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Decision Making and the Law: Truth Barriers

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ABSTRACT

Reaching an accurate outcome is a central goal of the American trial. But structural features of the legal system, in combination with the cognitive shortcomings of legal actors, hinder the search for truth. Regarding the legal system, various rules and policies restrict decision makers' access to evidence, violate the laws of probability, and limit the evidentiary concerns that may be considered on appeal. Regarding legal actors, informational deficits (particularly regarding scientific and statistical evidence) and cognitive biases of police investigators, witnesses (lay and expert), attorneys, judges, and jurors pose serious obstacles. We conclude by suggesting that research in judgment and decision making may hold the key to understanding legal decisions and increasing their accuracy.

Keywords: decision-making, law, evidence, statistical evidence, jurors, judges, cognitive bias, heuristics, DNA

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According to the U.S. Supreme Court, "The basic purpose of a trial is the determination of truth" (*Tehan v. U.S. ex. rel. Shott*, 1966, p. 416). Although much of the American public would likely agree with this normative sentiment, many of the rules and procedures associated with legal trials actually impede the truth-seeking process. Probative evidence is withheld from juries. Judges restrict the purpose for which juries may use evidence. Witnesses are admonished to answer questions narrowly even when an expanded answer would provide greater clarity or insight. In criminal cases, the proof standards are such that juries often acquit defendants even when the evidence persuades them that they are guilty. In civil cases, juries often return verdicts that violate elementary principles of probability. These legal rules and practices reflect values and policies that were deliberately built into the trial process. Laudable though some of those values and polices may be, they generally make it more difficult for factfinders to produce accurate verdicts.

The quest for true verdicts is also hindered by shortcomings in what legal actors understand and how they tend to think. For example, some jurors misunderstand scientific evidence or fail to appreciate how selection bias and evidentiary dependencies should impact a case. Moreover, a host of cognitive biases may affect the judgments of even the most intelligent and motivated legal actors. Key biases include confirmation bias, hindsight and memory biases, belief perseverance, framing effects, and anchoring and insufficient adjustment. In short, although the search for truth at trial is surely an important goal, the presence of other goals, and shortfalls in the knowledge and thinking processes of the various legal actors may hinder this search.

The Law Interferes with Accurate Decision Making

A. Social Policy Objectives

The Federal Rules of Evidence (FRE) govern how and when facts may be proved or disproved at civil and criminal trials in a U.S. District Court. Because most states model their own rules of evidence codes on the FRE, the FRE affect the way evidence is introduced in virtually all courts in the country. Whereas many rules of evidence clearly advance the search for truth (e.g., by admitting relevant evidence and excluding irrelevant evidence), others exist largely to advance *social policies* that little to do with reaching an accurate verdict. Consider, for example, FRE 407-409. These rules are frequently invoked in civil cases involving accidents, injuries, and charges of negligence. They generally exclude diagnostic evidence related to subsequent remedial measures (i.e., corrective actions taken by a party after an injury has occurred), settlement offers, and medical payment offers as proof of fault. On first consideration, these rules might surprise probabilistically-oriented behavioral scientists. Suppose that a material issue in a slip-and-fall case is whether a grocery store behaved negligently when it left the aisles wet after a morning mopping. The fact that the defendant began thoroughly drying the aisles following morning moppings the day after the accident would seem to be evidence that even the store knew that it was not doing all it reasonably could have done to ensure the safety of its customers at the time of the accident. But evidence of the store's actions to remedy the dangerous condition will usually not be admissible in court. The evidence will be excluded on grounds that its admission might discourage stores everywhere from remedying potentially dangerous conditions. Defendants charged with negligence would quickly learn that taking corrective actions following accidents will harm their chances in court. And so they will leave

potentially dangerous conditions uncorrected. A similar justification exists for excluding offers to settle civil cases and offers to pay for an injured party's medical expenses. By excluding such offers from being used against the party that makes the offer, the law encourages such offers, a situation that is generally believed to be socially desirable.

The U.S. Constitution may also provide a roadblock in the search for truth at trial. For example, evidence obtained from searches that violate the Fourth Amendment is usually excluded. Failure to admit this evidence often means that a defendant who would otherwise be found guilty will now be found not guilty or have the charges against him dismissed altogether. The Supreme Court has frequently acknowledged the "substantial social costs" of this exclusionary rule (*U.S. v. Leon*, 1984, p. 907). The social cost referred to here is, essentially, a reduction in outcome accuracy due to more false negative errors (i.e., more failures to convict the guilty).

Similarly, the confrontation clause of the Sixth Amendment to the Constitution excludes a great deal of probative evidence in criminal cases. The confrontation clause gives defendants in criminal cases the right to confront witnesses who provide evidence against them. When this right has not been satisfied (e.g., if a defendant is not able to cross-examine the source of testimonial evidence against him or her), the evidence will generally be excluded, regardless of its value to the prosecution's case. For example, suppose that the victim of a horrific assault tells police that the Alberto is the one who beat him and Alberto is charged with assault. Now suppose that the victim becomes unavailable to testify at Alberto's trial because he slips into a coma. The victim's identification of Alberto will ordinarily not be admissible as proof that Alberto committed the assault and Alberto may go free. Here the policy of ensuring that the accused has an opportunity to confront his accuser may thwart efforts to achieve an accurate verdict.

The high standard of proof that must be met in criminal matters (and some civil matters[1]) provides another example of how society sometimes places policy objectives ahead of the truth-seeking function of a trial. In criminal matters, the prosecution must prove its case "beyond a reasonable doubt." Although this standard does not lend itself to a clear probability equivalent, it certainly is a more demanding than the "preponderance of evidence" standard that is most commonly used in civil lawsuits. By requiring a "not guilty" verdict in criminal cases in which the trier of fact both believes that (a) the evidence makes it more likely than not that the defendant is guilty, and (b) there remains a reasonable doubt about the defendant's guilt, this standard of proof can interfere with verdict accuracy. Of course, when the presumably higher costs of falsely convicting the innocent relative to falsely acquitting the guilty are taken into account,[2] standards that decrease overall accuracy may be preferable to the one that maximizes overall accuracy.

B. Legal Rules, Policies, & Courtroom Procedures

[1] In some civil and administrative cases where important individual interests or rights are at stake (e.g., termination of parental rights, involuntary commitment, deportation, removal from life support petitions, etc.), courts require that the case against defendants be proved by "clear and convincing evidence." This standard is stronger than the preponderance standard but weaker than the beyond-a-reasonable-doubt standard.

[2] According to one study, the public regards the costs of the two errors to be similar (Arkes & Mellers, 2002).

1. Withholding Evidence: Overweighting Concerns. Sometimes evidence is withheld from juries not to promote a competing policy objective, but rather because courts and legal rule makers fear that jurors will misuse or overweight the evidence. For example, character evidence ("He's a jerk"), evidence of prior bad acts ("He robbed a bank last year"), and hearsay ("Marge told me that she was upset" – if offered to prove that Marge was upset) are generally not admissible. Other types of evidence are withheld if a judge determines that the probative value of the evidence is "substantially outweighed by a danger of … unfair prejudice, confusing the issues [and] misleading the jury" (Federal Rule of Evidence 403). This frequently-invoked rule reveals a mistrust of juries. Indeed, the Advisory Committee notes that accompany this rule expressly identify a concern that jurors may be prone to making decisions "on a purely emotional basis" (Advisory Committee Notes, FRE 403). Like many evidentiary rules, this one is not based on empirical data.

2. Conjunction. The accuracy of legal decisions may also be compromised in civil cases by the policies followed in cases in which a plaintiff must prove each of several claims to prevail. Trial judges generally instruct jurors to decide civil cases element by element, using a preponderance-of-evidence standard for each element. For example, suppose that a plaintiff in an injury case must prove that the defendant caused his injury and that the defendant's conduct in doing so was negligent. If the evidence shows that it is 51% likely that the defendant's actions (or inactions) caused the injury and 51% likely that the defendant was negligent, then the plaintiff prevails. Never mind that, in a case of this sort, a trier of fact should almost certainly believe that the probability that the defendant was *both* causally responsible and negligent is less than 50%. Such a blatant disregard for the rule of conjunctive probability will often harm verdict accuracy. On the other hand, there are policy advantages associated with this approach including reducing task complexity for factfinders, reducing the barriers to plaintiffs for collecting damages (which in turn serves as a motivator for others not to engage in misconduct), and helping to ensure verdicts that the public will understand and accept verdicts. Regarding this last claim, Nesson (1985) argues that the public will not embrace verdicts in which a party that has proved every element of a claim loses: "If a person believes that event A occurred and if he believes that event B occurred, then he will believe that both events – (A & B) – occurred" (p. 1839). This "conjunction paradox" in legal decision making has attracted the attention of jurists, legal academics, statisticians, economists, and others (Ron Allen, 1991 Cardozo; Levmore, 2001; Nesson, 1985; Nance, 1986; Posner, 1999; Dawid, 1987).

