PROBABILITY (2000), at 119–125.

23. While the reference-class problem is generally associated with frequentist theories of probability, it can be molded to fit other theories of probability, too, with the exception of the extreme subjectivism rejected above. *See* A. Hájek, *The Reference Class Problem Is Your Problem Too*, 156 SYNTHESE 563 (2007).

24. R.J. Allen & M.S. Pardo, *The Problematic Value of Mathematical Models of Evidence*, 36 J. LEGAL STUD. 107 (2007); M. Colyvan, H.M. Regan & S. Ferson, *Is It a Crime to Belong to a Reference Class?* 9 J. POL. PHIL. 168 (2001), *reprinted in* PROBABILITY IS THE VERY GUIDE OF LIFE: THE PHILOSOPHICAL USES OF CHANCE (H.E. Kyburg & M. Thalos eds., 2003).

25. Allen & Pardo, *supra* note 24, at 109.

26. Colyvan, Regan & Ferson, *supra* note 24, at 172.

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on the street are more relevant than those in the county. Colyvan et al. appear to accept that the toll-collector argument is a bad one;[27] it seems to have been used to prompt us to see that we have no reason to assume that the reference class of Nigerian drug smugglers is "privileged." For their part, Allen and Pardo would probably be satisfied by the response outlined above; their principal point is the uncontroversial one that formal models of inference always rely on judgment. But Allen and Pardo's discussion also touches on what might seem to be a more serious problem in Blue Bus: what if, unbeknown to us, the blue bus company had a better safety record than the red bus company?[28] Then there would be an intuitively relevant alternative reference class, and this would seem to destabilize the inference that the blue bus company is liable.

There are several reasons why arguments based on the reference-class problem do not offer a satisfactory analysis of the proof paradoxes. Perhaps the most important point to note is that reference-class arguments can be applied to all sorts of evidential inferences, including ones that are not normally taken to prompt antiliability intuitions. Suppose that instead of the bus-ownership statistics, we have an eyewitness who testifies that the bus she saw hit Mrs. Brown was blue. Standard evidence theory is that this evidence can be used to support a finding of liability only via a generalization such as "most eyewitnesses are reliable."[29] But, just as with *Shonubi*, the eyewitness is a member of a very large number of reference classes, and some of these reference classes may generate inferences of a different strength.

In practice, of course, we will try to refine the reference class that forms the basis of the generalization by taking into account intuitively relevant factors such as the witness's eyesight and the conditions under which she saw the accident. But it is clear that the mere fact that the subject of an inference is a member of multiple reference classes cannot block inference, for then all our inferences would be paralyzed. In fact, when it comes to Colyvan et al.'s argument, it seems that the reference-class problem is not really the issue. What they particularly object to is that in order to calculate the amount Shonubi smuggled, we are making assumptions, such as that Nigerian drug smugglers are likely to smuggle similar amounts of drugs to each other.[30] Perhaps there is room to argue that in *Shonubi* the prosecution could have

27. *See* M. Colyvan & H.M. Regan, *Legal Decisions and the Reference Class Problem*, 11 EVIDENCE & PROOF 274 (2007), at 279, where the toll-collector argument is described as a "bad defence." This is not as obvious in the original article.

28. Allen & Pardo, *supra* note 24 at 109.

29. *See* D.A. SCHUM, EVIDENTIAL FOUNDATIONS OF PROBABILISTIC REASONING (1994), esp. ch. 3. *See also* SCHAUER, *supra* note 13.

30. They appear to allow that the reference-class problem can be overcome if the reference class is "homogenous"; it is not clear what this means, given that no human classes will ever be completely homogenous. In reality, there is some evidence to suggest that organized drug smugglers have little choice about the amount they smuggle, and this is likely to undermine the importance of factors personal to the smuggler in determining the amount swallowed; A.J. Izenman, *Assessing the Statistical Evidence in the Shonubi Case*, *in* STATISTICAL SCIENCE IN THE COURTROOM (J.L. Gastwirth ed., 2000), at 423–424.

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done more to show that this was the case; on the other hand, the size of the sample and Shonubi's failure to argue that specific factors singled him out might be thought sufficient to secure the inference.

But what is clear, again, is that this is an issue that does not arise only in the proof paradoxes; assumptions are unavoidable when we are in the business of drawing inferences from evidence. Once we have refined the generalization involving our eyewitness, for instance, we still have to assume that there are no factors undermining the application of the generalization to this particular event, something we can never be assured of. When it comes to Allen and Pardo's point that the blue bus company may have an excellent safety record, there is a similar response. In any inferential problem there may be hidden variables that would affect the inference we are drawing if we knew about them: unbeknown to us, the eyewitness may be a pathological liar. If we do not know these things, there is not necessarily a problem in drawing the inference on the basis of the information we do have. But what if we do know both that the blue bus company has more buses on the road and that it has the better safety record? This raises the reference-class problem in something like its traditional form—there are multiple intuitively relevant reference classes—except that the safety record may not be quantified. Given that both pieces of evidence appear to be relevant, we can only combine them as best we can.[31]

The foregoing suggests that when it comes to the proof paradoxes, the reference-class problem is largely a red herring. Allen and Pardo's and Colyvan et al.'s arguments really tap into issues concerning assumptions and hidden variables in forensic inference. But to the extent that the reference-class problem is worrying—and in the original example involving John Smith, it does seem to cause a problem—the foregoing discussion provides some resources for responding to it. This allows us to say a little more about the idea of probability being relied on here: we can say that our probability judgments are always relative.[32] If all we know about the eyewitness is the conditions under which she saw the event, our judgment will be relative to that evidence. If our evidence pool expands, and we learn that she is short-sighted, we make a new judgment relative to that evidence. We can also make judgments relative to different reference classes, and this will allow us to say that, relative to the reference class of smokers, the probability that John Smith will live to age sixty is 0.9, while relative to another reference class it is some other figure.

To say that probabilities are relative, however, is not to say that anything goes. Rather, the focus shifts to the reference class—or more generally the evidence—we are conditioning on and our reasons for choosing it. In Blue Bus, if we base our probability of liability on the proportion of blue buses

31. *See* GILLIES, *supra* note 22, at 122–125.

32. *See* A. Hájek, *Conditional Probability Is the Very Guide of Life*, *in* PROBABILITY IS THE VERY GUIDE OF LIFE: THE PHILOSOPHICAL USES OF CHANCE (H.E. Kyburg & M. Thalos eds., 2003).

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in the county when we have figures for the street, we will have to defend that choice, and that will be difficult to do. In some cases we may not have a choice between reference classes but we might still be left with a very unsatisfactory basis for inference.

To introduce a new example, suppose we know that a briefcase has been stolen from an office during a period of time in which only A and B visited the office. If A was in the office for twice as long as B, we do not seem able to conclude that he is twice as likely to have committed the theft. Here, the information we have seems just orthogonal to the issue we are interested in. Perhaps there is an element of this in Blue Bus, but in Blue Bus the information does give us a somewhat better basis for inference. All else being equal, the more blue buses there are on the roads, the more accidents involving blue buses there will be. To reiterate: the claim is not that 0.6 is the correct probability in some strong objective sense, just that the figure can be given some rational justification. And Blue Bus is probably the most tenuous example in this respect: in none of the other examples does the reference-class problem appear to create an insurmountable barrier to a liability verdict. Thus even if one takes the view that the reference-class problem—or, better, the absence of other information—does prevent a verdict in Blue Bus, some other explanation is likely to be needed for the other examples.

Counterfactualizability

The centrality of the proof paradoxes to debates in evidence theory owes much to the work of L.J. Cohen.[33] Cohen explored these and other paradoxes that, he argued, demonstrate that legal proof cannot be modeled by conventional probability theory. His arguments about the law paralleled his work in normative psychology, where he criticized those psychologists who suppose that various experiments show that people are prone to fallacies of reasoning.[34] In his later work, he used the concept of "counterfactualizability" as the foundation for his views.[35] According to Cohen:

> To think of a probability as counterfactualizable is to think of it as applying not only to the entities that are actually members of the reference-class, but also to any others. To think of a probability as non-counterfactualizable is to think of it as applying only to the actual members of the reference-class. People are naturally inclined to think in terms of counterfactualizable probabilities,

33. *See*, in particular, COHEN, *supra* note 2. Much of the debate sparked by this work can be found in PROBABILITY AND INFERENCE IN THE LAW OF EVIDENCE (P. Tillers & E. Green eds., 1988), which collects papers originally published at 66 B.U. L. REV. 377–952 (1986).

