

# When Does Evidence Suffice for Conviction?

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There is something puzzling about statistical evidence. One place this manifests is in the law, where courts are reluctant to base affirmative verdicts on evidence that is purely statistical, in spite of the fact that it is perfectly capable of meeting the standards of proof enshrined in legal doctrine. After surveying some proposed explanations for this, I shall outline a new approach – one that makes use of a notion of *normalcy* that is distinct from the idea of statistical frequency. The puzzle is not, however, merely a legal one. Our unwillingness to base beliefs on statistical evidence is by no means limited to the courtroom, and is at odds with almost every general principle that epistemologists have proposed as to how we ought to manage our beliefs.

## 1. Statistical evidence in epistemology and the law

In February 1941, Betty Smith, a resident of Massachusetts, was driving along a street in the town of Winthrop, when a bus travelling in the opposite direction forced her to swerve into a parked car. The bus did not stop, Smith did not get a clear look at either the bus or driver and there were no other witnesses. In spite of this paucity of evidence, Smith brought a civil lawsuit against *Rapid Transit Inc.* – one of the companies that operated buses in the town (*Smith v Rapid Transit Inc.*, 317 Mass. 469, 470, 58 N.E 2d 754, 755 (1945)). According to information obtained from the department of public utilities, Rapid Transit Inc. was the only bus company that operated a line on the street in question and, as such, the *majority* of buses travelling along the street on any given day would be Rapid Transit buses, with the remainder being private or chartered buses. The trial court ruled that Rapid Transit Inc. could not be

held liable on this basis – a verdict that was upheld, on appeal, by the Supreme Judicial Court of Massachusetts. Flimsy lawsuits that are likely to fail are not uncommon, of course. What is remarkable about this case, though, is that the prevailing legal doctrine – both then and now, both in the United States and elsewhere – suggests that it should have *succeeded*.

Legal doctrine distinguishes a number of different *standards of proof* that courts might apply. The standard of proof that is supposed to be applied in civil trials is the *preponderance of evidence* standard – also known as the ‘balance of probabilities’. As any textbook on evidence law will attest, this standard is met when a proposition is shown to be more likely true than false – when its probability, given the evidence, exceeds 50%<sup>1</sup>. Clearly, though, the evidence presented in *Smith v Rapid Transit Inc.* *does* make it more likely true than false that the bus involved was a Rapid Transit bus. Given that evidence, we would sooner *bet* on the bus being a Rapid Transit bus than a bus of another sort. The standards of proof are more stringent in criminal trials, where a conviction famously requires that guilt be established *beyond reasonable doubt*. But this turn of phrase may also be interpreted in terms of a probability threshold – merely one much higher than 50%<sup>2</sup>.

Why, then, did the courts find in favour of Rapid Transit Inc. and not in favour of Smith? If not the preponderance of evidence standard enshrined in legal doctrine, what standard of proof were these courts *actually* applying? In explaining the Supreme Court

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<sup>1</sup> See, for instance, Elliott (1987, chap. 4, section B), Keane (1996, chap. 3, section B) and Dennis (2002, chap. 11, section F). For some well known commentary on this standard, see the remarks of Gibbs J and Murphy J in *T.N.T Management Pty. Ltd. v Brooks* 53 A.L.J.R. 267 (1979) and Lord Brandon in *Rhesa Shipping Co. SA v Edmunds and another (The Popi M)* 2 All E.R. 712 (H/L) (1985).

<sup>2</sup> See for instance Simon (1969), Simon and Mahan (1971). An early example of this interpretation is advanced by Bernoulli (1713), part IV, chap. II. In *Miller v Minister of Pensions* 2 All E.R. 372; 63 T.L.R. 474 KBD (1947) Denning J gave what is sometimes regarded as a definitive statement of the beyond reasonable doubt standard: ‘the ... degree of cogency ... required in a criminal case before an accused is found guilty ... is well settled. It need not reach certainty, but it must carry a high degree of probability... If the evidence is so strong against a man as to leave only a remote possibility in his favour which can be dismissed with the sentence ‘of course it is possible but not in the least probable’ the case is proved but nothing short of that will suffice.’ Denning continued ‘The ... degree of cogency ... required to discharge a burden in a civil case ... is well settled. It must carry a reasonable degree of probability, but not so high as is required in a criminal case. If the evidence is such that the tribunal can say: ‘We think it more probable than not’ the burden is discharged...’.

verdict in *Smith v Rapid Transit Inc.*, Justice Spalding remarked ‘The most that can be said of the evidence in the instant case is that perhaps the mathematical chances somewhat favour the proposition that a bus of the defendant caused the accident. This was not enough.’ The idea that a finding of liability cannot rest solely on ‘mathematical’ chances seems apt – but there is something puzzling about it also. After all, what other sorts of chances *are there?*

*Smith v Rapid Transit Inc.* is not the only case in which purely statistical evidence has been treated with suspicion at trial, in apparent disregard for legal doctrine. Indeed, it seems generally true that courts are reluctant to base affirmative verdicts – verdicts of guilt or liability – on evidence that is purely statistical in nature<sup>3</sup>. But *Smith v Rapid Transit Inc.* seems a particularly clear counterexample to the legal doctrine – almost like a case that a philosopher might dream up. And *Smith v Rapid Transit Inc.* has served as the inspiration behind several imaginary cases, such as the well-known Blue-Bus example: Suppose a bus causes harm on a city street. Suppose there are no witnesses to the incident, but we have evidence to the effect that 90% of the buses operating in the area, on the day in question, were owned by the Blue-Bus company. Should a court find the Blue-Bus company liable for the damage caused? The balance of probabilities would seem to weigh overwhelmingly in

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<sup>3</sup> Other cases that are sometimes cited in this regard include *Virginia & S.W. Ry. Co. v Hawk*, 160 F.2d 348, 352 (6th Cir. 1908), *Evans v Ely*, 13 F.2d 62, 64 (3rd Cir. 1926), *Sargent v Massachusetts Accident Co.* 307, 246, 250, 29 N.E. 2d 825, 827 (Mass. 1940), *Commercial Standards Insurance Co. v Gordon Transports Inc.*, 154 F.2d 390, 396 (1946), *People v Collins*, 438 P.2d 33 40-41 (Cal. 1968), *Guenther v Armstrong Rubber Co.* 406 F.2d 1315, 1318 (3d Cir. 1969), *State v Carlson*, 267 N.W. 170, 176 (Minn. 1978), *United States v Shonubi*, 103, F.3d 1085 (2d Cir. 1997), *R v Watters*, All ER (D) 1469 (2000). The situation with the case law is not, however, unequivocal. In *Kaminsky v Hertz Corp.*, 288 N.W. 2d 426 (Mich. Ct. App., 1980), Hertz was found to be liable for the damage caused by a truck on the grounds that it was yellow and bore a Hertz logo and that 90% of the yellow trucks bearing Hertz logos are owned by Hertz. This is sometimes put forward as an example of a case in which purely statistical evidence was allowed to carry the day (Enoch and Fisher, 2015, pp561-562).