3. Appellate Review. In criminal cases, defendants may appeal their convictions. One might suspect that the appellate review process acts as a check on policies at the trial level that could lead to wrongful convictions. But this suspicion would be wrong. Appellate courts ordinarily do not reconsider old evidence, hear new evidence, reassess the credibility of witnesses, or decide whether they agree with a jury's verdict (*In re Zeth S.*, 2004; *Uriarte v. United States Pipe & Foundry Co.*, 1996). Instead, appellate review is more about determining whether the trial court committed a procedural or legal error so grave that, had the error not been made, the jury would have returned a different verdict *(In re Marriage of Shaban*, 2001; Federal Rule of Evidence 103). Even when appellate courts find trial court errors, they generally treat the errors as "harmless" and uphold about 95% of convictions. Further, there is little evidence that appellate court reviews help reduce the number of falsely convicted defendants. As detailed in Garrett (2011), none of 69 convicted defendants who were later exonerated by DNA evidence

had their convictions overturned by an Appellate court when they specifically challenged the sufficiency of the evidence against them. Obviously this is an unusual group of defendants, so inferences and generalizations are risky. But, as Simon (2012) points out, "the DNA exonerees were no more likely to receive relief than a matching group of similarly situated inmates whose guilt was not refuted by DNA or by any other exonerating evidence" (p. 203). In short, the appellate process does not seem to do much to improve verdict accuracy.

Intellectual Deficits of Legal Participants: Harmful Effects of Innumeracy

A guiding principle in decision theory research is that people are limited information processors. But some are more limited than others. Although people share a disturbingly wide range of cognitive deficits with their fellow humans, there is evidence that, at least under some conditions, people who are simply more knowledgeable are relatively less prone to falling prey to various cognitive biases (Nisbett, Krantz, Jepson, & Kunda, 1983; Stanovich & West, 1998, 2000, 2008). In particular, performance on various reasoning tasks can be predicted by statistical training and statistical literacy (Fong, Krantz, & Nisbett, 1986; Nisbett, Fong, Lehman, & Cheng, 1987). Unfortunately, the statistical literacy rate is quite low (Paulos, 1988) and few participants in the legal process are likely to have any statistical training. These facts are important because scientific and statistical evidence often lie at the heart of legal cases. Even expert witnesses charged with presenting scientific and statistical information often have such a poor grasp of elementary statistical concepts that they frequently – and almost certainly unintentionally – misstate the meaning of the evidence (Garrett & Neufeld, 2009; Koehler, 1993). These mistakes often go unnoticed. Opposing parties rarely have statistically trained experts waiting in the wings to spot and correct misstatements. Lawyers and judges (including appellate judges) are unlikely to spot the misstatements. Jurors, most of whom do not have a college diploma (Levin & Emerson, 2006), are also unlikely to catch these mistakes (Angell, 1994). Indeed, research indicates that mock jurors are themselves poor at processing even properly presented statistical evidence.

Perhaps the most common and important statistical errors and misinterpretations occur in cases involving DNA evidence. DNA evidence can provide a powerful link between a defendant, a victim, and a crime scene. The evidence is usually presented in statistical form which opens the door to various potential errors. One error involves transposing a conditional probability. The net effect of the transposition in a DNA case is that decision makers may falsely believe that the genetic evidence can provide direct, probabilistic answers to such questions of interest as who committed the crime, and who is the source of the genetic evidence. A second type of error involves failure to appreciate the role that error rates play in the interpretation of DNA statistics. In particular, the false positive error rate places an upper bound on the probative value of DNA evidence. But this error rate, which is rarely admitted at trial and, arguably, unknown, is largely ignored by key players in the legal process. We discuss each of these two errors below.

A. Transposition Errors

When the police identify a genetic match (e.g., a DNA match) between a suspect and trace evidence recovered from the crime scene, a DNA analyst usually provides an estimate of the frequency with which the genetic profile occurs in one or more populations. In the language of conditional probability, this frequency is approximately equal to the probability of finding a

match with a person who is not the source of the trace evidence, i.e., $P(\text{Match}|\overline{\text{Source}})$. This probability, which is commonly referred to as the Random Match Probability (RMP), is easily confused with its inverse (or transposed conditional), $P(\overline{\text{Source}}|\text{Match})$. And when $P(\overline{\text{Source}}|\text{Match})$ is subtracted from 100%, one obtains a conditional probability that is of greater interest to jurors, namely, $P(\text{Source}|\text{Match})$. However, as Bayesians and other statistically-minded people know, an estimate of P(Source | Match) requires an estimate of P(Source), where P(Source) is the probability that the matchee is the source of the matching genetic evidence *prior to* the indication from the genetic test that the matchee is a member of the set of people who could be the source. When mock jurors confuse $P(\overline{\text{Source}}|\text{Match})$ with $P(\text{Match}|\overline{\text{Source}})$, they commit the "source probability error" (Koehler, 1993). This error, which is a common one (Gigerenzer, 2002; Koehler, 1993, 1996; Nance & Morris, 2002; but see Smith, 1996), is similar to other types of documented "inverse errors" (Kaye & Koehler, 1991) in the broader decision making literature (Casscells, Schoenberger, & Graboys, 1978; Chapman & Chapman, 1959; Eddy, 1982; Hamm, 1993; Wolfe, 1995).

1. Prosecutor's Fallacy. The "Prosecutor's Fallacy" is a particularly troubling inverse error (Balding & Donnelly, 1994; Thompson & Schumann, 1987). Those who commit it treat the RMP as a statement about the probability that the suspect is *innocent of the crime* charged. Although the RMP provides information about the strength of the forensic science match (up to a point), it does not translate into a probability that a defendant is (or is not) guilty of the crime charged. As in the case of conditional source probability statements, conditional guilt probability statements (e.g., P(Guilt | Match)) require an assessment of the prior odds that the matchee is guilty. Those prior odds depend on the strength of the non-genetic evidence in the case and will vary across decision makers.

An example clarifies the point. Suppose that a defendant matches semen recovered from a rape. Suppose further that the RMP is 1 in 10,000. This means that the approximate probability that a man who is not the rapist (assuming that the semen was left by the rapist) will match by sheer coincidence is about 1 in 10,000. In a large city, many men will match a 1 in 10,000 genetic profile. It would be ludicrous to suggest that each of these matching men has only a 1 in 10,000 chance of *not* being the rapist $P(\overline{\text{Guilty}}|\text{Match})$, as this would mean that each matching man has a 9,999 in 10,000 (i.e., 99.99%) chance to be the rapist. It would be more accurate to say that, based on the semen evidence alone, each matchee has only a 1/n chance to be the rapist where n is the estimated number of matchees in an appropriate reference population. To the extent that there is strong non-genetic evidence linking the defendant to the crime (e.g., he had greater motive and opportunity than other matchees), then a legal decision maker should believe that the chance the defendant is the rapist is larger than 1/n.

2. Paternity. Source Probability Errors and Prosecutor's Fallacies are so seductive that the entire field of paternity testing appears to have fallen victim to them (Kaye, 1989). In paternity testing, forensic scientists typically identify the likelihood ratio $\frac{P(\text{Match}|\text{Father})}{P(\text{Match}|\overline{\text{Father}})}$. Testifying experts commonly refer to this ratio (or an approximation thereof) as a "paternity index." A problem arises when experts claim that a paternity index of, say, 1,000:1 means that it

is 1,000 times more likely that the defendant is the father than a randomly selected man. Such a claim is an inversion error. The posterior odds ratio $\frac{P(Father \mid Match)}{P(\overline{Father} \mid \overline{Match})}$ cannot be identified directly from the likelihood ratio $\frac{P(Match \mid Father)}{P(Match \mid \overline{Father})}$ for the same reason identified above (a prior odds ratio is needed). Some paternity experts defend the inversion by claiming that it is the mathematically correct Bayesian result if one assumes a prior odds ratio of 1:1. That is, if one assumes that the strength of the non-genetic evidence in every paternity case is such that the tested man has 50% chance to be the father of the child prior to testing, then the Bayesian math works out such that $P(Match \mid \overline{Father})$ actually *is* identical to $P(\overline{Father} \mid Match)$. Most numerate people will see this statistical gambit for what it is: not only is it inappropriate for the forensic scientist to decide what the strength of the non-genetic evidence (including various claims and counterclaims pertaining to a sexual relationship between the mother, the putative father, and other potential fathers around the time of conception), but it is inappropriate to suggest that a probability of 50% fits the facts in each and every case. Nevertheless, many (and perhaps most) courts, including Appellate courts, simply regard the 50% prior probability assumption to be a "neutral" one (see e.g., *Griffith v. State of Texas*, 1998; but see *Plemel v. Walter*, 1987).

In *McDaniel v. Brown* (2010), the U.S. Supreme Court weighed in ever so slightly on statistical inverse errors. In *McDaniel*, the defendant was convicted of rape based largely on the strength of a DNA RMP of one in 3,000,000. At trial, a reluctant criminalist was unable to fend off a persistent prosecutor who tempted her to commit an inverse fallacy by subtracting the RMP from one "just for another way to look at it" (*McDaniel* Transcript, JA 458). She eventually did so, and mistakenly agreed with the trial judge's query about whether "it's the same math just expressed differently" (*McDaniel* Transcript, JA 460). In closing argument, the prosecutor committed the Prosecutor's Fallacy by arguing that the DNA RMP shows that the jury can be "99.999967 percent sure" that the defendant is guilty.[3] When this case reached the Supreme Court, the Court introduced some confusion of its own by referring to the Source Probability Error as the Prosecutor's Fallacy. More importantly, though, the Court correctly acknowledged the inverse error as such and noted that "it is important that [statistical evidence] be presented in a fair and reliable manner" (*McDaniel v. Brown*, 2010, p. 675). However, the Court treated the statistical errors as harmless because there was much other evidence that pointed to the defendant's guilt.