34. *See* L.J. COHEN, THE DIALOGUE OF REASON: AN ANALYSIS OF ANALYTICAL PHILOSOPHY (1986), ch. 3; *see also* the discussion, followed by commentary, in L.J. Cohen, *Can Human Irrationality Be Experimentally Demonstrated?*, 4 BEHAV. & BRAIN SCI. 317 (1981).

35. *See* COHEN, DIALOGUE OF REASON, *supra* note 34, at 165–192. *See also* R.J. Allen, *On the Significance of Batting Averages and Strikeout Totals*, 65 TUL. L. REV. 1093 (1991).

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rather than in terms of non-counterfactualizable ones, wherever it seems reasonable to do so.[36]

The example, used above, of the probability of a forty-year-old smoker living to age sixty can be used to illustrate this. If we say that this probability is 0.9, we would usually be taken to be talking in terms of a counterfactualizable probability. If we add more individuals to the reference class, then presumably this probability still holds, applying to the new members as much as to the old. In this way, the probability can guide decision-making: a forty-year-old wondering whether to take up or stop smoking should take the 0.9 probability into account, and policy-makers would have good reason to be guided by the statistic when deciding whether to discourage smoking. In contrast, to say that there is a 0.4 probability that a student in a particular seminar has blue eyes is to state a noncounterfactualizable probability. Had there been more or different students in the class, the probability might have been different. Cohen links this account to the distinction between law-stating and accidental generalizations; he also notes that counterfactualizability is a matter of degree. The smoking probability may not be perfectly counterfactualizable—perhaps medical advances will make people more or less prone to die from smoking—but the probability is certainly more counterfactualizable than that concerning student eye color.

It is obvious that the counterfactualizability account echoes many of the points made in the earlier discussion of reference classes. Cohen notes that the concept is linked to whether causal factors sustain the probabilities within the reference class:[37] smoking causes cancer, but attendance at a particular seminar does not cause, nor is it caused by, eye color. Insofar as the reference-class explanation of the paradoxes boils down to the question of whether our choice of reference class is justifiable, we might say that the choice should be guided by counterfactualizability or, more simply, by whether we take there to be a causal link between the probability and the reference class. One's employment as a toll collector presumably does not affect the amount of heroin one smuggles, whereas one's being involved with a particular smuggling network may do. However, when we return to the various versions of the proof paradox given at the start of this paper, this analysis becomes less satisfying. In Predicting Violence, the probability presumably has a reasonable degree of counterfactualizability; for one thing, the statistic provides a reason for policy-makers to intervene to try to

36. COHEN, DIALOGUE OF REASON, *supra* note 34, at 165.

37. *Id.* at 180. Another way of making the point is that the factors are explanatory; explanation plays a significant role in Allen & Pardo's discussion of the reference-class problem. (Allen & Pardo, *supra* note 24); indeed, they would argue that the fundamental structure of proof is explanatory (*see* M.S. Pardo & R.J. Allen, *Juridical Proof and the Best Explanation*, 27 LAW & PHIL. 223 (2008)). This line of argument is not explored here, because in this context it adds nothing to causal accounts of the paradoxes.

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reduce unemployment and drug-taking. In Blue Bus, Cohen would suggest that the statistic is not counterfactualizable: had there been more buses in the town, red buses might have predominated.[38] But it is difficult to see why the counterfactual is relevant to the inference problem we are faced with.[39] Had there been more red marbles in the bag, the probability of drawing a red marble would change, but that does not affect the probability of drawing a red one from this bag if 60 percent of them are red.[40]

It is true that the problem in Blue Bus is not like the (let us suppose) random process of drawing marbles from a bag, but that just brings us back to the fact that in Blue Bus we have no other information (accident rates and the like) to help us to work out the likelihood of it having been a blue bus that ran over Mrs. Brown. As noted above, in the absence of such information it is not obvious that we are not entitled to rely on the proportional ownership figure. Of course, blue buses may have an excellent safety record, but that may be equally true of red buses. If we do not know such things, we have no reason to take them into account or to suppose the one and not the other.[41] As emphasized above, our judgment is inevitably relative to the evidence we have.

Ultimately, then, counterfactualizability, or the similar concept of weight often used in this context,[42] takes us little further than the discussion in terms of reference classes. Neither analysis provides a satisfying solution to the paradoxes.

38. COHEN, DIALOGUE OF REASON, *supra* note 34, at 167.

39. Cohen comes close to accepting this: *see id.* at 166 for his "freshman" example; and discussion *id.* at 175, 177. But the precise point in the text is not explicitly discussed in DIALOGUE, where Cohen's emphasis is on psychological experiments that involve combining probabilities, and his argument is that one probability is more counterfactualizable than another and thus may rationally dominate calculations.

40. Cohen does argue that the noncounterfactualizability of this probability is significant. When discussing experiments in which subjects see colored chips drawn from a bag and are asked to state the probability that the bag is the one in which chips of a particular color predominate, Cohen criticizes psychologists for presuming that subjects should think that the draws are random. Subjects, he argues, are right to "allow for the effect of any bias in how chips lie, or are drawable from, a particular bag," and thus should let the prior probability of picking a bag containing mainly, e.g., red chips dominate their calculations, because "the drawing of the bag is stated to have been at random" (*id.* at 169). This is a rather gerrymandered argument: one can raise the same concerns about bias in how the bags lie or are chosen; and in any case, the possibility of bias in the bag does not tell us whether the bias will be towards red chips or blue chips (though there is presumably more likely to be a pocket of balls of the predominant color).

41. *See* T. McGrew, *Direct Inference and the Problem of Induction*, *in* PROBABILITY IS THE VERY GUIDE OF LIFE: THE PHILOSOPHICAL USES OF CHANCE (H.E. Kyburg & M. Thalos eds., 2003); S. Campbell & J. Franklin, *Randomness and the Justification of Induction*, 138 SYNTHESE 79 (2004); J.E. ADLER, BELIEF'S OWN ETHICS (2002), at 250–254.

42. In THE PROBABLE AND THE PROVABLE (COHEN, *supra* note 2), Cohen's discussion is in terms of weight, but by the time of AN INTRODUCTION TO THE PHILOSOPHY OF INDUCTION AND PROBABILITY, he suggests that weight can be analyzed in terms of counterfactualizability (L.J. COHEN, AN INTRODUCTION TO THE PHILOSOPHY OF INDUCTION AND PROBABILITY (1989), at 109 n. 22).

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IV. MORAL ACCOUNTS

The accounts of the proof paradoxes examined so far have concentrated on epistemic issues. Much of the rest of the paper will also focus on the epistemic, but it is important to examine an explanation of the proof paradoxes that concentrates on the morality, as opposed to the rationality, of inference. It is possible that moral factors play at least a subsidiary role in explaining the paradoxes.

David Wasserman suggests that the proof paradoxes are a product of our reluctance to find liability in cases where we are basing the conclusion "on the frequency of misconduct by others or by D himself."[43] This is because this is "inconsistent with law's commitment to treat the defendant as an autonomous individual, free to determine and alter his conduct at each moment."[44] Wasserman has some qualms about the strength of this objection and therefore supplements it with other objections that are not in themselves very convincing.[45] He also makes little attempt to defend the concern for autonomy he detects here, seeming to take it as a brute fact. An account provided by Antony Duff, however, might be thought to flesh out the sort of objection made by Wasserman.[46] Unlike other commentators, Duff does not attempt to analyze different versions of the proof paradox; he does not mention Blue Bus but concentrates on Predicting Violence as a way of exploring a debate in sentencing theory.