It may well be that the legal treatment of statistical evidence has not been entirely consistent – but we should be cautious in drawing this lesson from *Kaminsky v Hertz Corp.* One thing that has hampered much of the discussion of statistical evidence in legal theory and the philosophy of law is the lack of any clear criteria for determining when a body of evidence counts as ‘purely statistical’. It is often assumed that any evidence pertaining explicitly to frequencies or proportions must be purely statistical in nature – but this cannot in general be the case. While the evidence put forward in *Kaminsky v Hertz Corp.* does include information about a proportion, we should not be too quick to conclude that it is an example of purely statistical evidence. I shall return to this in n19.

favour of the proposition that the bus involved was a Blue-Bus bus – indeed the evidence might even meet the beyond reasonable doubt standard, if interpreted probabilistically. And yet, it seems that the court should not make any such finding. To hold the Blue-Bus company liable, purely on the basis of its large market share, would seem palpably unjust (Kaye, 1982, section I, Redmayne, 2008, Allensworth, 2009, section IIB). But to judge the Blue-Bus company *not* liable – which is the only alternative – would now seem to be in flagrant contravention of the textbook standard.

This mismatch between doctrine and practice seems curious enough – but there is yet more to find puzzling here. For a court surely would – and surely *should* – find the Blue-Bus company liable on the basis of *other* kinds of defeasible evidence. Suppose that, instead of the market share evidence, an eyewitness to the incident testifies that the bus involved was a Blue-Bus bus. Provided this testimony is not contradicted or called into question, it would generally be deemed sufficient for a finding of liability. But eyewitnesses are fallible. The fact that a witness testifies that the bus involved was a Blue-Bus bus does not *guarantee* that it was. The witness might have suffered a hallucination, or another sort of bus might have been sporting a Blue-Bus logo, or the witness might have been simply lying in order to smear the company etc. If we were forced to come up with some numerical estimate of how likely it is that the bus really was a Blue-Bus bus, given the witness testimony, it's doubtful that we would go quite as high as 90% – that would seem overly trusting. But 90% is, of course, precisely how likely it is that the bus involved was a Blue-Bus bus, given the statistical evidence about which we were so apprehensive. A verdict of liability based on this testimonial evidence would actually run a *greater* risk of error than a verdict of liability based upon the statistical evidence. And yet the former verdict would seem acceptable, while the latter would not.

Consider also the following example (based on Cohen, 1977, §24 and Nesson, 1979): Suppose an electronics store is struck by looters during a riot – 100 people walk out of the store carrying televisions, while the transaction record at the cash register indicates that only one television was paid for, though no receipt was issued. Suppose Joe is apprehended carrying a television from the store, but we have no other information about him. Should Joe be prosecuted for theft? Should he be convicted? Should he be punished? If our only evidence against Joe is that he carried a television from the store and that 99 out of the 100 televisions carried from the store were stolen, while one was legitimately purchased, then, by launching into such actions against Joe, we would do him a serious wrong.

Once again, we might contrast this with a case in which the statistical evidence is substituted for eyewitness testimony. Suppose only one television is stolen and a witness fingers Joe as the culprit. The testimony of a single eyewitness may not be deemed sufficient for a criminal conviction<sup>4</sup>, but we might imagine that the testimony is corroborated by further evidence that comes to light – perhaps the stolen television is found in Joe’s possession. But even if these two pieces of evidence were enough to secure a conviction, they wouldn’t remove *all* doubt as to Joe’s guilt. There are various possibilities that we might still imagine: Perhaps the witness is lying and the television was planted in an attempt to frame Joe. Such a turn of events may be very unlikely, but if we had to make some guess as to the probability of Joe’s guilt – to come up with some figure – 99% may seem too high. But this is just how likely Joe’s guilt is made by the statistical evidence available in the first case. In one sense the statistical evidence is more *probative* – more indicative of Joe’s guilt. And yet it would

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<sup>4</sup> Whether a single piece of eyewitness testimony is capable of meeting the criminal standard of proof is a question generally left, in any given case, to the discretion of judges and juries. In Scots law, the so called ‘corroboration rule’ explicitly prohibits criminal convictions based solely on the testimony of a single eyewitness. The rule has long aroused controversy, and the Scottish government is now committed, on the basis of a 2011 review of Scots law, to its abolition. The rule continues, at present, to be supported by the majority of Scotland’s High Court judges and criminal lawyers.

be less acceptable – *far* less acceptable – to base a finding of guilt upon it<sup>5</sup>. Why should this be?

This is a puzzle in evidence law. But an *epistemological* puzzle lies in the near vicinity. Not only would it be wrong for a court to condemn Joe purely on the basis of the statistical evidence against him, it would be wrong for an *epistemic subject* to do so. Suppose I'm not involved in any criminal proceedings against Joe, but I simply start *asserting* that he is a thief and a looter – telling his family, his friends, his employer etc. – all the while my only evidence against him being that he carried a television from the store and that 99 out of the 100 televisions carried from the store were stolen. In their own way such actions are no less unjust than a criminal conviction would be. And even if I merely *believed* that Joe committed theft without ever acting upon this belief or even voicing it, *still* I do him an injustice, albeit one of which he'll remain forever oblivious. Perhaps I could justifiably believe that Joe is *very likely* to have committed theft – but to conclude that he *has done so* is a further step that I'm just not entitled to take.

If, on the other hand, I spoke to an eyewitness, who swears that she saw Joe stealing a television, then there need be nothing wrong with my taking this testimony at face value. There need be nothing wrong with me believing that Joe stole a television and, perhaps, taking certain consequent actions against him. Consider, then, the two scenarios before us: In the first I believe that Joe stole a television on the basis of the statistical evidence, while in the second I believe that Joe stole a television on the testimony of an eyewitness. The evidence in the first scenario makes it *more likely* that Joe stole a television than the evidence in the second scenario – if I were to bet on Joe's innocence I'd ask for *longer* odds in the first

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<sup>5</sup> One might insist that 99% would actually be a *reasonable* figure for the probability of Joe's guilt, given the testimony and the recovery of the stolen item. Though I do suspect this would be an overestimate, it's important to note that nothing essential hinges on this – if needs be, we can simply strengthen the statistical evidence available in the first case in order to restore the intended structure of the example.

scenario than the second. In spite of this, my belief in the second scenario is *more justified* than my belief in the first – indeed, my belief in the first scenario seems not to be justified at all.

When it comes to the standards of proof that we ought to meet when forming beliefs, there's no 'official doctrine' that we can refer to. The closest thing we have are general accounts, proposed by epistemologists, of what it takes for a belief to be justified. But existing accounts of justification tend not to offer much help when it comes to this puzzle – and, through no accident perhaps, tend to be rather reminiscent of the standards of proof found in legal doctrine. Though they differ over the details, many epistemologists agree that securing justification for believing a proposition is a matter of ensuring that it is sufficiently *probable*, given one's evidence<sup>6</sup>. Such a view offers no explanation as to why we would privilege testimonial over statistical evidence – both kinds of evidence are equally capable of making propositions probable.

It may be possible to solve the epistemological puzzle of statistical evidence in a way that is consistent with a probabilistic approach to justification. According to the *knowledge* account of evidence (Williamson, 2000, chap. 9), a proposition P will be part of one's body of evidence just in case one knows P. One who accepts this account, and combines it with a generous epistemology of testimony, might argue as follows: When an eyewitness tells me that Joe stole a television I come to *know* that he did, at which point this proposition becomes part of my evidence and, thus, certain given that evidence. In this case, my evidence in the second scenario *does* make it more likely that Joe stole a television, contrary to the alleged set up of the puzzle (see Williamson, 2000, section 11.3).