B. Laboratory Error Rates

Failure to appreciate the role that laboratory error rates play in the interpretation of scientific and statistical evidence is another way innumeracy conspires to reduce accurate probabilistic judgment in the courtroom. Consider DNA evidence once again. One cannot accurately represent the probative value of what should really be referred to as a *reported* DNA match without taking laboratory error rate into account (Koehler, Chia, & Lindsey, 1995; Lempert, 1991). Indeed, the laboratory error rate is so important, that the probative value of DNA evidence is largely controlled by *this* probability rate rather than by the RMP. This point can be

[3] As noted previously, the Prosecutor's Fallacy is committed when P(Guilt | Match) is computed by subtracting the RMP from 100%. In this case, 1 – RMP = 1 – 1/3,000,000 = 99.999967%.

clarified by considering that DNA samples that came from different sources may reportedly "match" for one two reasons: either a very unlikely coincidence occurred (the person who matches happens to share a DNA profile with the person who is actually the source) or an error occurred (due, perhaps, to sample mix-ups, mislabeling, or cross-contamination). Because the laboratory error is usually several orders of magnitude higher (i.e., *more* likely) than the RMP, this error rate imposes an upper limit on the probative value of the reported DNA match.

A baseball analogy illustrates the broader principle (see Koehler et al., 1995). Suppose a shortstop makes throwing errors fewer than one time in a million, but makes fielding errors 2% of the time. Assuming that errors are equally distributed across trials, the chance of an error of some sort on the next ground ball (due to either throwing or fielding) is at least 2%. If an error occurs, it will almost surely be a fielding error. Further reductions in the infielder's throwing error rate to, say, one in millions, billions, or even septillions[4] will not alter the shortstop's overall error rate: it will still be about 2%. Thus, a baseball scout should be no more impressed by improvements in the infielder's throwing ability than the legal factfinder should be upon learning of the vanishingly small RMPs that arise in DNA cases. Just as the infielder's 2% fielding error rate imposes a lower bound threshold for an overall fielding error rate estimate, the laboratory error rate sets a lower bound for false positive DNA match reports (i.e., match reports between items that actually come from different sources).

With this in mind, we must ask ourselves whether it pays to risk confusion and inverse errors by providing factfinders with the RMP in cases where the RMP is several orders of magnitude smaller than our estimate of the false positive error rate. In such cases, the RMP contributes virtually nothing to an assessment of the probative value of a reported match beyond that which is given by the false positive error rate (Koehler et al., 1995; Thompson, Taroni, & Aitken, 2003). As a policy matter, then, jurors might might simply be told something like this: "The suspect reportedly matches the DNA evidence found at the crime scene. The chance that we would report such a match on non-matching samples, either because of a coincidence or because of an error, is approximately one in 500."

Empirical data provide some reason to be concerned about how jurors process DNA evidence in cases where the RMPs are very small. Mock jurors have trouble aggregating small RMPs (such as one in one billion) with various possible false positive error rates (Koehler et al., 1995; Schklar & Diamond, 1999; see also Nance & Morris, 2002, 2005). Specifically, there is some evidence that they ignore the risk of error in these cases and focus on the RMPs, rather than the other way around. However, courts and policy makers have not been impressed by the evidence and have expressly rejected policy proposals that "would deprive the trier of fact of the opportunity to evaluate separately the possibility that the profiles match by coincidence" (National Academy of Sciences, 1996, p. 85). There are other practical impediments to identifying the probative value of forensic science evidence based false positive error rates. First, reliable error rate data are virtually non-existent in any of the forensic sciences. Forensic scientists have no incentive to participate in testing that would help identify those rates and the courts have not sought this information either. Second, with the exception of DNA evidence, there are no large databases from which RMP statistics can be generated. As a result, it is

[4] *People v. Odom*, 2011 ("She testified that two in 24 septillion people … would be expected to match that profile," p. 5).

difficult to know whether the false positive error rate for a technique places an upper bound limit on the diagnostic value of the resultant evidence or not. Paradoxically, without the benefit of those databases, experts in the non-DNA forensic sciences often make very strong claims (e.g., "This latent print was made by the defendant to the exclusion of all other people in the world") that are unhinged from any sort of data.

In sum, experts, judges and jurors struggle with how to describe and make sense of scientific and statistical evidence. At least part of the problem is informational. Scientific and statistical training is practically non-existent in the law school curriculum, the forensic sciences are insufficiently scientific in their approach to conclusions (Mnookin et al., 2011), and jurors are not equipped to sort through the technical issues on their own. Errors such as those described here not only occur with great regularity, they are often defended as proper. Calls for greater attention to identifying rates of error are resisted within the forensic science community (Budowle et al., 2009). These realities leave us pessimistic about the likelihood of major reform in the near term.

Cognitive Biases

Following Tversky & Kahneman's influential work detailing the representativeness, availability, and anchoring heuristics (e.g., Tversky & Kahneman, 1974), legal scholars quickly recognized that cognitive biases affect nearly every aspect of the law, from contract negotiations to plea bargaining and settlement strategies to judicial admissibility decisions to jury verdicts to sentencing. The so-called behavioral law and economics movement has grown in recent decades to the point where there are now bodies of literature in the legal domain that expressly address the role that various cognitive limitations play on various legal judgments and decisions. Below, we discuss several well-known cognitive biases and how they affect various legal actors.

A. Confirmation Bias

Confirmation bias is ubiquitous in nearly every area of the law. Confirmation bias is a form of cognitive bias in which people search for, interpret and recall information in a manner that favors their pre-existing beliefs and hypotheses (Klayman & Ha, 1987; Nickerson, 1998). The bias affects all types of decision makers including experts (Andrews, Logan, & Sinkey, 2012), scientists (Fugelsang et al., 2004; Koehler, 1993) and judges (Kahan et al., 2012). Because confirmation bias is particularly relevant to the investigatory stages of litigation, we focus much of our attention here.

In the early stages of criminal investigations, police officers and other investigators are often presented with a large amount of information. Much of that information is ambiguous and can be used to support different theories of how, why and when a crime was committed, and who committed it. During the earliest stages of information collection, investigators often identify a theory of the crime that answers the how, why, when and who questions noted above. This theory is likely to be tested, albeit informally, against the information uncovered by the investigation on a rolling basis. In such cases, there is a risk that confirmation bias will influence the investigator's conclusions. That is, once police officers or investigators have generated hypotheses about the case, they may be more likely both to seek out evidence that confirms those

hypotheses and to interpret ambiguous information in ways that support those hypotheses (e.g., Nickerson 1998; Holyoak & Simon 1999).

Such strategies, which are not intentional (e.g., Gibson, Sanbonmatsu, & Posavic 1997), may increase investigators' confidence in their initial beliefs far beyond what a less biased review of the evidence would support. Such a bias coming from "neutral" investigators could interfere with the accuracy of the factfinding process (Findley & Scott, 2006; O'Brien & Ellsworth 2006; Rassin, Eerland, & Kuijpers, 2010).

Empirical data support the claim that confirmation bias may play a role in police investigations. O'Brien and Ellsworth (2006) instructed lay participants to read a case file about a shooting of a man in his home. The evidence implicated a primary suspect, but lacked strong evidence that would lead to a clear conclusion. An experimental group was asked to state who they thought committed the crime, while the other half read the full file before being asked to draw conclusions; participants were also presented with opportunities to choose what type of evidence would be most helpful in their investigation. The results were indicative of a strong confirmation bias among participants that formed an initial hypothesis. They remembered more details implicating the prime suspect, preferred evidence that implicated the suspect, interpreted new evidence against the suspect, and shifted their attitudes regarding earlier evidence against the suspect.

Although the participants in the O'Brien & Ellsworth (2006) were laymen, similar results have been found in studies of actual police investigators. Ask and Granhag (2007a, 2007b) provided experienced police investigators who had formed a belief about a case with witness evidence that was either consistent or inconsistent with their beliefs. The investigators assessed belief-consistent testimony to be more reliable and scrutinized it less than belief-inconsistent testimony.

Police investigations that carry the imprimatur of scientific authority are also affected by confirmation bias. Latent print (i.e., fingerprint) examiners, who are often local police officers (National Academy of Sciences, 2009, p. 36), appear to be influenced by non-forensic cues when making their forensic judgments. In one small controlled study, five fingerprint examiners received non-forensic ("contextual") information that suggested that two prints that they had previously reported as a match (individualization) were actually from different sources. After receiving this information, three of the five examiners changed their conclusion to an exclusion, and a fourth changed his/her individualization conclusion to an inconclusive (Dror et al., 2006). In a follow-up study with different participants, six fingerprint examiners received eight pairs of prints from their earlier casework that included a mix of individualization and exclusion decisions (Dror & Charlton, 2006). After receiving some non-forensic information (e.g., eyewitness testimony, confessions, etc.) that was at odds with their previous forensic conclusions, four examiners reached at least one different conclusion than they had reached earlier. In the end, examiners reached different conclusions about fingerprint evidence following introduction of contextual information. Subsequent studies reveal a similar pattern. For example, Dror, Champod, Langenburg et. al. (2011) showed that the presence of known fingerprint samples affects analyses conducted on unknown samples by redirecting the way examiners allocate their attention and visual searches, and even by changing examiners' thresholds for calling a match (see also Dror & Cole, 2010). Although courts continue to admit

forensic science evidence of all types, some have acknowledged that confirmation bias poses a significant risk in the forensic sciences (e.g., *U.S. v. Hardaway*, 2012).