The debate concerns the appropriateness of incapacitating offenders—detaining them for longer than they deserve—on the basis of actuarial predictors of dangerousness. For Duff it is important that in Predicting Violence, the factors that indicate D's dangerousness do not include a previous conviction for a violent offence. This is partly because of a conceptual argument about character: even if the actuarial evidence makes it very probable that D will commit an act of violence in a certain situation, we cannot talk of D having a violent character. Character is constituted by conduct; while we can talk of the likelihood of D *developing* a violent character, we cannot talk of the likelihood of his *having* such a character. This account of character is controversial.[47] For the sake of the argument, however, let us accept it. By itself, the conceptual argument does not show why we should not use the actuarial evidence against D. Why should we not take the likelihood that D will develop into a violent person into account? Here, Duff provides a moral argument. "Respect for autonomy, and the 'presumption of harmlessness' which follows from it, forbid us to ascribe criminal dangerousness to

43. D.T. Wasserman, *The Morality of Statistical Proof and the Risk of Mistaken Liability*, 13 CARDOZO L. REV. 935 (1991), at 943.

44. *Id.*

45. *Id.* at 949.

46. Duff, *supra* note 5.

47. *See* V. TADROS, CRIMINAL RESPONSIBILITY (2005), at 47–53. Duff discusses this theory of character in more detail in R.A. DUFF, CRIMINAL ATTEMPTS (1996), at 175–192.

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anyone, unless and until by his own criminal conduct he constitutes himself as having such a character."[48] For Duff, actuarial evidence is "the wrong kind of evidence" to use against a defendant:

> To respect the defendant as a responsible citizen, we must treat and judge him as an autonomous agent, who determines his own actions in the light of his own values or commitments. His membership of this actuarial group is part of the context of that self-determination; and as observers, we might think it very likely that he will have determined himself as a criminal. As judges of his guilt, however, we must rely on evidence related to him as an individual agent, not on evidence related to him only as a member of an actuarial group.[49]

There are a number of points to make about this. First, we noted in the introduction the appeal of the argument that we should rely only on "direct," or "specific," evidence against D. But we also saw that the idea of specific evidence is problematic, because all inferential argument seems to rely on generalization from other cases. As regards Duff's argument, then, the notion of "evidence related to [D] as an individual agent" is unhelpful; it at least needs explication in terms of more convincing distinctions. Second, while Duff allows that previous convictions can be used against a defendant, it is not clear why he takes this line. Indeed, Wasserman, who relies on a similar autonomy-based argument, applies it to evidence of the frequency of D's misconduct as much as to the frequency of misconduct by others. Wasserman would presumably argue that this makes sense if autonomy is the concern; if we regard D as free to determine his own conduct, then we should not use the fact that 30 percent of burglars burgle again as evidence that D is likely to burgle again.

However, no matter what we decide about the application of the argument to D's prior misconduct, both Duff's and Wasserman's use of the concept of autonomy to motivate the argument is awkward. That D is autonomous, someone who determines his own actions, is irrelevant to the question of whether he is likely to offend or reoffend. One displays one's autonomy just as much by offending as by not offending, by reoffending just as much as by ceasing to offend.[50] Autonomy cannot give rise to a presumption of

48. Duff, *supra* note 5, at 155. In this context, the idea of a presumption of harmlessness seems to be due to J. Floud & W. Young, Dangerousness and Criminal Justice (1981), at 43–45. While Floud and Young view the presumption as an important moral constraint on incapacitation, they see it as a restraint on practice (only those convicted of an offence should be considered for incapacitation on the basis of likely future offending) and do not discuss the issue considered here: whether the presumption should constrain the sort of evidence we use to judge dangerousness.

49. Duff, *supra* note 5, at 156.

50. Indeed, in one sense lawbreakers are more autonomous than the (literally) heteronomous law-abiding, and there is a certain romantic view of crime under which offending is an expression of freedom. Lurking here, however, are difficult questions about the meaning of autonomy. On a Kantian view of autonomy, the opposite conclusion would be reached, for lawbreakers lack autonomy because they cannot will their crimes as universal law. On this account of autonomy, *see* O. O'Neill, *Autonomy, Coherence and Independence, in* Liberalism, Citizenship,

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harmlessness, because a previously harmless person may demonstrate his autonomy by harming others. It is true that if we use evidence of, say, drug addiction for the argument that D is more likely to offend than others, then we are assuming that there is a causal factor influencing his choice, and to that extent we may be belittling his autonomy. But to argue that autonomy means that no one's decision is ever influenced by any factor would be to accept a ridiculous conception of autonomy,[51] and to see human behavior as random. To predict a person's behavior is not to demonstrate their lack of autonomy if autonomy is understood in a meaningful way.

Despite these difficulties, it is worth trying to salvage something from the Duff/Wasserman line of argument. For otherwise we seem driven to accept that there is nothing wrong with using the actuarial evidence in Predicting Violence as evidence of dangerousness or even of guilt, and that is sufficiently counterintuitive to give us pause. At this stage, we might look back to the inferential accounts above, for it often seems that in the proof paradoxes, the distinction between the inferential and the moral is thin. In our discussion above, Colyvan et al. were are taken to be making a point about appropriate choice of reference class in *Shonubi*: we have no reason to suppose that the class of Nigerian drug smugglers is privileged for inferential purposes.

But the authors also state that "the real issue is whether Shonubi should have been sentenced on the basis of evidence gathered from *other people*."[52] While there is no indication that Colyvan et al. take themselves to be making a moral argument, it seems that this is what they are doing at this point.[53] For if their real objection is based on the existence of multiple reference classes, this objection would apply equally to an inference based on the fact that we know that on one of the previous trips Shonubi smuggled x grams.[54] For something might always be supposed to mark that trip out from the others: Shonubi might have swallowed more balloons than usual on that

AND AUTONOMY (D. Milligan & W.W. Miller eds., 1992). It is clear from context, however, that neither Wasserman nor Duff are using "autonomy" in this Kantian sense. Nor is there any need to settle debates about the meaning of autonomy for the purposes of the present discussion; Kantians are free to replace references to autonomy in the text with references to some other concept, such as independence.

51. *See* J. RAZ, THE MORALITY OF FREEDOM (1986), at 155–156; PATRICIA SMITH, LIBERALISM AND AFFIRMATIVE OBLIGATION (1998), at 87–88.

52. Colyvan, Regan & Ferson, *supra* note 24, at 171, emphasis in original; *see also id.* at 175. This echoes Wasserman's clearly moral point that in some cases where statistical evidence is used, D is disadvantaged "not by his general bad luck, but by the misconduct of his statistical 'cellmates'"; Wasserman, *supra* note 43, at 946. *See also* SCHAUER, *supra* note 13, at 239, who, in an otherwise robust defence of the use of probabilities in Blue Bus, comments without elaboration that "the specter of imprisoning people because of the behavior of others or because of the aggregate behavior of a class in which they are placed is indeed frightening."

53. Peter Tillers also claims that a moral argument underlies Colyvan, Regan & Ferson's claims, though he suggests a slightly different one. *See* P. Tillers, *If Wishes Were Horses: Discursive Comments on Attempts to Prevent Individuals from Being Unfairly Burdened by Their Reference Classes*, 4 LAW, PROBABILITY & RISK 33 (2005).

54. As they acknowledge; Colyvan, Regan & Ferson, *supra* note 24, at 175.

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trip because he was then particularly short of money or because he got involved in competitive balloon-swallowing. It seems likely, then, that Colyvan et al. are influenced by the significance ascribed to human individuality: we do not want to presume that Shonubi, or the prisoner, or the defendant in Predicting Violence, are like other people, especially when some bad moral characteristic is concerned. But in purely inferential terms it is not clear that they are right to be especially concerned about the suitability of the reference class of other smugglers here, for it is an empirical matter whether it is more suitable than one based on Shonubi's own actions, and they offer no argument to suggest that it is. The empirical issue is complex and controversial. But one influential argument in social psychology is that our behavior is governed more by the situations we find ourselves in than by our personality.[55] To that extent, then, we should be more suspicious of the reference class composed of D's prior actions than of the one composed of the behavior of similarly situated others.[56] If our intuitions push us in the opposite direction, it would be because they are driven by moral, not inferential, concerns.

This suggests that moral concerns have considerable influence on our reasoning in at least some of the proof paradoxes. It seems that the significance of moral choice concerns us. One way to put it is that it makes us especially aware that D may not have made the bad choice; he may be in a "good" reference class, and external pressure may not make him act like the crowd. But where a factor radically undermines autonomy—bypassing moral choice, as it were—we may not be so worried. Thus if, in Predicting Violence, the drug could be shown to affect people physiologically in a way that makes them very aggressive, it would be more permissible to draw an inference against D from knowledge that he used the drug.