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<sup>6</sup> This view seems to be shared even by epistemologists who otherwise disagree quite profoundly about the nature of justification (see, for instance, Russell, 1948, chap. VI, Chisholm, 1957, pp28, Derksen, 1978, Alston, 1988, Fumerton, 1995, pp18-19, Lewis, 1996, pp551, Conee and Feldman, 2004, n32, Pryor, 2005, BonJour, 2010).

Intriguingly, this kind of manoeuvre seems to have no real analogue when it comes to the legal puzzle. The notion of evidence at play in the legal puzzle is, in effect, a kind of institutional one – whether something should be considered as evidence at trial is prescribed by explicit rules<sup>7</sup>. I don't mean to suggest that these rules will settle all difficult cases – but when it comes to the mechanics of the legal puzzle, the nature of legal evidence seems not to be one of the moving parts. In the cases considered, the evidence simply consists of the facts that have been admitted and are accepted by all parties. While the notion of evidence at play in the epistemological puzzle is more open textured, the present reflections may suggest that it is not, after all, the key to its resolution<sup>8</sup>. In any case, my primary concern here is not with the epistemological puzzle, but with the legal one.

What the legal puzzle requires for its resolution is a new standard of proof, unlike anything found in the textbooks or the legal doctrine more broadly; a standard that demands more than probability, though less than certainty, a standard that cannot be satisfied by statistical evidence, though testimonial evidence, and evidence of other kinds, can somehow meet it. In this paper, I will describe such a standard<sup>9</sup>. In the next two sections, I will

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<sup>7</sup> See, for instance, the *Federal Rules of Evidence* for the US Federal Court system, particularly articles 4 and 6-10 or part 11 of the *Criminal Justice Act* (2003) for English and Welsh law.

<sup>8</sup> I am inclined to think that many epistemological puzzles have legal analogues that are, in various ways, more tightly constrained. As such, enforcing a principle of uniform solution across the legal and epistemological domains could serve as a certain check on the potential excesses of epistemological theorising. I won't discuss this methodology further here, but will briefly employ it once more at the end of §2.

<sup>9</sup> Statistical evidence is sometimes taken not only to be insufficient for meeting the standards of proof in civil and criminal trials, but to be *inadmissible* – something that the trier of fact should not even take into consideration (see Koehler, 2002). I am not attempting to account for this feature of legal practice here – though what I say may have some relevance for it. Sometimes when statistical evidence has been deemed inadmissible, this is because the evidence is thought to have a dubious or questionable basis (*State v Sneed* 414 P.2d 858 (N.Mex 1966)) – a reason which can often be taken at face value. Other times, though the evidence is regarded as solid, it is excluded on the grounds that its strength is likely to be overestimated by the jury (*State v Carlson*, 267 N.W. 170, 176 (Minn. 1978)). In cases of this sort, the decision to exclude the statistical evidence in question rests on assumptions about its 'real' strength, and questions about its capacity to meet the legal standards of proof are thereby implicated. Some remarks of Justice Todd in *State v Carlson* seem, for instance, to cast doubt on whether statistical evidence may be capable of meeting the beyond reasonable doubt standard.

In yet other cases, statistical evidence appears to have been excluded on the grounds of *irrelevance* – excluded because it allegedly has no bearing on the question of innocence or guilt (*Stephens v State* 774 P.2d 60, 64 (Wyo. 1989)). These cases raise a more difficult interpretative challenge. It may be that some of the resources I deploy in developing a new standard of proof could offer a possible interpretation of such decisions

develop my account by contrasting it with some existing approaches to the puzzle – in particular, a recent proposal due to Enoch, Fisher and Spectre (2012) that exploits the notion of *sensitivity*. My primary aim here is to *interpret* the existing legal practice – to outline a standard that makes sense of the way in which statistical evidence is actually treated in the law. Having said this, however, the standard I put forward may have some revisionary implications – or may, at the very least, force a stand on certain contentious aspects of current legal practice. I take up these issues in §4, though without attempting to arrive at any final judgment about them.

## 2. Sensitivity

Consider the following familiar case, due to Chisholm (1989, pp93): Suppose I'm walking through the countryside and pass a meadow in which I spot a dog that has been cunningly disguised to look like a sheep. Taken in by the ruse, I come to believe that there is a sheep in the meadow. My belief would seem justified – there does appear to be a sheep in the meadow and I have no inkling of anything suspicious. Furthermore, as chance would have it, my belief is true – there really is a sheep in the meadow, grazing behind a hill, out of view. This was originally put forward as a Gettier case, showing that knowledge is more than justified, true belief. I don't know that there is a sheep in the meadow even though I justifiably and truly believe that there is.

One observation we might make about this case is that the evidence for my belief seems *disconnected* from the fact that makes it true. What makes me believe that there is a

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(though not necessarily a legitimisation of them) and of the notion of 'relevance' at work. I won't attempt to engage with this in detail here – but I will say a little more on this topic in n12 and n18.

sheep in the meadow is the animal before my eyes. What makes it true that there is a sheep in the meadow is the animal behind the hill. Say that a body of evidence E is *sensitive* to a proposition P just in case, had P been false, E would also have been false. Following Lewis (1973), this may be spelled out in terms of possible worlds – E is false in all of the most similar possible worlds in which P is false. A belief based upon sensitive evidence might be described as a sensitive belief.

If there hadn't been a sheep in the meadow, my evidence would have been unchanged. It would still have appeared as though there was a sheep in the meadow and I would still have believed, now erroneously, that there was. My belief that there is a sheep in the meadow is not sensitive. This pattern can be found in many Gettier cases, prompting some epistemologists to conjecture that sensitivity may be a necessary condition for knowledge (Dretske, 1971, Nozick, 1980, chap. 3) or that it may have some correlation with knowledge (DeRose, 2004). Whatever one makes of these claims, we can agree that sensitivity is, at least, a *notable* feature for a belief or a piece of evidence to possess.

According to a recent proposal made by Enoch, Fisher and Spectre (2012), the notion of sensitivity holds the key to resolving the legal puzzle of statistical evidence. Suppose a court does find the Blue-Bus company liable on the grounds that 90% of the buses operating in the area on the day in question were Blue-Bus buses. This evidence might make it highly probable that the bus involved was a Blue-Bus bus, but it could not, it seems, be sensitive to this proposition. If the bus had not been a Blue-Bus bus, 90% of the buses operating in the area would still have been Blue-Bus buses and the court would still have found the Blue-Bus company liable. The most similar possible worlds in which the bus involved was not a Blue-Bus bus are worlds in which the Blue-Bus company has the same market share and the court verdict is the same.

Now suppose that a court finds the Blue-Bus company liable on the basis of eyewitness testimony. While not as probabilistically strong as the statistical evidence, this testimonial evidence may be sensitive to the proposition that the bus involved was a Blue-Bus bus. If the bus involved had not been a Blue-Bus bus, the eyewitness would not have said that it was, and the court would not have found the Blue-Bus company liable (or so we are invited to suppose). According to Enoch, Fisher and Spectre, it is the *insensitivity* of statistical evidence that explains our reluctance to base an affirmative legal verdict upon it.