Unfortunately, the influence of confirmation bias in the legal system extends well beyond evidentiary issues. Consider jury selection. In most American jurisdictions, potential jurors are subjected to a verbal examination called *voir dire*, in which the attorneys and/or the judge question potential jurors to attempt to determine whether they have any biases that may favor a particular party in the case. After questioning, attorneys may attempt to strike (i.e., eliminate) particular jurors for specified or unspecified reasons. Confirmation bias may affect this process by influencing the questions that judges and attorneys ask particular jurors. For example, attorneys who believe that blacks are more skeptical of police and more sympathetic toward criminal defendants than most other ethnic groups, they may be especially likely to ask black jurors about negative police experiences with police. This approach can reinforce the view that black jurors are more likely to sympathize with the criminal defendant (Burke, 2012) and lead to a disproportionate exclusion of black jurors.

Confirmation bias may also affect how jurors process evidence. If jurors form an initial belief about a defendant's guilt or innocence after hearing opening arguments (or even earlier), there is a danger that they will interpret the evidence that they hear through this lens of belief, giving more credence to evidence that supports their initial belief and less credence to evidence that oppose that belief (Koehler, 1993; Lord, Ross, & Lepper, 1979).

Resisting the many potential sources of confirmatory reasoning in the legal process will be difficult, but there is some reason to be optimistic. Debiasing strategies such as consider the opposite" (Lord, Lepper, & Preston, 1984) and "consider-an-alternative" (Hirt & Markman, 1995) may help. O'Brien (2009; see also O'Brien & Ellsworth, 2006) reported that generating reasons for positions not held reduces confirmation bias in mock criminal investigations. Regarding forensic science analyses, some researchers have recommended a debiasing procedure called "sequential unmasking" in which relevant information (e.g., the DNA profile from a reference sample) is released or "unmasked" to the forensic scientist only when needed (Krane et al., 2008; Thompson, 2011). Under this approach, much of the biasing contextual information that the work of Dror and his colleagues suggests can influence forensic decisions (e.g., incriminating witness statements) will remain hidden from analyst who directly tests the evidence because this information will not ordinarily be required to conduct those tests. Administrative solutions, such as separating forensic science analyses from other facets of the police investigation (National Academy of Sciences, 2009; Whitman & Koppl, 2010), may also reduce unwanted confirmatory influences. Reducing confirmation bias on jurors will be more difficult because courts and lawmakers will be reluctant to place restrictions (or even give suggestions) to factfinders about how they should go about making their decisions.

B. Hindsight

Hindsight bias is the tendency for people who have outcome knowledge (hindsight) to overestimate the probability that they would have assigned to this particular outcome in foresight (Hawkins & Hastie, 1990). It is an important bias in legal settings because the central issue in many civil cases is whether a bad outcome was (or should have been) foreseeable. Legal rule-makers and judges are generally aware of the dangers of hindsight bias and, in some areas, they

have taken steps to reduce its impact. In this section, we focus on a few areas in which hindsight bias may exist. Rachlinski (1998, 2000) and Harley (2007) provide more complete discussions.

The causal relationship between conduct and result plays a central role in tort law (the law governing personal injuries resulting from unreasonable conduct). A defendant who causes harm to a plaintiff may be liable for the plaintiff's injury. In cases where the injury would not have occurred "but for" (except for) the defendant's actions, the law treats causation as established. But causal chains are often complex and cannot be directly linked to the actions (or inactions) of a particular defendant.

In such situations, the law typically requires proximate case—a finding that defendant's actions (or inactions) are linked closely enough to the plaintiff's injury to find the defendant legally culpable. One factor in assessing proximate cause is the foreseeability of the harm that occurred. That is, could one have reasonably predicted that the resultant harm may have occurred given the defendant's actions? Clearly, hindsight bias can affect such a determination and some courts are sensitive to this.[5] In an early study, Kamin and Rachlinski (1995) instructed participants to determine whether a municipality should have taken precautions against a flood. Participants found the flood to be more foreseeable in a hindsight condition, when the flood had already occurred and litigation had been initiated, than in a foresight condition before the flood occurred. This led participants to find the defendant more negligent in the hindsight condition. Similar results pertaining to foreseeability have been found in other contexts (e.g., LaBine & Labine 1996).

Some situations require judges to act with hindsight. When judges decide whether to grant a search warrant, they must determine whether the police have probable cause for the search. If so, the search warrant is granted. Sometimes, however, police carry out a search without first obtaining the warrant. This can occur when police judge that there is insufficient time to obtain the warrant. In cases where the search uncovers incriminating evidence that the police expected to find, a prosecutor may wish to introduce that evidence at trial. But the evidence may only be introduced at trial if a judge determines, in hindsight, whether the police had probable cause for the search. Although data from the majority of published hindsight studies might suggest that judges will fall victim to hindsight bias in this situation, studies on judges suggest otherwise. In a controlled study that used various written hypothetical fact scenarios, Rachlinski, Guthrie, and Wistrich (2011) found that judges' probable cause rulings were not influenced by knowledge that a search yielded incriminating evidence (see also Guthrie, Rachlinski, & Wistrich, 2000-2001, 2007-2008).

Hindsight bias is also a concern in patent litigation. According to U.S. law, an invention or technique may merit patent protection only if it is novel, timely, useful, and "non-obvious" (U.S. Code, Title 35, Section 103, 2011). It is easy to see how hindsight bias issues can arise in this context. A judge or juror charged with deciding whether a device was obvious at its time of invention makes this decision only after the device was been invented and described to them.

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[5] *Corales v. Bennett*, 2009 ("[The plaintiff's] argument ignores the purpose of proximate causation, which seeks to avoid hindsight bias by limiting causation to those results which were foreseeable at the time of the action," p. 573).

These features could make the device seem more obvious. Empirical work supports this intuition. People who read only the lead-up to an invention (e.g., the prior knowledge of the field prior to an invention), consider the inventions less obvious than those who are also told what the invention is (Mandel 2006, 2007). Here, judges do not seem to be more resistant to hindsight bias than mock jurors (Allison & Lemley, 1998). The good news is that appellate courts have explicitly recognized the risk of hindsight bias in the obviousness decisions that must be made in patent cases (e.g., *U.S. v. Broxmeyer*, 2010; *Santarus v. Par Pharmaceutical*, 2012), and the U.S. Supreme Court has tried to provide some guidance as well (*Graham v. John Deere*, 1966; *KSR International v. Teleflex*, 2007). Specifically, the Court recommended focusing on "secondary considerations" such as commercial success, long felt needs, and previous failures to assess nonobviousness (*Graham v. John Deere*, 1966, p. 694). Unfortunately, such secondary evidence does not appear to reduce hindsight bias, at least in lab contexts, and neither do explicit jury instructions that identify and warn against the bias (Mandel 2006). Similar debiasing methods have also failed in other contexts (e.g., Kamin & Rachlinski, 1995). In response, some commentators recommend a bifurcation of nonobviousness trials in which the nonobviousness issue is tried first, before complete information about the invention itself is given to the jury (Mandel 2006, 2007).

One area of the law that appears to clamp down on hindsight bias is fraud litigation. The so-called "fraud by hindsight" doctrine provides that fraud cannot be alleged if the supposed fraud can only be discerned after the fact (*Denny v. Barber*, 1978). However, a comprehensive review of the doctrine by Gulati, Rachlinki, and Langevoort (2004) concludes that courts do not actually apply the fraud by hindsight doctrine as a way to correct for the risk of hindsight bias. Instead, judges seem to use the doctrine in a flexible - or even cynical - way to manage their case loads by creating entry barriers to the courts for cases that they pre-judge to be unworthy. But, as Guiliati et al. (2004) point out, the doctrine is a discretionary one that "allows judges to carve out exceptions when they suspect fraud" (p. 824).

In sum, hindsight bias may affect various legal judgments and the courts are not oblivious this fact. At the same time, it is not clear that the steps courts have taken to counteract hindsight bias are effective. To be fair, hindsight debiasing strategies in other domains have not proven to be completely effective and those strategies that have helped (e.g., writing down reasons why a different result might have occurred) may not be practical in some legal contexts.

C. Memory Biases

Human memory is *reconstructive*, rather than *reproductive* (Roediger & McDermott, 1995). In other words, memory is not a rote storage and retrieval system. Instead, memories are reconstructed at the point of recall and, as such, are subject to distortions that may have occurred during encoding, storage, or the retrieval itself. This potential for memory distortions is profoundly important to the legal system because information retrieved from memory is often disputed and can be the difference between a conviction and an acquittal at trial. Though memory distortions affect us all, we focus in this section on witnesses and criminal defendants. Regarding witnesses, reconstructive memory can distort what they think they saw and experienced, leading to inaccurate sworn testimony. Regarding criminal defendants, reconstructive memory can distort what they think they did, leading to false confessions.