The existence of some sort of presumption of harmlessness that acts as a restraint on evidential reasoning is not implausible. It is, though, not easy to pinpoint the reasoning underlying the presumption; as Wasserman's objection to using even evidence of D's own past behavior against D suggests, there are probably no sharp distinctions here. Inferences can be more or less permissible. But while this leaves things rather vague, the vagueness is a not unfamiliar aspect of evidence theory. Criminal adjudication is seen by many to involve strong legitimacy constraints on the admissibility of evidence.[57] It may be very difficult to explain why we should exclude illegally or improperly obtained evidence, but that does not prevent many people arguing that we

55. *See, e.g.*, J.M. Doris, Lack of Character: Personality and Moral Behavior (2005). *Cf.* D.C. Funder, Personality Judgment: A Realistic Approach to Person Perception (1999).

56. More, rather than as, suspicious because we have a larger and hence more reliable sample of the behavior of others.

57. *See, e.g.*, I.H. Dennis, The Law of Evidence (3d ed. 2007), esp. ch. 2; P. Roberts & A. Zuckerman, Criminal Evidence (2004), esp. ch. 4; H.L. Ho, *Justice in the Pursuit of Truth: A Moral Defence of the Similar Facts Rule*, 35 Common L. World Rev. 51 (2006). *Cf.* L. Laudan, Truth, Error and Criminal Law: An Essay in Legal Epistemology (2006), esp. chs. 7, 9.

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should do, at least in certain cases, and courts are sometimes responsive to such arguments.

Some sort of presumption of harmlessness, then, may operate as a similar legitimacy constraint on criminal adjudication. But if a moral presumption of harmlessness does explain the reaction to Predicting Violence, and probably to Prisoners, it is not clear that that explanation can be extended to the other examples. Blue Bus is different in several respects: first, D is part of a tightly defined group (bus operators in the town), one member of which must be responsible for the accident. Where the group is as small as in Blue Bus, what role should a presumption of harmlessness play? Second, we do not seem to be using actuarial evidence here but simply deducing a probability of responsibility from proportional ownership. Third, because the harm caused to Mrs. Brown was accidental rather than intentional, a presumption of harmlessness rooted in the significance of moral choice might not weigh so heavily in the scales. Similarly, the Duff/Wasserman account does not apply easily to Summers and Tice, nor, perhaps, to *Shonubi*.

V. KNOWLEDGE-BASED ACCOUNTS

Knowledge and Causation

Judith Jarvis Thomson argues that what is lacking in the proof paradoxes is an appropriate causal connection between the evidence and the fact to be proved (e.g., that a blue bus ran over Mrs. Brown).[58] The proportion of blue buses is not caused by nor is it a cause of the accident.[59] Initially this account may not seem to add anything especially novel. The idea of a causal connection has been raised in the discussion of counterfactualizability. It has problems in explaining Predicting Violence, where there does seem to be a causal connection. But at this point we should note the possibility that there could be more than one explanation for the proof paradoxes. If we accept something like the presumption of harmlessness discussed in the previous section, then the presumption may provide an explanation for Predicting Violence, leaving the other examples to be explained in some other fashion. So let us ignore the problems caused by Predicting Violence. Even then, we might have some doubts about Thomson's argument. While it seems true that the proportion of blue buses did not cause the accident (the accident, let us suppose, was caused by a problem with the brakes), there must, as noted above, be some sort of link between the number of blue buses on the road and the likelihood that it was a blue bus that hit

58. Thomson, *supra* note 6.

59. *See also* R. Sorensen, *Future Law: Prepunishment and the Causal Theory of Verdicts*, 40 NOÛS 166 (2006). Sorensen argues for a casual account of verdicts to explain why we do not prepunish crimes. His account differs from Thomson's in that he would not allow evidence of factors that cause (as opposed to being caused by) the crime, though he is prepared to allow some trade-off. Given that this would rule out motive evidence, it is problematic.

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Mrs. Brown, and it does not seem perverse to describe the link as causal.[60] We return to causation below, for the causal theory gains a little support from another source, but we need to note here that Thomson's point may not rely too heavily on causation. Thomson goes on to explain the importance of a causal connection in terms of luck. In Blue Bus, she suggests, our conclusion that the blue bus company was responsible may be correct, but if so, that will be a matter of luck.[61] A conclusion that may be true only luckily, Thomson argues, would be an inappropriate basis for a verdict. She goes on to connect this argument to epistemological theory: just as knowledge should not rest on luck, nor should a verdict.

Thomson's attempt to link the legal debate with debates in epistemology was perceptive. In fact, the sort of epistemological example Thomson had in mind had received relatively little attention from epistemologists at the time she was writing.[62] Today it is a staple of the literature; whole books have been written about it.[63] Much of the rest of this paper explores the parallels between these epistemological examples and the proof paradoxes. To understand the parallel Thomson was drawing, we need to introduce some more examples:

- *Lottery*. You own a ticket in a million-ticket lottery; if your ticket is drawn at the end of the week, you will win $ 1 million. You are aware that the odds of winning are a million to one against, and in fact the ticket will lose, but it seems that you do not *know* that it will lose; this is not a case of knowledge. This is immediately quite odd.[64] Your losing the lottery is pretty close to a sure thing; if you cannot claim to know that you will lose, what can you claim to know? Unless Lottery can be separated from other everyday examples of knowledge claims—such as my knowing that it is raining because I have just looked out of the window and seen rain falling—it appears to invite widespread skepticism. This point can be sharpened by noting that Lottery can give rise to the following paradox: it seems that while you are walking around with the ticket in your pocket but not on your mind, you are able to say "I know I won't be able to afford a house on millionaire's row this year" (and in fact you will not). If this is a case of knowledge, as it is usually taken to be, then there seems to be a contradiction, because you also do not know that you will not win the lottery and thus have the funds to buy the house.

Some writers think that Lottery can be replicated with various examples that do not involve explicit quantification. For example:

60. *Cf.* R.W. Wright, *Causation, Responsibility, Risk, Probability, Naked Statistics, and Proof*, 73 IOWA L. REV. 1001 (1998), at 1059–1061.

61. Explaining just when a conclusion is due to luck is obviously difficult; *see* discussion in the following subsection; and J. Greco, *Knowledge as Credit for True Belief*, *in* INTELLECTUAL VIRTUE: PERSPECTIVES FROM ETHICS AND EPISTEMOLOGY (M. DePaul & L. Zagzebski eds., 2007).

62. Thomson acknowledges Gilbert Harman for comments on the paper; Harman had already discussed the Lottery paradox in GILBERT HARMAN, THOUGHT (1973), at 161.

63. J. HAWTHORNE, KNOWLEDGE AND LOTTERIES (2004).

64. The oddness can be accentuated by noting that if, after the draw, I read the number of the winning lottery ticket in the newspaper, I can claim to know which ticket won, even if the probability of a misprint is greater than the probability of a particular ticket winning.

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- *Heart Attack.* If I say "I know I'll be at the conference in Paris next week" (and I will be), that would usually be taken to be a valid knowledge claim. But many epistemologists think that I cannot say "I know I won't die of a heart attack in the next week," even though, if I do not know that, I do not know that I will be in Paris. Similarly (Bomb), I do not know that there will not be a bomb on the flight to Paris.

Lottery is striking for its similarity to Prisoners. In both examples we have a proposition with a high probability of being true, yet we are precluded from claiming knowledge just as we are precluded from ascribing liability. That suggests the possibility of a shared explanation. But why might there be a link between the legal and philosophical examples? If we just focus on Prisoners, it is tempting to suggest the following: criminal verdicts require knowledge. D cannot be found guilty because we do not know that he is. To understand the significance of that claim and to set the stage for the discussion to come, it is helpful to step back for a moment and sketch some pertinent features of contemporary approaches to knowledge.