There is something striking about this story – but I suspect that it is not ultimately correct. While it's true that the testimonial evidence in the Blue-Bus case *may* be sensitive to the proposition that the bus involved was a Blue-Bus bus, whether it really *is* sensitive depends on further features of the case – features that have yet to be spelled out. In the original description of the case, it was never specified, for instance, that the witness testimony was truthful. Suppose instead that the witness testimony is false and that the bus involved belonged to another company. Perhaps the witness really did hallucinate or really was lying in order to smear the company etc. In this case, the witness testimony is clearly not sensitive to the proposition that the bus involved was a Blue-Bus bus. There is a very similar possible world – the *actual* world – in which the bus involved was not a Blue-Bus bus, even though the witness testified that it was. In spite of this, it would still be acceptable for a court to find the Blue-Bus company liable. Such a verdict would not, of course, be *correct*, and could perhaps be overturned if further evidence came to light – but this is beside the point. The court has to base its verdict on whatever evidence is available – and the only evidence that is available is the unchallenged testimony of an eyewitness. Testimonial evidence may be insensitive, but it can still be acceptable to rest an affirmative verdict upon it<sup>10</sup>.

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<sup>10</sup> Enoch, Fisher and Spectre also consider a qualified sensitivity condition of the following sort: Evidence E is sensitive to proposition P just in case had P been false, E would *most probably* have been false – a condition that

In general, evidence can never be sensitive to a *false* proposition – and, as such, the sensitivity account cannot accommodate the possibility of incorrect, though acceptable, affirmative legal verdicts (see Blome-Tillmann, 2015, section 6). In fact, in order to make trouble for the sensitivity account, we needn't even imagine that the court verdict in question is incorrect. Suppose the bus involved really was a Blue-Bus bus, and the witness saw it but, if it hadn't been a Blue-Bus bus, she would still have said that it was, due to a private gripe against the company. That is, suppose the witness was secretly *prepared to lie* in order to smear the company but, as things turned out, she didn't have to. A verdict of liability based on this testimony would be correct and acceptable – and yet the testimony is insensitive. As these possibilities show, the sensitivity or otherwise of the testimonial evidence depends on how we fill in further details of the Blue-Bus case. The acceptability or otherwise of finding the company liable does not depend on these details however – it depends only on the evidence before the court.

While Enoch, Fisher and Spectre don't suppose that sensitivity is a necessary condition on knowledge, as I noted above it was with this role in mind in that the notion was first brought into epistemology. And, in a way, this should already make us suspicious of the idea that sensitivity is required in order for an affirmative verdict to be acceptable. There is a kind of misfire here – for an acceptable affirmative verdict would seem the legal analogue of a *justified belief*, rather than a piece of knowledge<sup>11</sup>. And sensitivity has little promise as a

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is taken to be met iff E is false in the majority of the most similar worlds in which P is false (Enoch, Fisher and Spectre, 2012, pp204). It's worth noting that even this qualified sensitivity condition is not satisfied in the case described. Arguably, no other world is as similar to the actual world as it is to itself. As such, if the bus involved was not a Blue-Bus bus, then the actual world is the *only* most similar world in which the bus involved was not a Blue-Bus bus – and it is a world in which the witness testifies that it was. Further, even if we do allow other worlds to be included in this set – worlds that differ minutely from the actual world perhaps – there is no reason at all to think that the witness would do something different at the *majority* of these worlds. A similar problem besets Thomson's attempt to distinguish statistical and testimonial evidence by using a causal condition, which is also unsatisfied in cases of the kind described (see Thomson, 1986).

<sup>11</sup> Epistemologists often regard belief as a threefold affair – for any proposition P one can either believe P, believe ~P or suspend judgment. Court decisions exhibit the same threefold structure. An affirmative verdict is the analogue of a belief that the defendant is guilty/liable. A negative verdict covers the two remaining

necessary condition on justified belief. As noted, insensitivity is widely regarded as being a distinctive feature of at least the first generation of Gettier cases – and Gettier cases are supposed to be cases of justified belief. If our final story about knowledge does find some part for sensitivity, it will be in bridging the gap between justified belief and knowledge, and not the gap between belief and justified belief.

Enoch, Fisher and Spectre do briefly consider cases in which testimony is insensitive because the testifier is lying or mistaken (fn 23). What they suggest is that, although testimonial evidence is not always sensitive, what sets it apart from statistical evidence is that it is sensitive in the best cases – and this explains why it can be acceptable to base affirmative verdicts upon it. It may be that Enoch, Fisher and Spectre could avoid the foregoing problem in this way – but the proposal would need to be developed more fully. If the claim is simply that testimonial evidence has the *potential* to be sensitive, when the conditions are right, while statistical evidence does not, then that claim seems incorrect. For insensitivity is no more an *essential* feature of statistical evidence than sensitivity is an essential feature of testimonial evidence.

Consider the Joe case again. Suppose a court did convict Joe of theft purely on the grounds that he carried a television from the store and that 99 out of the 100 televisions carried from the store were stolen. Is this evidence sensitive to the proposition that Joe stole a television? Assume Joe really did steal a television. Assume, further, that he never set out to acquire a television, but committed an opportunistic crime when he noticed that the store was being looted. In this case, if Joe had not stolen a television, he would have simply left

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possibilities; a belief that the defendant is not guilty/not liable or a suspension of judgment on the issue. This asymmetry between affirmative and negative verdicts owes to the way in which the burden of proof is allocated in civil and criminal trials – to the plaintiff and prosecution, respectively (see Laudan, 2006, pp96-97). The threefold structure underlying court verdicts is more transparent in Scots law, which permits a third verdict in criminal trials – a verdict of ‘not proven’ in addition to the verdicts of ‘guilty’ and ‘not guilty’. In California, a defendant found not guilty in a criminal trial can seek from the judge a ruling of ‘factual innocence’.

the area without one. If Joe had not stolen a television, the evidence would have been different. Presumably only 98 out of 99 televisions carried from the store would have been stolen and, more importantly, Joe would not have been found carrying a television from the store. That is, if Joe had not stolen a television, the evidence on which he was convicted would not have obtained. But these further facts hardly make the court verdict into an acceptable one. It remains the case that the court should never have convicted Joe on the grounds that it did. Statistical evidence can be sensitive, but it is still unacceptable to rest an affirmative verdict upon it (for further cases of this type see Blome-Tillmann, 2015).

There are cases in which testimonial evidence is insensitive but it is still acceptable to base an affirmative verdict upon it and cases in which statistical evidence is sensitive but it is still unacceptable to base an affirmative verdict upon it. What this shows is that neither the property of sensitivity, nor the property of potential sensitivity, draws the line in the right place. As I mentioned, Enoch, Fisher and Spectre's notion of 'sensitivity in the best cases' may be developed in an alternative way that fares better – but I won't speculate about this further here.

I will conclude this section with some more general remarks about the connection between sensitivity and the acceptability of a legal verdict. Taken together, what the foregoing examples appear to show is that considerations of sensitivity are not what's ultimately driving our judgments of acceptability. But the game here is not just one of comparing predictions with intuitions and noting mismatches. These mismatches are I think indicative of something deeper. I suggested in §1 that an adequate solution to the legal puzzle must provide a new standard of proof that demands more than probability, but less than certainty. Sensitivity is a feature of certain pieces of evidence that does meet these conditions. In a very real sense, though, it is not, and could not be, a *standard of proof*.