Early experimental research on false eyewitness memory demonstrated a misinformation effect—when study participants are presented with misleading information during questioning about what they saw, they tend to assimilate that information into their recollections of the event (Wells & Loftus, 2003). Similarly, eyewitnesses sometimes incorporate post-event visual information into their memories about who they saw at a crime scene (Clark, Howell, & Davey, 2008; Wells, 1993). Such distorting information is a common cause of false convictions (*California v. Brewster*, 1997; Garrett, 2008). The effects of misinformation could also lead to wrongful suits being brought by plaintiffs who falsely believe they were wronged (Hyman, Husband, & Billings, 1995; Loftus et al., 1996). Indeed, the effect appears to be robust enough to persuade some people to falsely believe that they were victims of sexual abuse (Porter, 1998; Porter, Yuille, & Lehman, 1999).

Reducing the incidence of false witness memories will depend, in part, on reducing exposure to conditions or stimuli that promote distortion. In the eyewitness arena, research shows that attention to the way in which line-ups are conducted by police departments can reduce the risk of false identifications. The traditional line-up suffered from a number of shortcomings that hindered accurate identification of suspects such as instruction deficiencies, biased selection of foils, and use of a simultaneous presentation of suspects (for reviews, see Busey & Loftus 2007; Wells & Loftus, 2003). In recent years, many police departments have responded to this research by altering their line-up policies, including moving away from simultaneous presentation of suspects to sequential suspect presentation[6] (Wells, Steblay, & Dysart, 2012). The data suggest that these line-up reforms reduce the incidence of false positive identifications without significantly increasing the incidence of false negatives (Steblay, Dysart, & Wells, 2011; but see Clark, 2012 for a more skeptical view).

When there is concern about the possibility of a false witness memory at trial, we support the use of expert witness testimony that informs triers of fact about the ways in which memories may become distorted. The courts are divided about the admissibility of such expert testimony. Some courts contend that the testimony is helpful to jurors and thus meets the requirement in Federal Rule of Evidence 702 that expert testimony must assist the trier of fact. Other courts contend that the testimony invades the province of the jury to assess witness credibility, or is unfairly prejudicial (see e.g., Leippe, 1995; *Robertson v. McCloksey*, 1988).

False confessions in which the confessor *actually believes* what he or she is saying (as opposed to cases in which a false confession is made by one who feels trapped or who does so in hopes of reduced punishment) is an extreme example of how memory can be distorted by post-event information and circumstances. As research by Saul Kassin and his colleagues shows, false information provided to crime suspects can influence their memories about their own motives and behavior, and can lead to a detailed, albeit inaccurate, confession (Kassin, 2008; Kassin & Kiechel, 1996). In this respect, internalized confessions of innocent suspects are similar to the

[6] In simultaneous lineups, witnesses usually view six suspects together. This format heightens the risk of false positive identifications by encouraging a decision based on relative judgment ("who looks most like the person I saw?"). In sequential lineups, witnesses view suspects one at a time. This approach encourages a direct comparison of each suspect with the witness's memory. Although "information" from any type of lineup may change a witness's memory, the data indicate that false identifications are reduced using a sequential approach.

memories of some psychotherapy patients who develop memories for past traumas that never occurred (Kassin, 1997). Jurors are understandably skeptical of the idea that a person would false confess to a serious crime that he or she did not commit. Indeed, there is evidence that confession evidence fundamentally transforms jurors' opinions about a case (Hasel & Kassin, 2009; Kassin et al., 2010; Kassin & Sukel, 1997; Leo, 2008).

One solution to the problem of false confessions is to disallow any form of coerced confession at trial. Currently, confessions that are elicited using direct force are inadmissible, but confessions using minimization and the presentation of false evidence are typically admissible. If the exclusionary policy were expanded to include a wider range of confessions, the incidence of false confessions would surely decrease. Of course, this would result in a loss of highly probative evidence in many cases, and overall verdict accuracy may suffer. A less drastic solution, and one that probably poses less risk to verdict accuracy, would be to require that all interrogations be videotaped and to permit judges and juries to review those tapes in cases where the defense alleges false confession. Expert testimony may also be effective to address potential misconceptions.

D. Framing

Framing effects play a key role in the presentation of evidence in our adversarial legal system. Whereas one party may frame an item of evidence in a manner that draws attention to features of the item that favor a particular conclusion, the other party will seek to reframe that same item in ways that draw attention to other features. Prosecutors would seem to have a natural "first mover" advantage over the defense in a contest of competing evidentiary frames because the prosecution is entitled to go first in opening arguments, presentation of cases in chief, and closing arguments. Further, there is a stickiness to initial frames that may help prosecutors see view the evidence their way.

DNA evidence poses an illustrative example of the potential power of evidentiary frames at trial. Research suggests that choices about how to present statistical DNA evidence can have a profound impact on the persuasiveness of that evidence (Koehler, 2001a, 2001b; Koehler & Macchi, 2004; McQuiston-Surrett & Saks, 2009). As indicated earlier, when a suspect matches DNA evidence from a crime scene, forensic scientists commonly report the random match probability (RMP) associated with the matching DNA profile in a given population. That is, they report the proportion of people who share that profile. Because DNA RMPs are typically on the order of .000001 or less, jurors hearing the RMP are unlikely to focus their attention on the number of others who will also match. Instead, they are likely to consider that it is unlikely that this particular match can be explained through reference to a one-in-a-million coincidence, and they are likely to believe strongly that the suspect is the source of the DNA evidence. In contrast, jurors who hear the DNA evidence framed in a way that calls attention to the possibility that a number of other will match as well (e.g., "1 in 1,000,000 people in a city of 5,000,000 people will match this DNA profile) may think about others beside the suspect who may match and therefore be less persuaded by the evidence. Though the impact of competing presentations under realistic conditions has yet to be tested, research in the papers cited above supports this framing effect. Furthermore, this finding fits well with other research that shows that the way people respond to legally relevant probabilistic information depends on how that information is

framed and communicated (see e.g., Scurich & John, 2011; Slovic, Monahan, & MacGregor, 2000).

E. Anchoring & Adjustment

Attorneys also have an opportunity to gain strategic advantage over an adversary by anchoring the legal decision maker on quantitative values that favor its side. Research in psychology shows that people often anchor on initial values and adjust insufficiently for other relevant evidence or information (Epley & Gilovich, 2006; Tversky & Kahneman, 1974). The risk of an anchoring bias is most obvious in civil trials where one party seeks monetary damages against the other. Although some dollar values can be tied to actual expenses incurred (e.g., medical bills), there are few guidelines for determining, say, the appropriate damage award for a plaintiff who suffers daily back pain that resulted from a rear-end automobile crash. In these cases, anchors provided by the parties may be especially influential.

Laboratory research on anchoring in the legal setting generally finds that as the anchor provided by an attorney increases, the amount that a juror is likely to give correspondingly increases, at least to a point (Chapman & Bornstein, 1996; Hastie, Schkade, & Payne, 1999;). There appears to be some push back against truly outrageous anchors (Marti & Wissler, 2000) but this same study showed that even damage requests that seem too large (such as $15 million in a slip and fall case) tend to be effective anchors.

Although such apparent reliance on anchors in legal contexts, even irrelevant ones (Englich, Mussweiler, & Strack, 2006), fits well with research on the anchoring bias in other contexts, caution is need when interpreting the results. What little data are available from juries that deliberated in real civil cases suggest that attorney-provided anchors may not be quite so influential. One recent study examined the effects of attorney damage requests on jurors in 31 Arizona state court cases (Diamond, Rose, Murphy, & Meixner, 2011). By coding deliberation transcripts from those cases, the study provided a unique look at the jurors' opinions of the attorney damage recommendations. In general, jurors appeared to be skeptical of recommended damage anchors for pain & suffering both in their deliberation comments and in their final awards. Jurors awarded only 15 percent of the pain and suffering request on average. Clearly additional research is needed on real juries in civil contexts.

There is also a need for research on anchoring effects in criminal cases. In one study, individuals taking the role of a judge sentencing a convict were influenced by the prosecutor's sentencing request (Englich & Mussweiler, 2001). Correlational evidence in a follow-up study points to a similar pattern in real sentencing decisions (Englich, Mussweiler, & Strack, 2005). However, the jury is still out on whether and when simple anchors influence final judgments in complex real world cases.

Conclusion

We have argued that the ability to achieve accurate legal decisions may be threatened by legal rules and policies that focus on other concerns, as well as by the intellectual shortcomings and cognitive biases of the relevant legal actors. The conclusion that follows – that verdict accuracy

may suffer in our legal system – is not particularly consistent with the finding that about 80% of the American public believes that the U.S. system of justice is the "best in the world" and that "the jury system is the most fair way to determine the guilt or innocence of a person accused of a crime" (American Bar Association, 1999, p. 1342). Some jury research scholars have also concluded that the jury is a "sound decision maker" and that juries generally "listen to the judge and decide cases on the merits of the evidence rather than on biases and prejudice" (Vidmar & Hans, 2007, p. 339 & 340). Though some of the issues we describe in this chapter are not specific to *jury* decision making, we focus on juries now to reinforce our own view that policy reasons that favor the use of juries should not necessarily spill over into a conclusion that juries routinely overcome their own imperfections to arrive at accurate verdicts.