Much recent epistemology focuses on the analysis of the concept of knowledge. The standard account is that knowledge is justified true belief, plus some extra "fourth element" in addition to justification, truth, and belief. Here we can focus on justification and the fourth element.[65] In very simple terms, justification concerns the degree to which beliefs are rationally supported. No position is taken here on the various approaches to justification—for example, internalist and externalist, coherentist and foundationalist—because, for the purposes of the discussion to follow, nothing hinges on the difference between these analyses.[66] Justification is best though of as coming in degrees: beliefs can be more or less justified, and one of the problems in the analysis of knowledge is to specify the degree of justification needed for knowledge. There can be no denying that verdicts require, at a minimum, justified belief.[67] But that does not take us very far in understanding either verdicts or the proof paradoxes, because it tells us nothing about the degree or type of justification needed.[68] This brings us to the mysterious "fourth element" of knowledge.

One reason why a fourth element is thought to be required is the existence of Gettier cases: examples where justified true belief is intuitively

65. Not because "truth" and "belief" are simple concepts that require no analysis, but because debates about these concepts are not central to the debates about knowledge surveyed here.

66. A good analysis of justification is S. HAACK, EVIDENCE AND INQUIRY: TOWARDS RECONSTRUCTION IN EPISTEMOLOGY (1993).

67. *See, further,* S. Brewer, *Scientific Expert Testimony and Intellectual Due Process*, 107 Yale L.J. 1535 (1998), at 1596–1601.

68. The analysis of "inferential" accounts earlier in the paper could be thought of as exploring whether a particular type of justification, such as a causal one, is intrinsic to legal verdicts, but it is difficult to find support for any such requirement. The brief discussion below of contextualist approaches says a little more about the degree of justification required for a true belief to amount to knowledge.

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not sufficient for knowledge.[69] A basic example is where S looks at her usually reliable watch and comes to believe that it is 7 o'clock; it is in fact 7 o'clock, but S's justified belief is true only because her watch stopped twelve hours ago. This is usually taken not to be a case of knowledge. Although Lottery is not considered to be a Gettier case, there are similarities between the examples. In both it might be said that what prevents there being a valid knowledge claim is that the claim—that the ticket will win, that it is 7 o'clock—if true, is true due only to luck. So some analyses of the fourth element look for a criterion that by ruling out luck will block both Gettier and Lottery-type cases.

With that by way of background, we can now return to the suggestion that verdicts require knowledge. This must be taken to mean that verdicts, like knowledge, require a particular degree of justification and the presence of the fourth element. There are some proponents of this view;[70] indeed, it has been suggested that the unacceptability of "Gettier verdicts" supports it.[71] We do explore that possibility here,[72] for all that is really relevant here is the idea canvassed above: that the similarities between Lottery and Prisoners suggest that verdicts require knowledge. There is an obvious problem with this view, however. It is plausible that whatever prevents a liability verdict in Prisoners also prevents a liability verdict in Blue Bus. If Prisoners is explained by a knowledge requirement for proof, then Blue Bus is too. But that would involve arguing that civil as well as criminal verdicts require knowledge, and that is not easy to accept. Civil verdicts require no more than proof on the balance of probabilities. This standard seems too low to satisfy the degree of justification required for knowledge.[73]

While arguing for a relationship between verdicts and knowledge, Thomson avoids the problem just described. She suggests that because verdicts are important decisions, they share certain requirements with valid knowledge claims. I refer to this as the "knowledge-like" argument, and we can think of it as rejecting the idea that verdicts require the degree of justification required by knowledge but accepting that verdicts need the fourth element

69. *See* E. Gettier, *Is Justified True Belief Knowledge?*, 23 ANALYSIS 121 (1963). A good discussion is L. Zagzebski, *The Inescapability of Gettier Cases*, 44 PHIL. Q. 65 (1994).

70. *See, e.g.*, R.A. DUFF ET AL., THE TRIAL ON TRIAL: VOLUME THREE: TOWARDS A NORMATIVE THEORY OF THE CRIMINAL TRIAL (2007), at 89–91. For a skeptical response to this claim, *see* J.F. Beltrán, *Legal Proof and Fact Finders' Beliefs*, 12 LEGAL THEORY 293 (2006) at 301–303.

71. *See* M.S. Pardo, *The Field of Evidence and the Field of Knowledge*, 24 LAW & PHIL. 321 (2005), at 322–323.

72. While the example used by Pardo (*id.*) is suggestive, there are more complex examples of Gettier cases, and it is not clear that these raise antiliability intuitions. For a skeptical view on importing the Gettier requirement to verdicts, *see* Sorensen, *supra* note 59.

73. This does raise the question of how high the justification criterion for knowledge should be. Beliefs can be more or less justified, but exactly how well justified does a belief have to be to count as knowledge? It is not easy to find a cutoff point, and some of the more radical analyses might allow something like weak knowledge that could be applied to civil cases; *see* S. HETHERINGTON, GOOD KNOWLEDGE, BAD KNOWLEDGE: ON TWO DOGMAS OF EPISTEMOLOGY (2001). Contextualists also admit of variable standards for knowledge; contextualism is discussed briefly below, but it is doubtful that contextualists would go so low as the balance of probabilities.

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of knowledge (or at least enough of it to block Lottery-type examples). If we accept the argument, the question then becomes: What is the fourth element lack of which defeats knowledge in the epistemological examples? If we identify the fourth element, we can then inquire whether it will also explain the legal examples. As shown above, Thomson's own argument is that the problem in the various examples—legal and philosophical—is that if true, the conclusion would be true only luckily. Thomson explicates "luck" in terms of the absence of an appropriate causal connection between evidence and conclusion. Proportionate bus ownership does not cause and is not caused by the accident. Similarly, the lottery ticket's not being drawn is not caused by the improbability of its winning. An eyewitness report that a blue bus was responsible for the accident could, however, be caused by its being a blue bus that was involved.

Above, some doubts were raised about this causal account in relation to Blue Bus by suggesting that there is a causal link between proportions and accidents, but causation is a sufficiently murky notion that perhaps this argument is not definitive. And the causal account gains some support from the fact that one commentator on Lottery, Dana Nelkin, has also argued that causation is the key.[74] The account, however, is problematic for reasons other than those noted above. If knowledge is absent in Heart Attack, then it is absent despite my having a decent causal explanation (my family medical history, good diet, regular exercise, etc.) as to why I will not drop dead in the next week. Variations on Lottery also create problems for the causal account. We can imagine a lottery where the tickets sold are of varying sizes, with the bigger tickets being more likely to be drawn and therefore being more expensive. If I am the holder of a small ticket, the fact that I have a causal explanation for why it will lose (and it will) does not enable me to claim that I know that it will lose.

Rejecting a causal account of the paradoxes, however, is by no means the end of the story. There are many other accounts of the fourth element. Any one of these might provide a satisfying analysis that would also explain the proof paradoxes. We explore some of them below.

74. D.K. Nelkin, *The Lottery Paradox, Knowledge, and Rationality*, 109 PHIL. REV. 373 (2000). Nelkin's article also points to another way of analyzing the proof paradoxes. Nelkin draws parallels between Lottery and a similar paradox that involves belief rather than knowledge: you hold a ticket in a large lottery; it is initially plausible to suppose that you believe that the ticket will not win, as it is very improbable that it will. But you should then be prepared to form the same belief about any ticket in the lottery; the conjunction of your beliefs then entails that you believe that no ticket will win, hence the paradox. Nelkin resolves the belief version of the Lottery paradox by arguing that you do not in fact believe that your ticket will lose because, again, of the missing causal element. One might then argue that what is required for verdicts is belief rather than knowledge and that it is belief that is missing in the proof paradoxes. This possibility is not pursued at length here, largely because Nelkin's argument about the lack of belief in the belief version of the Lottery paradox has received little support. *See, further*, D. CHRISTENSEN, PUTTING LOGIC IN ITS PLACE: FORMAL CONSTRAINTS ON RATIONAL BELIEF (2004). For a skeptical view of a belief requirement for verdicts, *see* Beltrán, *supra* note 70.