The Joe case provides a vivid illustration of how questions about the sensitivity of presented evidence can fail to offer any guidance or leverage on the primary question of fact that a court is to decide. If we suppose that Joe is one of the 99 who did steal a television then, as discussed, the evidence against him may well be sensitive to his guilt. If, on the other hand, we suppose that Joe is the one innocent who purchased a television that day, then the evidence would be insensitive to his guilt. In this case, the most similar possible world in which Joe does not steal a television will be the actual world, and this is a world in which the statistical evidence holds. In trying to decide whether or not Joe is guilty it is no use asking whether the presented evidence is sensitive to his guilt. In effect, the evidence will be sensitive on the condition that Joe is guilty and it will be insensitive on the condition that Joe is innocent. We cannot take a view on the sensitivity or otherwise of the evidence without *already* taking a view on Joe's guilt.

Whether the evidence that is presented to a court is sensitive to a given proposition is not, in general, something that can be discerned by inspecting the evidence itself – it is determined by further facts that have *not* been presented to the court. And yet, these further facts can have no bearing on what verdict the court should reach. The court must reach a verdict on the basis of the evidence before it – and the acceptability or otherwise of the verdict is purely a function of this evidence<sup>12</sup>.

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<sup>12</sup> Enoch, Fisher and Spectre put forward the sensitivity condition first and foremost as a way of distinguishing statistical evidence from testimonial and other kinds of evidence which may serve as an adequate basis for an affirmative verdict. If the preceding examples are on the right track, the sensitivity condition does not divide up the cases in the right way. Nowhere, however, do Enoch, Fisher and Spectre suggest that the sensitivity condition should be understood as a *standard of proof* – and they may take it to relate more closely to the issue of *admissibility* than proof (Enoch, Fisher and Spectre, 2012, section V(B)). For what it's worth, I think that standards of admissibility must be transparent in just the same way as standards of proof. Much as a jury in a criminal trial has to reach its verdict based upon the presented evidence, so too does a judge at a pre-trial hearing have to make an admissibility decision based on the presented evidence. It is also important to note that, if our focus is not on sensitivity itself but on potential sensitivity or sensitivity in the best cases, then these may be properties that can be discerned by inspecting a piece of evidence – though this will depend on precisely how these notions are spelled out.

Some epistemologists have, of course, advanced ‘externalist’ theories of epistemic justification, on which the justificatory status of a belief is not wholly determined by the evidence on which it is based, but may depend on certain external, extra-evidential factors. This may be an available position in epistemology – but could we take seriously a corresponding view about the acceptability of legal verdicts? If two courts were presented with equivalent bodies of evidence against two individuals charged with equivalent crimes, could it really be acceptable for them to reach *different* verdicts – for one individual to be found guilty and the other innocent – even if there was some variation in external circumstances? No doubt we can persuade ourselves to say all manner of things about epistemological thought experiments, but there seems to be something almost *viscerally* bad about such a turn of events<sup>13</sup>.

### 3. Normic support

Some philosophers have claimed that, alongside standard Gettier cases, lottery cases provide further counterexamples to the analysis of knowledge as justified, true belief (see Hawthorne, 2003, pp9, Pritchard, 2007, pp4). Suppose I hold a single ticket – ticket #72 say – in a fair lottery of 100 tickets with a single guaranteed winner. Suppose the lottery has been drawn, and my ticket is not the winner, but I’m yet to hear the result. Suppose that, in spite of this, I’m convinced that ticket #72 is not the winner, purely on the basis of the odds involved. Surely I don’t *know* that ticket #72 has lost, even though this happens to be true. Presumably,

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<sup>13</sup> Such a pattern of verdicts would, arguably, violate the *principle of precedent* – foundational to common law systems – according to which judges are bound by previous decisions on questions of law. It is generally true that common law systems place great emphasis on deciding cases in such a way as to ensure that similar bodies of evidence lead to consistent and predictable outcomes. This kind of consideration does, I’m inclined to think, apply in epistemology as well (though there it is much less stark).

though, my belief that ticket #72 has lost is justified. After all, the belief is based on some very strong evidence – evidence that makes it 99% likely to be true. Here, then, is another kind of example of a justified, true belief that falls short of knowledge.

This reasoning can seem compelling – but these cases have a very different ‘feel’ to standard Gettier cases. Think again of Chisholm’s sheep case. I noted, in discussing this case, that the evidence on which I believe that there’s a sheep in the meadow seems disconnected from the fact that makes the belief true. But this is not a criticism of the evidence *per se*. Rather, it seems to belie a problem with the circumstances in which I find myself. If the circumstances had been more obliging – if the animal before me really had been a sheep rather than a disguised dog – then this evidence would have been sufficient for me to know that there is a sheep in the meadow. In the lottery case, though, it’s difficult to see how the external circumstances could have been any more obliging than they already are. Things pan out much as expected – the lottery is drawn, everything is fair and above board, ticket #72 does indeed lose etc. It seems that I could never *know* that ticket #72 has lost purely on the grounds that there are 100 tickets in the lottery and only one winner, irrespective of what the external circumstances are like.

In the lottery case, the failure of my belief to qualify as knowledge really must be down to some shortcoming of my evidence, which immediately calls into question the supposition that this belief is justified. We know there is no question about the *probabilistic* strength of the evidence I possess – so what could the problem be? An observation by Jonathan Vogel may provide a clue: ‘...although winning a lottery on a particular ticket is unlikely or improbable, it would not be *abnormal* in some intuitive sense, for the ticket one holds to turn out to be a winner’ (Vogel, 1990, pp16). In some sense, there would be nothing abnormal about ticket #72 winning the lottery, despite the odds against it. After all, some ticket has to win, and it might just as well be ticket #72 as

any other. If I believe that ticket #72 has lost the lottery, based just on the odds involved, then my belief could turn out to be false without anything abnormal having transpired. In contrast, if there appears to be a sheep in the meadow, but there *isn't one*, then there must be something abnormal happening. If I believe that there is a sheep in the meadow, based on the appearance of a sheep in the meadow, then only some kind of abnormal circumstance could part my belief from the truth.

This is a genuine disanalogy between the evidence available in the lottery case, and the evidence available in the sheep case – but what is this notion of normalcy that is being appealed to? One attractive thought is that normalcy is just a statistical notion – normal circumstances are circumstances that frequently obtain while abnormal circumstances are circumstances that infrequently obtain. Perhaps we do use the words ‘normal’ and ‘abnormal’ in this way on occasion. But this seems not to capture Vogel’s notion of abnormality – after all, the situation in which ticket #72 wins a 100 ticket lottery is, presumably, *infrequent*.

Another attractive thought is that abnormal circumstances require more *explanation* than normal circumstances do. This may be more helpful in the present case. If ticket #72 really did win the lottery, in spite of the odds, then, while I may be surprised and delighted, I wouldn’t try to find some special explanation as to how this could possibly have occurred. It could ‘just so happen’ that ticket #72 is the winning ticket and there’s no more to be said on the matter. If, on the other hand, there was no sheep in the meadow, in spite of the fact that there appeared to be a sheep in the meadow, then there really *would* have to be some special explanation as to how this came about. Perhaps I’m looking at a dog disguised as a sheep, or I’m taken in by some strange trick of the light or I’m hallucinating etc. Whatever the truth, there *is* more to be said.