Scholars who believe that juries generally reach sound (and presumably accurate) decisions commonly offer several reasons in support: (1) studies show that the single factor that exerts the most influence on jurors' verdicts is evidentiary strength ($r^2 = .25$; for a review, see Simon, 2012, p. 204); (2) studies show that juries and judges reach the same binary verdicts as much as 75% of the time; (3) deliberation provides jurors with crucial information and improves comprehension of existing evidence; and (4) there is little empirical research that points to a more accurate fact-finding mechanism. We are less convinced by these reasons and therefore less certain that jurors are predominantly accurate and unbiased decision makers.

Regarding the evidentiary strength point, we approach the issue from the other direction and wonder why evidentiary strength doesn't explain even more of the variance in verdicts. As Simon (2012) points out, given that a correlation between evidence strength and verdict is both prescribed and expected, the really noteworthy and worrisome aspect of the data is that 75% of the verdict variance appears to be driven by *non-evidentiary* factors.

Regarding the high correlation between judge and juror verdicts, we approach this issue from the other direction as well. If the verdicts of jurors and judges were completely uncorrelated – a truly bizarre suggestion – they would still reach the same verdict 50% of the time in binary cases (e.g., guilty vs. not guilty). Leaving aside the issue that many important decisions judges and juries make are not binary (e.g., amount of damages to award), we note that even an extremely high judge-jury correlation tells us little about verdict accuracy. Judges and jurors appear to be affected by most of the same cognitive limitations discussed here (see e.g., Guthrie, Rachlinski, & Wistrich, 2000-2001, 2007-2008; Vidmar, 2011) and therefore their verdicts may be biased in similar ways.[7]

Regarding the informational value of deliberation, we are skeptical, at least with respect to a general conclusion that deliberation reduces the effects of individual misconceptions and biases. In Chapter 7 of his extensive analysis of the jury decision making literature, Devine (2012) reviewed the literature on deliberation effects and concluded that "the effect of deliberation is not reliable" (p. 178). This conclusion mirrors that of Kerr, Niedermeier, and Kaplan (1999) who set out to determine whether juries are more or less influenced by extralegal biasing information

[7] In support of the proposition that judges are people too, one recent study found that the favorability of 1,000 parole decisions made by eight experienced Israeli judges were highly correlated with food breaks. Favorable rulings dropped from around 65% immediately after food breaks to "nearly zero" just before the next food break (Danziger, Levav, & Avnaim-Pesso, 2011, p. 6889).

than individual jurors. Kerr et al. (1999) found that deliberation decreased the influence of biasing information (pretrial publicity) in cases where the actual evidence is very strong and unequivocal. However, deliberation actually increased the impact of biasing information when the actual evidence was weaker and more ambiguous. This finding fits well with Devine's (2012) conclusion as well as Diamond's (1997) suggestion that deliberation may sometimes *reinforce* jurors' misconceptions.

Finally, regarding the lack of research pointing to a more accurate truth-seeking mechanism, we agree, but this says more about the lack of research on the issue than about the validity of jury verdicts.

We close with a few caveats to our suggestion that outcome accuracy may be threatened by legal rules and shortcomings in what legal actors understand and how they think. First, as a practical matter, it's often impossible to know whether a particular legal outcome is or is not accurate. Indisputable evidence that identifies ground truth is rarely available in criminal cases, and objective criteria for assessing, say, negligence or the appropriate level of damages in a civil case are hard to identify. Second, there are significant limits on the external validity of experimental studies of legal decision makers. Some factors that may affect legal judgments and decisions are hard to recreate in the laboratory, and it is possible that some of these factors counteract some cognitive limitations. Finally, our comments on verdict accuracy should not be taken to imply that factual accuracy is the *only* measure of trial quality. We readily acknowledge that the process within which factfinding is achieved and verdicts are rendered incorporates a host of arguably worthwhile procedures, rules, values and policies that little to do with promoting verdict accuracy. But we also believe that if the basic purpose of a trial really is the determination of truth as the Supreme Court says, then judgment and decision making research may hold the key to revealing more of those truths.

References

Allen, Ronald J. (1991). The nature of juridical proof. *Cardozo Law Review*, 13, 373-422.

Allison, John R. and Lemley, Mark A. 1998. "Empirical Evidence on the Validity of Litigated Patents." *American Intellectual Property Law Association Quarterly Journal*, 26:208-209.

American Bar Association (1999). American Bar Association report on perceptions of the U.S. justice system. Albany Law Review, 62, 1307-1347.

Angell, M. (1994). Do breast implants cause systemic disease? Science in the courtroom. New England Journal of Medicine, 330, 1748-1749.

Andrews, Rodney, Trevon Logan, & Michael Sinkey (2012). Identifying confirmatory bias in the field: Evidence from a poll of experts. Accessed on 2-4-13. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2056692

Arkes, H. R., & Mellers, B. A. (2002). Do juries meet our expectations? Law and Human Behavior, 26, 625-639.

Ask, K., & Granhag, P. A. (2007a). Hot cognition in investigative judgments: The differential influence of anger and sadness. Law and Human Behavior, 31, 537-551.

Ask, K., & Granhag, P. A. (2007b). Motivational bias in criminal investigators' judgments of witness reliability. Journal of Applied Social Psychology, 37, 561-591.

Balding, David J., & Peter Donnelly (1994). The Prosecutor's Fallacy and DNA evidence. Criminal Law Review, 711-721.

Budowle Bruce, Bottrell M. C., Bunch S. G., Fram R., Harrison D., Meagher S., Oien C. T., Peterson P. E., Seiger D. P., Smith M. B., Smrz M. A., Soltis G. L., & Stacey R. B. (2009). A perspective on errors, bias, and interpretation in the forensic sciences and direction for continuing advancement. Journal of Forensic Sciences, 54, 798-809.

Burke, Alafair S. 2006. "Improving Prosecutorial Decision Making: Some Lesions of Cognitive Science." *William and Mary Law Review*, 47:1587-1633.

Burke, Alafair S. 2012. "Prosecutors and Peremptories." *Iowa Law Review*, 97:1467-1488.

Busey, Thomas A., and Loftus, Geoffrey R. 2008. "Cognitive Science and the Law." Trends in Cognitive Sciences, 11:111-117. DOI:10.1016/j.tics.2006.12.004.

California v. Brewster, 95 F. 8703 (Ca. 1984).

Casscells, W., Schoenberger, A., & Graboys, T. B. (1978). Interpretation by physicians of clinical laboratory results. New England Journal of Medicine, 299, 999-1001.

Chapman, L. J. & Chapman, J. P. (1959). Atmosphere effect re-examined. Journal of Experimental Psychology, 58, 220-226.

Chapman, Gretchen B., and Bornstein, Brian H. 1996. "The More You Ask for, the More You Get: Anchoring in Personal Injury Verdicts." *Applied Cognitive Psychology*, 10:519-540.

Clark, Steven E. 2012. Costs and Benefits of Eyewitness Identification Reform: Psychological Science and Public Policy. *Perspectives on Psychological Science*, 7:238-259.

Clark, Steven E., Howell, Ryan T., and Davey, Sherrie L. 2008. "Regularities in Eyewitness Identification." *Law and Human Behavior*, 32:187-218. DOI:10.1007/s10979-006-9082-4.

Corales v. Bennett, 567 F.3d 554 (9th Cir. 2009).

Danziger, Shai, Jonathan Levav, & Liora Avnaim-Pesso (2011). Extraneous factors in judicial decisions. Proceedings of the National Academy of Sciences, 8, 6889-6892.

Dawid, A. Philip. (1987). The difficulty about conjunction. Journal of the Royal Statistical Society, Series D., 36, 91-97.

Denny v. Barber, 576 F.2d 465 (2d Cir. 1978).

Devine, Dennis J. (2012). Jury Decision Making: The State of the Science. New York, NY: New York University Press.

Diamond, Shari S., & Rose, Mary (2005). Real juries. Annual Review of Law & Social Sciences, 1, 255-284.

Diamond, Shari Seidman, Rose, Mary R., Murphy, B., and Meixner, J. 2011. "Damage Anchors on Real Juries." Journal of Empirical Legal Studies, 8:148-178. DOI:10.1111/j.1740-1461.2011.01232.x.

Dror, I. E., Champod, C., Langenburg, G., Charlton, D., Hunt, H., & Rosenthal R. (2011). Cognitive issues in fingerprint analysis: Inter-and intra-expert consistency and the effect of a 'target' comparison. *Forensic Science International*, *208*, *10-17*.

Dror, I. E., & Charlton, D. (2006). Why experts make errors. Journal of Forensic Identification, 56, 600-616.

Dror, I. E., Charlton, D., & Peron A. (2006). Contextual information renders experts vulnerable to making erroneous identifications. *Forensic Science International*, *156*, 74-78.

Dror, I. E., & Cole, S. (2010). The vision in 'blind' justice: Expert perception, judgment and visual cognition in forensic pattern recognition. *Psychonomic Bulletin & Review*, *17*, 161-167.

Eddy, D. M. (1982). Probabilistic reasoning in clinical medicine: Problems and opportunities. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), Judgment Under Uncertainty: Heuristics and Biases. Cambridge: Cambridge University Press.

Englich, E., Birte, Mussweiler, Thomas, and Strack, Fritz. 2005. "The last word in court—A hidden disadvantage for the defense." *Law and Human Behavior*, 29:705-722. DOI:10.1007/s10979-005-8380-7.