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Antiluck

We saw above that Thomson links her account of the proof and knowledge paradoxes to luck. Luck is generally thought to be incompatible with knowledge claims (hence the Gettier problem), so a close analysis of luck and the role that it plays in the epistemological examples might provide us with a solution to the proof paradoxes. Such an analysis has recently been provided by Duncan Pritchard.[75] Pritchard argues for a "safety" requirement for knowledge, under which knowledge of a proposition fails for an agent unless, in nearly all nearby possible worlds in which A forms her belief about P in the same way as she forms it in the actual world, A believes P only when P is true.[76] This explains lottery cases by privileging possibility over probability. That is, because worlds in which the lottery ticket wins are close worlds (they are more or less indistinguishable from the actual world, at least at the level at which humans take an interest in the world, and thus, while improbable, are very possible), belief that the ticket will win is not safe, and knowledge fails. This does not explain Heart Attack; if I am in fact healthy, and there is nothing wrong with my heart, the world in which my heart is about to give up is not close. In Lottery, I feel that my ticket could easily have won—there was nothing to prevent it doing so; not so in Heart Attack. Pritchard's response is to reject the claim that I do not know that I will not drop dead.[77]

When we turn to the legal examples, Pritchard's analysis is initially very promising. Because the verdict in Blue Bus is based on no more than the predominance of blue buses, worlds in which the blue bus company is found liable but it was in fact a red bus that caused the accident are very close. The same goes for Prisoners and Summers and Tice. Predicting Violence is a more complex example: because we are concluding no more than that D is likely to be violent, it is not easy to analyze in Pritchard's terms, but we have already noted that there may well be something to the Duff-Wasserman analysis of this example, so it may be explicable on other grounds.

There are, however, still difficulties with Pritchard's account. If we developed the Lottery example so that the result of the lottery is predetermined and well embedded, winning worlds would not be so close. Suppose that the winning ticket is selected a month before the official announcement, with the winner informed and sworn to secrecy, and no one apart from the lottery organizers knowing that this is how the lottery works. Three

75. DUNCAN PRITCHARD, EPISTEMIC LUCK (2005). *See also* the discussion in Duncan Pritchard, *Knowledge, Luck and Lotteries*, *in* NEW WAVES IN EPISTEMOLOGY (D. Pritchard & V. Hendricks eds., 2008).

76. For objections to this account, *see* A. Hiller & R. Neta, *Safety and Epistemic Luck*, 158 SYNTHESE 303 (2007); J. Comesaña, *Unsafe Knowledge*, 146 SYNTHESE 395 (2005); J. Lackey, *Pritchard's Epistemic Luck*, 56 PHIL. Q. 284 (2006).

77. *See* Pritchard, *Knowledge, Luck and Lotteries*, *supra* note 75, at 46–48. Pritchard also suggests that I do not know that I will not be able to afford the expensive house if I own a lottery ticket. It is unclear whether Pritchard would stand by his claim in respect of Heart Attack if, for example, I have a history of sudden heart attacks in my family.

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weeks before the announcement I do not know that my ticket will lose, even though the world in which I win is not close. The obvious response to this is that if we extend the time frame back, then the world in which I bought the ticket that won is close. But further embedding is possible. I might always buy a ticket with the same number, based on my birth date, and the number of the winning ticket might not be selected at random but based on some secret, complex, predetermined formula depending on the position of various stars and planets at the time of the choice. In that case, I never had any chance of winning; the winning world is far away. But although my belief satisfies Pritchard's safety criterion for knowledge, it is doubtful that I know that I will lose.

Pritchard's account might also give odd answers in some legal examples. Take a case where strong DNA evidence links D to the crime; in addition, D lives close to the crime scene. D's innocence is very improbable, and few commentators would raise any objection to a conviction in such a case.[78] If D is guilty, might there be a close world where the same evidence appears but he is innocent? It is possible, though very unlikely, that someone else with the same DNA profile lives close to the crime scene and did in fact commit the crime. One problem in assessing an example such as this is that it is difficult to make judgments about the closeness of possible worlds;[79] indeed, finding a metric to measure closeness is a notoriously difficult problem.[80] However, it does seem to be a matter of luck whether you live close to a criminal who shares your DNA profile, so this world might well be close enough to block a guilty verdict. And if the same criteria apply to civil verdicts, the crime victim could not successfully sue D. These are difficult results to accept.

Contextualism and Salience

Prominent among responses to Lottery-type paradoxes are various versions of contextualism about knowledge.[81] The basic idea behind contextualism is that the truth conditions of "know" and "knowledge" vary with context, just as the truth conditions of certain other words do. For example, we describe people of very different heights as being "tall" depending on whether the context in which we are applying the concept involves a group of children, a normal group of adults, or a group of basketball players. Applied to knowledge, the claim is that in some situations, knowledge requires high standards of justification, and in other situations, lower standards may suffice. The appropriate standard may depend on what is at stake; ordinarily, my prior visits to the bank will allow me to claim that I know the bank is

78. For an actual example, *see* R v. Smith, Court of Appeal Criminal Division (UK), 8 February 2000.

79. *See* Hiller & Neta, *supra* note 76.

80. *See* D. NUTE, TOPICS IN CONDITIONAL LOGIC (1980), at 65–73; R. NOZICK, INVARIANCES: THE STRUCTURE OF THE OBJECTIVE WORLD (2001), at 148–155.

81. *See, e.g.*, HAWTHORNE, *supra* note 63; E. Sosa, *Relevant Alternatives, Contextualism Included*, 119 PHIL. STUD. 35 (2004).

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open on Saturday morning, but if I need to visit the bank to pay in a check so that it clears in time to make some crucial payment, the fact that I cannot rule out a change in opening hours prevents me from claiming that I know that it is open. In this situation, the high stakes make the possibility of a change in opening hours salient.

Salience may also be affected by the evidential background. In Lottery, the prize money might be $1, and thus the stakes very low, but it seems that the simple vividness of the possibility that I will win makes this possibility salient and prevents me from claiming knowledge. But I can properly claim to know that I will not be able to afford a house on millionaire's row this year as long as the fact that I have a lottery ticket is not brought to my attention. For then the possibility of my winning the lottery is not salient, and I do not need to be able to dismiss it. An attractive feature of contextualism is its ability to account for skeptical doubts and their irrelevance in everyday life. I currently know that I am sitting at my computer, because the possibility of my being a brain in a vat is not salient; but if asked "Do you know that you are not a brain in a vat?" I can only respond negatively, because the question makes that possibility, which I cannot rule out, salient.

It is difficult to develop a contextualist account of the proof paradoxes. We might take it that in Blue Bus and Prisoners, as in Lottery, the statistical nature of the evidence makes the possibility of error salient. But criminal cases, in particular, always involve high stakes, so why should we be reluctant to convict in Prisoners, no matter how many prisoners are in the yard, but not in a case involving good eyewitness evidence, even though error cannot be completely ruled out and will have been made as salient as possible by the defense lawyer? For our purposes, however, contextualism is of some interest because of one of the responses it has received. The case for contextualism in epistemology relies heavily on the "linguistic data" that are said to support it; these data include the responses to cases such as Lottery.[82] However, there is considerable dispute as to whether the data really do make the case for contextualism; they can be interpreted in other ways.[83] Significantly, for our purposes, Timothy Williamson suggests that what is going on in the philosophical cases is simply cognitive bias. We are reluctant to say we know that our ticket will win the lottery not for respectable philosophical reasons but because the salience of the possibility of winning means that we pay undue attention to it.[84] The same goes for Heart Attack. Because there is

82. Or at least, the responses of the philosophically literate. There have been no surveys of the responses of the general public to Lottery cases. *Cf.* J.M. Weinberg, S. Nichols & S. Stich, *Normativity and Epistemic Intuitions*, 29 PHIL. TOPICS 429 (2001).

83. *See, e.g.*, J. STANLEY, KNOWLEDGE AND PRACTICAL INTERESTS (2005); B. Weatherson, *Questioning Contextualism*, *in* ASPECTS OF KNOWING: PHILOSOPHICAL ESSAYS (S. Hetherington ed., 2006); W.A. Davies, *Knowledge Claims and Context: Loose Use*, 132 PHIL. STUD. 395 (2007).

84. T. Williamson, *Knowledge, Context and the Agent's Point of View*, *in* CONTEXTUALISM IN PHILOSOPHY (G. Preyer & G. Peters eds., 2005); T. Williamson, *Contextualism, Context-Sensitive Invariantism, and Knowledge of Knowledge*, 55 PHIL. Q. 213 (2005).

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no need for such cognitive bias to be particular to knowledge, it would not be too surprising if we found it occurring with verdicts as well.