Say, at a first pass, that a body of evidence *E* *normically supports* a proposition *P* just in case the circumstance in which *E* is true and *P* is false would be less normal, in the sense of requiring more explanation, than the circumstance in which *E* and *P* are both true (Smith, 2010, 2016). Given that there appears to be a sheep in the meadow, the situation in which there is no sheep in the meadow requires more explanation than the situation in which there is a sheep in the meadow. The appearance of a sheep in the meadow normically supports the proposition that there is a sheep in the meadow. Given that there are 100 tickets in the lottery and only one winner, the situation in which ticket #72 is the winner requires no more explanation than the situation in which ticket #45 is the winner or ticket #12 is the winner etc. The fact that there are 100 tickets in the lottery and only one winner does not normically support the proposition that ticket #72 has lost.

We can draw a similar contrast between the two kinds of evidence at play in the Blue-Bus example. Given that an eyewitness testified that the bus involved was a Blue-Bus bus, if it turned out that the bus involved was *not* a Blue-Bus bus, then there would have to be some accompanying explanation. Possible explanations have already been floated above – perhaps the witness was hallucinating, or a bus owned by another company was sporting a Blue-Bus logo or the witness concocted a story to smear the company etc. It can't 'just so happen' that the testimony was wrong. But it *could* just so happen that the bus involved was not a Blue-Bus bus, in spite of the fact that 90% of the buses operating in the area on the day in question were Blue-Bus buses. While this might in a sense be surprising, given the proportions involved, it clearly wouldn't demand any kind of further explanation.

Given the statistical evidence it would *frequently* be the case that the bus involved was a Blue-Bus bus. Given the testimonial evidence it would *normally* be the case that the bus involved was a Blue-Bus bus. The testimonial evidence normically supports this proposition, while the statistical evidence does not. Furthermore, the testimonial evidence

normically supports this proposition irrespective of how we fill in the external facts and details of the case<sup>14</sup>. It makes no difference, for instance, whether the bus involved really was a Blue-Bus bus or a bus of another kind – what is important is that the bus *could not have been* a bus of another kind without there being some associated explanation.

Similar remarks apply to the Joe case. In one scenario, an eyewitness claims that she saw Joe stealing the television and the television is found in Joe’s possession. If it *still* turns out that Joe is innocent of this crime, then explanation is needed. In the other scenario, what we have is the information that Joe carried a television from the store and that 99 of the 100 televisions carried from the store were stolen. This evidence does make it very likely that Joe is guilty – but if we choose to wield it against Joe we effectively know, going in, that he could simply be the one innocent person and *that’s that*. The former body of evidence normically supports the proposition that Joe stole a television, while the latter body of evidence does not.

Once again, these claims are independent of any further details of the case that are yet to be specified. Whether Joe is guilty, whether Joe is innocent, the statistical evidence leaves it open that he be innocent without any special explanation being required. The question of whether the statistical evidence normically supports Joe’s guilt can perfectly well be

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<sup>14</sup> If, however, there was additional *evidence* available in this case, then the conclusion that the bus involved was a Blue-Bus bus may no longer be normically supported. Normic support is *defeasible* – just because a given body of evidence normically supports a proposition, it does not automatically follow that an expanded or enriched body of evidence will continue to do so. If the witness admits, under cross examination, that she is prone to colour hallucinations, then the normic support for the proposition that the bus involved was a Blue-Bus bus would be defeated. Given the expanded body of evidence, the falsity of this proposition would no longer require more explanation than its truth. More plausibly, if we learned that the witness had changed her initial story, or if another witness took the stand and denied that the bus was a Blue-Bus bus, then this would arguably have the same effect. I give a more detailed discussion of the defeasibility of normic support in (Smith, 2016, particularly sections 4.3 and 7.2).

In some cases there may be a kind of ‘standing defeater’ for testimony offered in court – this may be so, for instance, in the case of testimony that a defendant offers on his own behalf, or testimony offered by an eyewitness with an obvious interest in fabricating a story so as to avoid incrimination. In any case with this structure, the standing defeater would itself need to be defeated or neutralised before the testimony would supply normic support for its content. I won’t pursue these issues further here.

answered without our taking any prior view on Joe's guilt. It is straightforwardly answered in the negative.

In the cases considered, our judgments about the presence or absence of normic support track our judgments about whether an affirmative legal verdict would be acceptable or unacceptable. What I suggest is a standard of proof that is met only if a proposition is normically supported by the evidence – only if the evidence makes the falsity of that proposition less normal, in the sense of calling for more explanation, than its truth. What I suggest is that a verdict of guilt or liability is only acceptable in so far as this normic standard is met. This is my proposed solution to the legal puzzle of statistical evidence<sup>15</sup>.

A few points of immediate clarification: First, the proposed normic standard is not meant to be applied to each individual item of evidence presented in a trial but, like the probabilistic standards found in legal doctrine, is to be applied to the total evidence presented. Second, the normic standard is being proposed only as a *necessary* condition for the acceptability of an affirmative verdict. It is compatible with the proposal that a normically supportive body of evidence be deemed insufficient for an affirmative verdict. Third, and relatedly, the normic standard is not being put forward as an *alternative* to probabilistic standards of proof, but can exist alongside such standards. If we imagine a legal system that

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<sup>15</sup> To give a corresponding solution to the epistemic puzzle of statistical evidence, we would need to accept a normic standard for justified belief – a view on which one only has justification to believe a proposition if it is normically supported by one's evidence. While I am inclined to accept this view, it does raise a number of issues which I haven't attempted to address here. The idea that we cannot justifiably believe, on the basis of the odds involved, that a single ticket has lost a fair lottery is non-standard, though it has been defended, often as a response to the lottery paradox (see, for instance Ryan (1996), Nelkin (2000), Smithies (2012), Littlejohn (2012)).

Further, in *Knowledge and Lotteries*, John Hawthorne famously argues that many of the things we ordinarily believe, particularly about the future, entail propositions about lottery outcomes. If, for instance, I believe that I won't be able to afford an African safari holiday next year, this entails that I'm not about to win a large cash prize in the lottery. If I lack justification for believing the latter, as the normic view would seem to imply, and justification is closed under single premise deductive consequence, then I must lack justification for believing the former – a concession which might seem to invite a more general sceptical threat. I think that the normic view has the resources to meet this threat (Smith, 2016, section 3.2), but I won't attempt to engage with this issue here. In any case, this problem does not appear to beset the normic solution to the legal puzzle of statistical evidence – at least not in the same form.

really did operate with purely probabilistic standards of proof – with, say, one threshold for civil trials and a higher threshold for criminal trials – then a normic standard could be introduced while leaving the existing probabilistic standards in place. This would never make verdicts of guilt or liability any *easier* to secure. Rather, it would place further limits on such verdicts – and would do so, or so it is hoped, in such a way as to bring the imagined system closer to our own.