Englich, E., Birte, Mussweiler, Thomas, and Strack, Fritz. 2006. "Playing Dice with Criminal Sentences: the Influence of Irrelevant Anchors on Experts' Judicial Decision Making." *Personality and Social Psychology Bulletin*, 32:188-200. DOI:10.1177/0146167205282152.

Englich, E., Birte, and Mussweiler, Thomas. 2001. "Sentencing under Uncertainty: Anchoring Effects in the Courtroom." *Journal of Applied Social Psychology*, 31:1535–1551. DOI:10.1111/j.1559-1816.2001.tb02687.x.

Epley, Nicholas, & Gilovich, Thomas (2006). The anchoring-and-adjustment heuristic: Why the adjustments are insufficient. Psychological Science, 17, 311-318.

Federal Rule of Evidence 103.

Federal Rule of Evidence 403.

Federal Rule of Evidence 702.

Findley, Keith A., and Scott, Michael S. 2006. "The Multiple Dimensions of Tunnel Vision in Criminal Cases." *Wisconsin Law Review*, 2006:291-397.

Fong, Geoffrey T., David H. Krantz, and Richard E. Nisbett (1986). The effects of statistical training on thinking about everyday problems. Cognitive Psychology, 18, 253-292.

Freedman, Eric M. 2001. "Earl Washington's Ordeal." *Hofstra Law Review*, 29:1089-1112.

Fugelsang, J. A., C.B. Stein, A. E. Green, K. N. Dunbar (2004). Theory and data interactions of the scientific mind: Evidence from the molecular and the cognitive laboratory. Canadian Journal of Experimental Psychology, 58, 86-95.

Garrett, Brandon L. 2008. "Judging Innocence." *Columbia Law Review*, 108:55-142.

Garrett, Brandon (2011). Convicting the Innocent: Where Criminal Prosecutions Go Wrong. Cambridge, MA: Harvard University Press.

Garrett, B. L., & Neufeld, P. J. (2009). Invalid forensic science testimony and wrongful convictions. Virginia Law Review, 95, 1-97.

Gibson, Bryan., Sanbonmatsu, David. M., and Posavac, Steven. S. 1997. "The Effects of Selective Hypothesis Testing on Gambling." *Journal of Experimental Psychology: Applied*, 3:126-142. DOI:10.1037/1076-898X.3.2.126.

Gigerenzer, G. (2002). Calculated Risks. New, NY: Simon & Schuster.

Graham v. John Deere, 383 U.S. 1, 86 S. Ct. 684 (1966).

Griffith v. State of Texas, 976 S.W.2d 241 (Tex. App. 1998).

Gulati, Mitu, Rachlinski, Jeffrey J., and Langevoort, Donald C. 2004. "Fraud By Hindsight." *Northwestern University Law Review*. 98:773-825.

Guthrie, Chris, Rachlinski, Jeffrey J. & Wistrich, Andrew J. (2000-2001). Inside the judicial mind. Cornell L. Rev., 86, 777-830.

Guthrie, Chris, Rachlinski, Jeffrey J. & Wistrich, Andrew J. (2007-2008). Blinking on the bench: How judges decide cases. Cornell L. Rev., 93, 1-43.

Harley, Erin M. 2007. "Hindsight bias in legal decision making." *Social Cognition*, 25:48–63. DOI:10.1521/soco.2007.25.1.48.

Hasel, Lisa E., and Kassin, Saul M. 2009. "On the Presumption of Evidentiary Independence: Can Confessions Corrupt Eyewitness Identifications?" *Psychological Science, published online.*

Hastie, Reid, Schkade, David A., and Payne, John W. 1999. "Juror Judgments in Civil Cases: Effects of Plaintiffs Requests and Plaintiff's Identity on Punitive Damage Awards. *Law and Human Behavior*, 23:445-470. DOI:10.1023/A:1022312115561.

Hawkins, S. A., & Hastie, R. (1990). Hindsight: Biased judgment of past events after the outcomes are known. Psychological Bulletin, 107, 311–327.

Hirt, E. R., & Markman, K. D. (1995). Multiple explanation: A consider-an-alternative strategy for debiasing judgments. Journal of Personality and Social Psychology, 69, 1069-1086.

Holyoak, Keith. J., and Simon, Dan. 1999. "Bidirectional Reasoning in Decision Making by Constraint Satisfaction." *Journal of Experimental Psychology: General*, 128:3-31. DOI:10.1037/0096-3445.128.1.3.

Hyman, Ira E., Husband, Troy H., and Billings, F. James. 1995 "False Memories of Childhood Experiences." *Applied Cognitive Psychology*, 9:181-197. DOI: 10.1002/acp.2350090302.

In re Marriage of Shaban 88 Cal.App.4th 398 (2001).

In re Zeth S. 31 Cal.4th 396 (2004).

Kahan, Dan M., David A. Hoffman, Donald Braman, Danieli Evans & Jeffrey J. Rachlinski (2012). They saw a protest: Cognitive illiberalism and the speech-conduct distinction. Stanford Law Review, 64, 851.

Kahneman, D. (2011). Thinking Fast and Slow. NY: Farrar, Straus and Giroux.

Kamin, Kim A., and Rachlinski, Jeffrey J. "Ex Post ≠ Ex Ante: Determining Liability In Hindsight." *Law and Human Behavior*, 19:89-104.

Kassin Saul M. 1997. "False memories turned against the self." *Psychological Inquiry,* 8:300–302. DOI:10.1207/s15327965pli0804_4.

Kassin, Saul M. 2008. "The Psychology of Confessions." *Annual Review of Law and Social Science,* 4:193-217. DOI:10.1146/annurev.lawsocsci.4.110707.172410.

Kassin, Saul M., Drizin, Steven A., Grisso, T., Gudjonsson, Gisli H., Leo, Richard A., and Redlich, Allison D. 2010. "Police-Induced Confessions: Risk Factors and Recommendations." *Law and Human Behavior*, 34:3-38.

Kassin, Saul M., & Kiechel, Katherine L. 1996. "The Social Psychology of False Confessions: Compliance, Internalization, and Confabulation." *Psychological Science,* 7:125-128. DOI:10.1111/j.1467-9280.1996.tb00344.x.

Kassin, Saul M., and Sukel, Holly. 1997. "Coerced Confessions and the Jury: An Experimental Test of the 'Harmless Error' Rule." *Law and Human Behavior*, *21*, 27–46. DOI:10.1023/A:1024814009769.

Kaye, D. H. (1989). The probability of an ultimate issue: The strange case of paternity testing. 75, *Iowa Law Review*, 75-109.

Kaye, D. H. & Koehler, J. J. (1991). Can jurors understand probabilistic evidence? Journal of the Royal Statistical Society (Series A), 154, 75-81.

Kerr, Norbert L., Niedermeier, K. E., & Kaplan, M. F. (1999). Bias in jurors vs. bias in juries: New evidence from the SDS perspective. Organizational Behavioral and Human Decision Processes., 80, 70-86.

Klayman, J., & Ha, Y. (1987). Confirmation, disconfirmation and information in hypothesis testing. Psychological Review, 94, 211-228.

Koehler, J.J. (1993). DNA matches and statistics: Important questions, surprising answers. Judicature, 76, 222- 229.

Koehler, J. J. (1993). The influence of prior beliefs on scientific judgments of evidence quality. Organizational Behavior and Human Decision Processes, 56, 28-55.

Koehler, J. J. (1993). Error and exaggeration in the presentation of DNA evidence. Jurimetrics Journal, 34, 21-39.

Koehler, J. J. (1996). On conveying the probative value of DNA evidence: Frequencies, likelihood ratios and error rates. University of Colorado Law Review, 67, 859-886.

Koehler, J. J. (2001a). The psychology of numbers in the courtroom: How to make DNA match statistics seem impressive or insufficient. Southern California Law Review, 74, 1275-1306.

Koehler, J. J. (2001b). When are people persuaded by DNA match statistics? Law and Human Behavior, 25, 493-513.

Koehler, J. J., Chia, A. & Lindsey, J. S. (1995). The random match probability (RMP) in DNA evidence: Irrelevant and prejudicial? Jurimetrics Journal, 35, 201-219.

Koehler, J. J., & Macchi, L. (2004). Thinking about low-probability events: An exemplar cuing theory. Psychological Science, 15, 540-546.

Krane, D., Ford, S., Gilder, J., Inman, K., Jamieson, A., Koppl, R., Kornfield, I., Risinger, D., Rudin, N., Taylor, M., Thompson, W. C. (2008). Sequential unmasking: A means of minimizing observer effects in forensic DNA interpretation. Journal of Forensic Sciences, 53,1006-1007.

KSR International v. Teleflex, 550 U.S. 398 (2007).

LaBine, Susan J., and LaBine, Gary. 1996. "Determinations of Negligence and the Hindsight Bias." *Law and Human Behavior*, 20:501-516.

Leippe, Michael R. 1995. "The Case for Expert Testimony About Eyewitness Memory." *Psychology, Public Policy, and Law*, 1:909-959. DOI:10.1037/1076-8971.1.4.909.

Lempert, R. O. (1991). Some caveats concerning DNA as criminal identification evidence: With thanks to the Reverend Bayes. Cardozo Law Review, 13, 303-341.

Leo, Richard A. 2008. *Police Interrogation and American Justice*. Cambridge: Harvard University Press.

Levin, Hillel Y., & Emerson, John W. (2006). Is there a bias against education in the jury selection process? Connecticut Law Review, 38, 325-353.