Cognitive bias seems to be a fairly simple way of explaining the proof paradoxes. However, an account in which it features needs to accommodate the basic empirical facts about the paradoxes: as observed at the outset, it is not just statistics that cause people to have qualms about liability verdicts. DNA cases do not create too much trouble in practice.[85] The empirical evidence also shows that reactions change with the form of the statistical evidence presented. What the available evidence suggests is that in legal examples, people respond differently to evidence showing that there is a particular chance that D is liable (as in Blue Bus) from how they respond to evidence with a particular degree of reliability that shows D is liable (as when a test that is *x* percent reliable links D to the event).[86] Even when the probability of liability is the same, the latter scenario is much more likely to result in a liability verdict. The reason for this seems to be that in the former scenario it is easier to imagine that someone other than D was responsible for the accident than it is in the latter scenario. Indeed, even in the latter scenario, simply making an implausible suggestion that someone else may have been responsible for the accident can make people more reluctant to ascribe liability to D.[87]

This "ease of simulation" explanation for the data also accounts for results in experimental research on DNA evidence. Here it has been found that mathematically equivalent ways of expressing the probative force of a DNA match have different effects on subjects: subjects think guilt more likely when told that "the probability that the suspect would match the blood drops if he were not the source is 0.1 percent" than when told that "1 in 1,000 people in Houston who are not the source would also match the blood drops."[88] This seems to be because the latter formulation makes the possibility of a match with an innocent person easier to imagine. An ease-of-simulation bias fits fairly well with the legal examples (ignoring the more complex Predicting Violence and Shonubi). It also seems to support Williamson's critique of contextualism, for it latches on to the feature of salience that the contextualists themselves use to explain the epistemological examples.[89]

85. That said, quantification does sometimes seem to cause courts to refuse to convict even when the evidence is very strong: *see, e.g.*, R v. Watters, Court of Appeal Criminal Division (UK), 19 October 2000. It may be that quantification alone makes doubt seem more vivid, and that particular forms of quantification (as in Blue Bus) have effects over and above this.

86. *See* Wells, *supra* note 8.

87. *See* K.E. Neidermeier et al., *Jurors' Use of Naked Statistical Evidence: Exploring the Basis and Implications of the Wells Effect*, 76 J. PERSONALITY & SOC. PSY. 533 (1999). *See also* K.J. Heller, *The Cognitive Psychology of Circumstantial Evidence*, 105 MICH. L. REV. 241 (2006).

88. J.J. Koehler, *The Psychology of Numbers in the Courtroom: How to Make DNA Match Statistics Seem Impressive or Insufficient*, 74 S. CAL. L. REV. 1275 (2001).

89. It also explains the embedded Lottery example given in discussion of Pritchard; it is easy to imagine that I might win even though that world is far off.

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Challenge

There is another factor that may link the legal and epistemological examples. In the examples there seems to be no way to interact with or gain anything further from the evidence. In Blue Bus, the statistic of proportional ownership is simply all there is; we cannot inquire beyond it. And in Lottery we cannot ask the ticket holder if there is any particular reason for thinking that this ticket will lose; the ticket is like all of the others and there is nothing more to be said about it. If you ask me how I know that I will be in Paris next week, I can wave the plane ticket in your face. But if you ask me how I know that there will not be a bomb on the plane, or that I will not die of a heart attack tomorrow, there is little I can do to back up my dismissal of these possibilities. Perhaps in Heart Attack I can show you the results of a recent health check or explain to you about my good diet and so on. In Bomb, if I were head of security at the airport I was flying from, I might be able to convince you of the near impossibility of smuggling a bomb onto a plane. But these responses involve some modification of the original hypothetical—more so in Bomb, which may be why it is a clearer case than Heart Attack (recall that Pritchard disputes the intuition in Heart Attack).

One epistemological theory that can be linked to this feature of the cases is Austin's account, which emphasizes our everyday use of the verb "to know."[90] "Whenever I say I know," Austin noted, "I am always liable to be taken to claim that, in a certain sense appropriate to the kind of statement . . . , I am able to *prove* it."[91] "If I have any reason to doubt my claim, I cannot say that I know."[92] This would not go as far as my being able to prove that I am not a brain in a vat when I claim that I am sitting at my computer; the precautions we take with our knowledge claims "cannot be more than reasonable, relative to our current intents and purposes."[93] This provides an appealing analysis of cases such as Lottery and Heart Attack. The problems

90. J.L. Austin, *Other Minds*, *in* PHILOSOPHICAL PAPERS (3d ed., J.O. Urmson & G.J. Warnock ed., 1979). It is not really accurate to describe Austin's account as a theory of knowledge; it hardly aims at completeness and is developed in the context of the problem of knowledge of other minds. However, Mark Kaplan is currently filling out the Austinian account. *See* M. Kaplan, *If You Know You Can't be Wrong*, *in* EPISTEMOLOGY FUTURES (S. Hetherington ed., 2006).

91. Austin, *supra* note 90, at 85.

92. *Id.* at 82. One stream in the epistemological literature picks up on this insight and takes the nonexistence of "defeaters" as a condition for knowledge. Most tantalizingly, for our purposes, we find this comment: "A belief is epistemically justified for knowledge, according to the "criminal" standard that we endorse, when one has strong reasons in support of it, no undefeated epistemic reason to doubt it, and no undefeated epistemic reason to believe that one's evidence for it is unreliable"; E. CONEE & R. FELDMAN, EVIDENTIALISM: ESSAYS IN EPISTEMOLOGY (2004), at 296. However, this does not really give us a clear answer to the puzzles that concern us: in Prisoners, what makes the slim possibility of the prisoner being innocent a defeater, when the same slim possibility of an eyewitness mistake is not?

93. Austin, *supra* note 90, at 88. There are obvious connections here with contextualist approaches, noted in M. Kaplan, *Deciding What You Know*, *in* KNOWLEDGE AND INQUIRY: ESSAYS ON THE PRAGMATISM OF ISAAC LEVI (E.J. Olsson ed., 2006).

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come in transferring this sort of explanation to the legal examples. This is partly due to the vagueness of the notion of responsiveness to challenge. In epistemology, the existence of penumbral cases of knowledge might not be too troubling. Our concept of knowledge may simply be vague,[94] and this does not cause problems because usually nothing much hangs on whether we use the word "know" in relation to a particular claim.[95] In law, of course, evidence may conflict and be open to interpretation, and this may lead to disagreement over whether a case is proved. This is inevitable, but it is not so easy to accept that the very notion of proof, and thus important decisions about liability, should contain a fair dose of conceptual indeterminacy.

In Blue Bus, for example, it can be argued that, given that what needs to be proved is only that it is more probable than not that the blue bus company is liable, the proportional-ownership statistic is perfectly adequate. If the liability conclusion is challenged, we can at least say, as we did above, that there is surely some connection between the number of buses on the street and the likelihood of one being involved in an accident. Perhaps there is something unsatisfying about this response, but it is difficult to say exactly what, and it is not very reassuring to let liability depend on our feelings about whether the response is appropriate.

Even if we were to accept this indeterminacy, further problems for an Austinian account of verdicts emerge when we recognize that there are cases that are not thought to create problems of proof where the evidence is not easily challenged: D was close to the crime scene at the relevant time, a thread similar to ones in his shirt is found on the victim, and he had a motive to commit the crime. All this might well be taken to amount to proof beyond reasonable doubt, but if D admits all these facts, where is the sense in which he can challenge the inference that he is guilty?[96] If we look at the items of evidence individually, it can, of course, be said that each backs up the others; if the inference from the thread is challenged, we can say "but consider the motive and the opportunity evidence." But highlighting this feature of the case does not meet the current point, for there is no good reason why the ability to identify other unchallengeable evidence should make a difference.

In Austin's examples, a response to a challenge will sometimes be inadequate. If I claim that the bird we are looking at is a goldfinch, and you

94. *See* E. CRAIG, KNOWLEDGE AND THE STATE OF NATURE (1990), at 2; S. HAACK, *supra* note 66, at 7.

95. *See* M. Kaplan, *It's Not What You Know That Counts*, 82 J. PHIL. 350 (1988).