As this discussion illustrates, the existence of a normic standard for civil and criminal trials is still compatible with the overall standards of proof being higher in criminal trials. One way to achieve this is to conjoin a normic standard with a more demanding probabilistic standard for criminal trials and a less demanding probabilistic standard for civil trials. It is worth noting, however, that the notion of normic support may enable a more radical departure from the standard conception of legal standards of proof. The above definition of normic support is naturally extended to comparisons: Say that a body of evidence  $E_1$  normically supports a proposition  $P$  more strongly than a body of evidence  $E_2$  just in case the circumstance in which  $E_1$  is true and  $P$  is false is less normal, in the sense of requiring more explanation, than the circumstance in which  $E_2$  is true and  $P$  is false. While I won't attempt to develop such an account here, it may be possible to make sense of different standards of proof, of varying strength, from within a purely normic framework, without any appeal to probabilistic standards whatsoever<sup>16</sup>.

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<sup>16</sup> I've considered a number of cases in which evidence provides strong probabilistic support for liability or guilt but no normic support, and used such cases to argue against purely probabilistic standards of proof. But cases of the reverse sort are also possible – and might weigh against the idea of purely *normic* standards of proof. It is possible for a body of evidence  $E$  to provide normic support for a proposition  $P$ , whilst providing only weak probabilistic support. One way in which this can occur is if the falsity of  $P$ , given  $E$  would require more explanation than its truth but there are numerous independent factors that could potentially explain falsity, and a significant likelihood that *some* such factor obtains, though none has been identified. In this case the probability of  $P$ , given  $E$  may be relatively low, even though  $P$  is normically supported by  $E$ .

This is not merely an abstract possibility – there are cases of eyewitness testimony that arguably fit this pattern. Much of the psychological research on the reliability of eyewitnesses has served to highlight the sheer range of factors that can potentially interfere with the accurate reporting of a witnessed event (Loftus, 1996).

#### 4. Some difficulties: The case of DNA evidence

I have put forward a normic standard of proof as a way of interpreting what would otherwise be a puzzling feature of our legal practice – namely, the legal preference for testimonial over statistical evidence. If we accept that normic support is also a necessary condition for ordinary justified belief, it may go some way towards rationalising the legal preference – testimonial evidence can give rise to justified belief while statistical evidence cannot<sup>17</sup>. For all I have said, though, it may be that the normic standard clashes with *other* aspects of our legal practice. Even if eyewitness testimony is capable of meeting the normic standard, it may be that other kinds of evidence routinely appealed to in civil and criminal trials – and sometimes treated as a sufficient basis for an affirmative verdict – cannot.

At first glance, the remarks that I've made about testimonial evidence would seem to carry over to many other categories of incriminating evidence. If we have, say, photographs or video footage that appears to show a defendant in the act of committing a crime, or a defendant is shown to have lied about his whereabouts at the time a crime took place, or we have a signed confession etc. then these kinds of evidence clearly do more than simply 'stack the odds' in favour of guilt. In the event that a defendant is innocent, the existence of such evidence is a circumstance that would demand special explanation.

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There may well be circumstances in which some kind of interference with a piece of eyewitness testimony should be regarded as significantly likely, although no evidence of actual interference has been presented. In such circumstances, it would seem highly questionable to base a criminal conviction on the testimony in question – which speaks in favour of operating with probabilistic as well as normic standards of proof. It may be that such convictions could also be blocked by utilising stronger normic standards of proof – but I won't pursue this here.

<sup>17</sup> It's plausible to think that it could not be acceptable to base a verdict of guilt or liability on evidence that would be insufficient to ground justified belief in guilt or liability (see for instance Ho, 2008, chap. 3). However, Enoch, Fisher and Spectre argue that the law should not care about epistemological niceties such as knowledge or justified belief – at least not as ends in themselves (Enoch, Fisher and Spectre, 2012, section V). I won't pursue this topic here but, suffice it to say, if Enoch, Fisher and Spectre are correct, then the normic standard may offer only an interpretation of the legal practice, and one that effectively leaves questions about its legitimacy open.

There will be more difficult cases, though – and I will focus here on one: *DNA evidence*. Suppose a DNA sample is lifted from a crime scene and identified as belonging to the perpetrator. When run against a database the sample yields a ‘cold hit’ – a matching DNA profile belonging to some member of the population, with no other known connection to the crime. Suppose this individual is arrested and charged with the crime. Suppose that no further evidence against the individual emerges, but an expert witness testifies that the chance of two individuals in the population sharing the same profile is exceedingly slim. Should the individual be convicted of the crime, just on the basis of the DNA match? Whatever our feeling about this, it seems that a conviction in a case like this may violate a normic standard. While it may be very unlikely that there is another person in the population who matches the profile, and is the source of the sample at the crime scene, this would not, or not obviously, be a circumstance requiring special explanation. To put it differently, the individual in this case may be innocent and his profile match the sample as a result of sheer chance.

A few points are immediately worth making. First, most uses of DNA evidence in criminal prosecution are, at present, not like the case described. DNA evidence often takes the form of a match between a crime scene sample and the profile of a person upon whom suspicion has *already fallen* for independent reasons, such as eyewitness testimony. These ‘confirmatory’ uses of DNA evidence may often result in successful conviction, and a normic standard is in no conflict with this – for the standard could easily be met by the total evidence presented. And if, as suggested above, we understand ‘beyond reasonable doubt’ to incorporate both a normic and a probabilistic standard, then the DNA evidence may even play a pivotal role in ensuring that a conviction is acceptable<sup>18</sup>.

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<sup>18</sup> Given a mixed normic/probabilistic standard of proof, we would expect DNA evidence to be deemed relevant and admissible in criminal trials, consistent with the actual practice – but would face a residual puzzle of explaining why statistical evidence of other kinds is often deemed to be inadmissible. In contrast, a *pure* normic standard of proof, of the kind suggested at the end of §3, would serve to raise doubts about the relevance and

Similar remarks apply to cases in which a suspect, initially identified via a cold hit, is subsequently linked to a crime in independent ways. In these cases, too, conviction may be consistent with a normic standard. But there are real cases that come closer to the above description – cases in which a conviction has been secured based on nothing more, or little more, than a DNA cold hit<sup>19</sup>. Further, there is some indication that such ‘pure cold hit’ convictions will become increasingly common, driven partly by improvements in DNA recovery techniques and by the massive expansion of offender databases (see Roth, 2010, section IB, section II)<sup>20</sup>. This practice remains controversial amongst legal theorists, however (see Semikhodskii, 2007, Roth, 2010), and there are also examples of cold hit DNA prosecutions that have resulted in acquittals or reversals on appeal.

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admissibility of (normically inert) statistical evidence, but such doubts would appear to extend to DNA evidence as well. As I mentioned in n9 admissibility is not my primary concern here – but I hope to pursue these questions elsewhere.

<sup>19</sup> See, for instance, *State v Toomes*, 191 S.W.3d 122, 129 (Tenn. Crim. App. 2005), *State v Hunter*, 861 N. E.2d 898, 901 (Ohio Ct. App., 2006), *People v Puckett*, No. A121368 (Cal. Ct. App. 2009)). Cold hit DNA convictions are sometimes presented as an exception to courts’ general reluctance to rely on purely statistical evidence. The claim that DNA evidence is just a kind of statistical evidence seems widely accepted (see, for instance, Roth, 2010, Enoch and Fisher, 2015, part III) though it is seldom defended in any detail. It is true enough that the provision of DNA evidence tends to be accompanied by some numerical estimate, from an expert witness, of the probability of error. But it doesn’t follow from this alone that the evidence is purely statistical in nature. After all, *any* sort of evidence – testimony included – could in principle be accompanied by a probability estimate from an expert. Even if a piece of eyewitness testimony came with an attached probability value based on extensive research into the reliability of eyewitnesses, that would not make it into purely statistical evidence. The normic support that the testimony provides for its content is not *lost* simply because probability has been allowed to enter the picture.

While I think it may ultimately be correct to categorise DNA evidence as statistical, there may be other cases in which the salience of probability estimates has led to evidence being mischaracterised. In n3 I mentioned a well known case – *Kaminsky v Hertz Corp.* – in which a finding of liability was, allegedly, based on evidence that is purely statistical. In this case, once again, the evidence presented had a very clear probability attached, and the supposition that the evidence was purely statistical seems based on nothing more than this. Arguably, though, the fact that a truck bears a Hertz logo *does* provide normic support for the proposition that it is owned by Hertz – normic support which is not diminished by learning of the precise frequency with which this is borne out. In this case, the presented evidence would meet a normic standard of proof. Some suggestive commentary in *Kaminsky v Hertz Corp.* suggests that the evidence was *not* taken to be purely probabilistic: ‘We find...that the Hertz color scheme and logo establish a prima facie showing of ownership or control...The named firm may introduce evidence indicting lack of control or ownership. But such explanations are for the jury to evaluate and appraise in light of all the surrounding circumstances’. The ‘descriptive’ question of what it means for evidence to be purely statistical and the ‘normative’ question of what it takes for evidence to support an acceptable affirmative verdict cannot be completely disentangled from one another.

<sup>20</sup> There are political reasons also. In the United States, local authorities have received large federal grants to expand the use of DNA evidence in resolving backlogged cases. See *National Research Council, Strengthening Forensic Science in the United States: A Path Forward* (2009).

A normic standard of proof would block pure cold hit DNA convictions. If an individual is innocent of a crime, and is not the source of a DNA sample found at a crime scene, there may be an explanation as to why it matched his profile in a database – the sample was compromised, the test results were tampered with, someone was trying to frame him – but, equally, there may not be. Even if nothing like this has taken place, the individual may still be innocent, and the match a result of sheer chance<sup>21</sup>. This is one respect in which pure cold hit DNA convictions depart from pre-existing legal practice.

None of this is to say that cold hit DNA convictions are illegitimate. The clash with the normic standard could be portrayed as a reason for being critical of such convictions – but could also be seen as a reason for resisting the standard, and seeking an alternative solution to the legal puzzle of statistical evidence. I have argued that Enoch, Fisher and Spectre’s sensitivity-based solution to the puzzle is not effective. But it is nevertheless instructive to note that it *does* appear to offer a different verdict on pure cold hit DNA evidence (Enoch and Fisher, 2015, part III). If an individual identified via a cold hit really is the source of a DNA sample found at a crime scene then, had he not committed to crime, there would have been no cold hit. The evidence is sensitive to his guilt<sup>22</sup>.

In so far as the normic standard is supported by its capacity to make sense of certain aspects of legal practice, the fact that it conflicts with other aspects, even contentious ones, can carry only limited weight against them. One potential way to take the argument against cold hit DNA convictions further would be to offer a principled reason as to why the law should *care* about normic support – about ensuring that convictions are normically supported.

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<sup>21</sup> Cases in which a match results from laboratory error or tampering or interference of some other kind are sometimes referred to as ‘false’ matches. While a cold hit DNA conviction may be wrongful as a result of a false match, the crucial point is that the conviction may be wrongful *even if the match is ‘true’*.

<sup>22</sup> Naturally, if the individual in question is *not* the source of the DNA at the crime scene, and the match is a false one or a coincidental true one, the evidence will not be sensitive to his guilt. This is another instance in which the sensitivity or insensitivity of the evidence hinges upon the guilt or innocence of the defendant.

If it could be shown that a normic standard is important for the overarching aims or purposes of the legal system, then this could increase the pressure on such convictions. Enoch, Fisher and Spectre do provide a principled account of why the law should care about sensitivity and, in that respect, my theory is less complete than theirs<sup>23</sup>. I won't attempt to pursue this here however.

Legal adjudication is one setting in which we are made acutely aware of our own uncertainty – and the notion of probability offers us a powerful way in which our uncertainty can be quantified, and made more tractable. Perhaps it is understandable, in this setting, that we should always try and view our uncertainty through this lens – to take the significance of evidence to be exhausted by its probabilistic significance. As some commentators on the legal puzzle of statistical evidence have claimed ‘*all* factual evidence is ultimately ‘statistical’ and all legal proof ultimately ‘probabilistic’ (Tribe, 1971, pp1130, n2) and that ‘all information is probability information’ (Saks and Kidd, 1980-81, pp153). And yet, there is nothing *God-given* about the notion of probability. When it comes to managing our uncertainty, all that we have are a number of human contrivances, better and worse suited to different purposes. If we are open, from the outset, to a range of different ways of managing

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<sup>23</sup> Enoch, Fisher and Spectre's account appeals to the aim of *detering* criminal or negligent behaviour, which undoubtedly has a strong claim to being one of the aims of the legal system. Put roughly, if courts were willing to base affirmative verdicts on insensitive evidence then, according to Enoch, Fisher and Spectre, this might lead people to reason that they could be convicted or found liable *irrespective* of what they do – thus removing an important incentive for responsible or law abiding behaviour. If, for instance, courts were prepared to find the Blue-Bus company liable for any bus related incident, purely in virtue of its large market share, then that could make rival companies, and perhaps even the Blue-Bus company itself, *less* inclined to take proper precautions, maintain high safety standards etc. It may be that a willingness to base affirmative verdicts on statistical evidence would have the adverse consequences that Enoch, Fisher and Spectre suggest – but, once again, I doubt that the *insensitivity* of such evidence could adequately explain this. After all, courts *already do* base affirmative verdicts on evidence that is insensitive. This is just a consequence of the fact that courts sometimes arrive at affirmative verdicts that are incorrect. This doesn't dampen the capacity of the legal system to deter crime – or, if it does, then it does so unavoidably. I won't pursue this criticism here.

uncertainty, the legal puzzle of statistical evidence need not strike us as a ‘puzzle’ at all. It is this perspective that I’ve argued for here<sup>24</sup>.

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<sup>24</sup> Versions of this paper were presented at the University of Groningen in April 2014, at Yonsei University in June 2014, at a workshop on Statistical Evidence in Epistemology and the Law at the University of Glasgow in December 2014, at the University of St Andrews in October 2015, at a workshop on Legal Standards of Proof at the University of Edinburgh in February 2017 and at a workshop on Truth, Knowledge and the Criminal Trial at the University of Nottingham in June 2017. Thanks to all of those who participated on these occasions. Particular thanks to Neil Mehta for providing detailed written comments on an earlier version of the paper and to Aness Webster for presenting a response to the paper at the Nottingham workshop. Thanks also to two anonymous referees for this journal. This paper owes its existence to the groundbreaking work of David Enoch, Talia Fisher and Levi Spectre on statistical evidence in the law. Work on this paper was supported by the Arts and Humanities Research Council (Grant Nos. AH/L009633/1 and AH/M009610/1).

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