96. D can, of course, challenge the facts that he was near the crime scene, that the thread matched, and so on, but likewise, the blue bus company can challenge the fact that 60 percent of buses are blue. For actual cases that obviously call for conviction but where the evidence seems unchallengeable in the sense explored here, *see* R v. Straffen, [1952] 2 Q.B. 911; R v. Smith (1916) 11 Cr. App. R. 229; United States v. Veysey, 334 F.3d 600 (7th Cir. 2003). There are obvious connections here with Alex Stein's account of legal proof, though Stein arrives at the significance of challengeability by a different route; *see* A. STEIN, FOUNDATIONS OF EVIDENCE LAW (2005); *cf.* M. Redmayne, *The Structure of Evidence Law*, 26 OXFORD J. LEGAL STUD. 805 (2006); D.A Nance, *Allocating the Risk of Error*, 13 LEGAL THEORY 129 (2007).

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question that, my pointing out that it is small will not do. So why should the combination of the evidence in our example be enough to make a difference? The obvious response is to say that the combination makes it very unlikely that D is innocent. That may well be true, but probability judgments are just what we are trying to avoid by exploring options such as challengeability. Note also that in some cases the combination strategy will lead to arbitrary results. If the only evidence against D is a DNA match, the case might be thought to have problems on challengeability grounds. But we can break the DNA evidence down into the individual loci on the DNA profile and claim that each backs the other up.

VI. CONCLUSION

The proof paradoxes are incredibly suggestive. They are a very rich source of arguments about the nature of proof. Too rich, perhaps: this paper has reviewed a large number of arguments, but there is little that is conclusive. In summary, however, here is what can be said. With inferential approaches to the paradoxes, the reference-class problem (which overlaps with the analysis in terms of counterfactualizability) has some bearing on the examples. Where an inference is drawn from a bizarre, very small, or gerrymandered reference class, we may be better off rejecting the inference altogether. But it is not clear that this solves key examples such as Blue Bus; in the absence of other evidence, the reference class of proportional ownership is not obviously the wrong one to use.

Moral objections are difficult to state clearly. It is possible that there are moral constraints on the way in which we draw inferences in criminal cases and that something like a presumption of harmlessness operates, in particular, in Predicting Violence. But this presumption does not offer a general explanation for the paradoxes. When it comes to epistemological parallels, the similarities between paradoxes such as Lottery and the proof paradoxes are tantalizing. Perhaps there is a knowledge-like requirement for verdicts. But there is no agreed solution to Lottery in the epistemological literature, and there is considerable difficulty in applying any of the solutions put forward so far to the legal examples. It is therefore reasonably plausible that cognitive bias is one explanation of the proof paradoxes. One final point on this: those who are attracted to the idea that there is a link between verdicts and knowledge need to show why such a link is plausible. Thomson's suggestion—that because verdicts are significant decisions, they require knowledge—does not really meet this challenge, in part because it is difficult to say what is valuable about knowledge above and beyond its constituent elements.[97] While this paper has taken seriously attempts to identify elements of knowledge in addition to justified true belief—because

97. *See* J.L. KVANVIG, THE VALUE OF KNOWLEDGE AND THE PURSUIT OF UNDERSTANDING (2003).

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that seems to offer a potentially fruitful way of analyzing the paradoxes—it should be noted that there are those who doubt the significance of this enterprise and who see the obsession with Gettier and Lottery-type cases as a wrong turning in epistemology.[98] As Pollock and Cruz put it, knowledge may simply be a perverse notion.[99] When a belief is as well justified as it is in Lottery, just what are we lacking that we would have if we were in a position to say that we know that the ticket will lose?[100]

As stated at the outset, a principal aim of this paper is to set out various analyses of the proof paradoxes rather than to offer a definitive solution to them, so the rather complex picture that emerges is as it should be. One reason for this somewhat modest aim is that there genuinely does seem to be a large number of possible analyses of the paradoxes; it may well be that multiple factors explain our reluctance to ascribe liability in the examples. This has been underappreciated, as has the fact that the various examples, though seemingly similar, are amenable to different solutions. Predicting Violence in particular may raise moral issues that are not as prominent in the other scenarios.

Another reason for being content with mapping rather than resolution is that the proof paradoxes are genuinely difficult to resolve. In lieu of a more positive conclusion, it is worth trying to say why this should be so. One reason is that we are relying very heavily on intuitions about the various examples. In the legal context, we do have empirical research to back up the claim that Blue Bus is a genuine problem and even to suggest what is driving the reluctance to ascribe liability. But in the philosophical literature there are just the intuitions and the theories that are meant to render them plausible.[101] This is not a terribly stable source of data, and it is not surprising to find disagreement among commentators about how to respond to the various examples; some think, for example, that in Lottery we *do* know that the ticket will lose.[102]

Even where we can identify a widely shared intuition about these examples, there are different ways in which we can respond to it. At this point it is worth noting certain debates in moral philosophy that have interesting parallels with some of the arguments relating to the proof paradoxes. Peter Unger argues that the common intuition that we should do more to help

98. *See* J.L. POLLOCK & J. CRUZ, CONTEMPORARY THEORIES OF KNOWLEDGE (2d ed. 1999), at 13–15; HAACK, *supra* note 66, at 7; Kaplan, *supra* note 95.

99. POLLOCK & CRUZ, *supra* note 98, at 14.

100. And note that (*see* note 64 *supra*), our knowledge that the ticket lost may be less certain than our justified true belief that it did.

101. *Cf.* Weinberg, Nichols & Stich, *supra* note 82.

102. *See, e.g.*, W. Lycan, *On the Gettier Problem Problem*, *in* EPISTEMOLOGY FUTURES (S. Hetherington ed., 2006), at 165 n. 22. HETHERINGTON, *supra* note 73, at 104, describes the lottery proposition as "excellent, but not perfect, knowledge." Olsson suggests that Isaac Levi is committed to the view that there is knowledge in Lottery, though he himself states that "our lack of knowledge [in Lottery] is as clear a part of common sense as any other claim I can think of"; E.J. Olsson, *Levi and the Lottery*, *in* KNOWLEDGE AND INQUIRY: ESSAYS ON THE PRAGMATISM OF ISAAC LEVI (E.J. Olsson ed., 2006), at 174.

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victims we come across than those who live far away is based on nothing more philosophically respectable than moral salience,[103] while Cass Sunstein suggests that many moral judgments—including some that are taken to have normative implications—are mistakes caused by moral heuristics.[104] Intuitions have tended to get more respect in epistemology, but we have noted Williamson's claim that cognitive bias explains some of the phenomena taken seriously by certain epistemologists.[105]

At the risk of oversimplifying complex debates, we might say that one person's normative intuition is another person's cognitive bias.[106] To the extent that this is the case, divergent responses to the proof paradoxes will be hard to resolve.[107] For instance, the presumption of harmlessness may reflect a deep normative fact about criminal verdicts or it may simply reflect the distortions caused by moral salience. It might also be a normative fact that verdicts are knowledge-like, or this, too, may reflect a bias whereby we confuse legal proof with knowledge (or perhaps the bias lies deeper, residing in our judgments about knowledge, as Williamson suggests). It is not as if the analysis of proof in terms of probability lacks arguments in its favor. For one thing, probability makes it easy to compare cases, and lawyers are very partial to the argument that like cases should be treated alike. We can well imagine the defendant convicted on eyewitness evidence complaining when we refuse to convict in Prisoners, no matter how probable the prisoner's guilt. The parallels with debates between utilitarians and deontologists are obvious and underline how difficult it is to adjudicate disagreements about the proof paradoxes.

103. P. Unger, Living High and Letting Die: Our Illusion of Innocence (1996).

104. C. Sunstein, *Moral Heuristics*, 28 Behav. & Brain Sci. 531 (2005).

105. *See also* F. Spicer, *Epistemic Intuitions and Epistemic Contextualism*, 72 Phil. & Phenomenological Res. 366 (2006); B. Weatherson, *What Good Are Counterexamples?*, 115 Phil. Stud. 1 (2003).

106. Thus note, for example, David Lewis's response to Unger in D. Lewis, *Illusory Innocence? in* Papers Ethics & Soc. Phil. (2000); and Barbara Fried's to Sunstein in B. Fried, *Moral Heuristics and the Means/End Distinction*, 28 Behav. & Brain Sci. 549 (2005).

107. A similar point is made in D. Shaviro, *Statistical Probability Evidence and the Appearance of Justice*, 103 Harv. L. Rev. 530 (1989), at 543.

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