Levmore, Saul (2001). Conjunction and aggregation. *Michigan Law Review*, 99, 723.

Loftus, Elizabeth F., Coan, James A., and Pickerell, and Jacqueline E. 1996. Manufacturing False Memories Using Bits of Reality. In *Implicit Memory and Metacognition*, Hillsdale, NJ: Erlbaum.

Lord, C. G., Lepper, M. R., & Preston, E. (1984). Considering the opposite: A corrective strategy for social judgment. Journal of Personality and Social Psychology, 47, 1231-1243.

Lord, C., Ross, L., & Lepper, M. R. (1979). Biased assimilation and attitude polarization: The effects of prior theories on subsequently considered evidence. Journal of Personality & Social Psychology, 37, 2098-2109.

Mandel, Gregory. 2006. "Patently Non-Obvious: Empirical Demonstration That the Hindsight Bias Renders Patent Decision Irrational." *Ohio State Law Journal*, 67:1391-1463.

Mandel, Gregory. 2007. "Patently Non-Obvious II: Experimental Study on the Hindsight Issue Before the Supreme Court in *KSR v. Teleflex*." *Yale Journal of Law and Technology*, 9:1.

Marti, Mollie W., and Wissler, Roselle L. 2000. "Be Careful What You Ask For: The Effect of Anchors on Personal Injury Damage Awards." *Journal of Experimental Psychology: Applied*, 6:91-103. DOI:10.1037/1076-898X.6.2.91.

McDaniel v. Brown, 130 S. Ct. 665, 175 L. Ed. 2d 582 (2010).

McQuiston-Surrett, D., & Saks, M. J. (2009). The testimony of forensic identification science: What expert witnesses say and what factfinders hear. Law and Human Behavior, 33, 436-453.

Mnookin, J. L., Cole, S. A., Dror, I. E., Fisher, B. A. J., Houck, M. M., Inman, K., Kaye, D. H., Koehler, J. J., Langenburg, G., Risinger, D. M., Rudin, N., Siegel, J., & Stoney D. A. (2011). The need for a research culture in the forensic sciences. UCLA Law Review, 58, 725-779.

Nance, Dale A. (1986). A comment on the supposed paradoxes of a mathematical interpretation of the logic of trials. Boston University Law Review, 66, 947.

Nance, Dale. A. & Scott B. Morris (2002) "An empirical assessment of presentation formats for Trace Evidence With a Relatively Large and Quantifiable Random Match Probability," *Jurimetrics Journal*, *42,* 403.

Nance, Dale A. & Scott B. Morris (2005) "Juror Understanding of DNA Evidence: An Empirical Assessment of Presentation Formats for Trace Evidence With a Relatively Small Random Match Probability," *Journal of Legal Studies*, 34, 395.

National Academy of Sciences, National Research Council, Committee on DNA Forensic Science: An Update (1996). The Evaluation of Forensic DNA Evidence. Washington D.C.: National Academies Press.

National Academy of Sciences, National Research Council, Committee on Identifying the Needs of the Forensic Science Community (2009). Strengthening Forensic Science in the United States: A Path Forward. Washington D. C.: National Academies Press.

Nesson, Charles (1985). The evidence or the event? On judicial proof and the acceptability of verdicts. Harvard Law Review, 98, 1357.

Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. Review of General Psychology, 2,175-220.

Nisbett, Richard. E., Geoffrey T. Fong, Darrin R. Lehman, and Patricia W. Cheng (1987). Teaching reasoning. Science, 238, 625-631.

Nisbett, Richard E., David H. Krantz, Christopher Jepson, and Ziva Kunda (1983). The use of statistical heuristics in everyday inductive reasoning. Psychological Review, 90, 339-363.

O'Brien, B. (2009). Prime suspect: An examination of factors that aggravate and counteract confirmation bias in criminal investigations. Psychology, Public Police, and Law, 15, 315-334.

O'Brien, Barbara, and Ellsworth, Phoebe C. 2006. "Confirmation Bias in Criminal Investigations." Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=913357.

Paulos, J. A. (1988). Innumeracy: Mathematical Illiteracy and Its Consequences. New York: Hill and Wang.

People v. Odom, Not Reported in Cal.Rptr.3d, 2011 WL 5121175, Cal.App. 2 Dist., October 31, 2011.

Plemel v. Walter, 735 P.2d 1209 (Or. S. Ct. 1987).

Porter, S. 1998. "An Architectural Mind: The Nature of Real, Created, and Fabricated Memories of Emotional Childhood Events." Doctoral Dissertation, University of British Columbia, Vancouver, Canada.

Porter, Stephen, Yuille, John C., and Lehman, Darrin R. 1999. "The Nature of Real, Implanted, and Fabricated Memories for Emotional Childhood Events." *Law and Human Behavior*, 23:517-538. DOI: 10.1023/A:1022344128649.

Posner, Richard A. (1999). An economic approach to the law of evidence. Stanford Law Review, 51, 1477.

Rachlinski, Jeffrey J. 1998. "A Positive Psychological Theory of Judgment." *University of Chicago Law Review*, 65: 571-624.

Rachlinski, Jeffrey J., Guthrie, Chris, and Wistrich, Andrew J. 2011. Probable Cause, Probability, and Hindsight." *Journal of Empirical Legal Studies*, 8:72-98.

Rachlinski, Jeffrey J. 2000. "Heuristics and Biases in the Courts: Ignorance or Adaptation?" *Oregon Law Review*, 79:61-102.

Rassin, Eric, Eerland, Anita, and Kuijpers, Ilse. 2010. "Let's Find the Evidence: An Analogue Study of Confirmation Bias in Criminal Investigations." *Journal of Investigative Psychology and Offender Profiling*, 7:231-246. DOI:10.1002/jip.126.

Robertson v. McCloskey, 676 F.Supp. 351 (D.D.C. 1988).

Roediger, Henry L. III, and McDermott, Kathleen B. 1995. "Creating False Memories: Remembering Words Not Presented In Lists." *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21:803-814. DOI:10.1037/0278-7393.21.4.803.

Santarus v. Par Pharmaceutical, 2012 WL 3797966 (Fed. Cir. 2012).

Schklar, Jason & Shari Diamond (1999) "Juror Reactions to DNA Evidence: Errors and Expectancies," 23 *Law and Human Behavior* 159.

Scurich, Nichloas, John, Richard S. (2011). The effect of framing actuarial risk probabilities on involuntary civil commitment decisions. Law and Human Behavior, 35, 83-91.

Simon, D. (2012). In Doubt: The Psychology of the Criminal Justice Process (pp. 187-204). Cambridge, Massachusetts: Harvard University Press.

Slovic, Paul., Monahan, John., & MacGregor, D. G. (2000). Violence risk assessment and risk communication: the effects of using actual cases, providing instruction, and employing probability versus frequency formats. Law and Human Behavior, 24, 271-96.

Smith, B. C., Penrod, S. D., Otto, A. L. & Park, R. C. (1996). Jurors' use of probabilistic evidence. Law and Human Behavior, 20, 49-82.

Stanovich, K. E. & West, R. F. (2008). On the relative independence of thinking biases and cognitive ability. Journal of Personality and Social Psychology, 94, 672-695.

Stanovich, K. E. & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate. Behavioral and Brain Sciences, 23, 645-726.

Stanovich, K. E. & West, R. F. (1998). Individual differences in rational thought. Journal of Experimental Psychology: General, 127, 161-188.

Steblay, Dysart, Jennifer E., and Wells, Gary L. 2011. "Seventy-two Tests of the Sequential Lineup Superiority Effect: A Meta-Analysis and Policy Discussion." *Law and Human Behavior*, 21:283-297.

Tehan v. U.S. ex. rel. Shott, 382 U.S. 406, 416 (1966).

Thompson, William C. 2011. “What Role Should Investigative Facts Play in the Evaluation of Scientific Evidence?” *Australian Journal of Forensic Sciences*, 43:123-134. DOI: 10.1080/00450618.2010.541499.

Thompson, W. C. & Schumann, E. L. (1987). Interpretation of statistical evidence in criminal trials: The prosecutors' fallacy and the defense attorney's fallacy. Law and Human Behavior, 11, 167-187.

Thompson, W. C., Taroni, F., & Aitken, C. G. G. (2003). How the probability of a false positive affects the value of DNA evidence. Journal of Forensic Sciences, 48, 47-54.

Tversky, Amos, and Kahneman, Daniel. 1974. “Judgment Under Uncertainty: Heuristics and Biases.” *Science*, 185: 1124-1131.

Uriarte v. United States Pipe & Foundry Co. 51 Cal.App.4th 780 (1996).

U.S. Code, Title 35, § 103 (2011). Conditions for patentability; non-obvious subject matter.

U.S. v. Broxmeyer, 616 F.3d 120 (2d Cir. 2010).

U.S. v. Hardaway, 466 Fed. Appx. 154 (3d Cir. 2012).

U.S. v. Leon, 468 U.S. 897 (1984).

Vidmar, Neil (2011). The psychology of trial judging. Current Directions in Psychological Science, 20, 58-62.

Vidmar, N., & Hans, V. P. (2007). American Juries: The Verdict. Amherst, NY: Prometheus Books.

Wells, Gary L. 1993. “What Do We Know About Eyewitness Identification?” *American Psychologist*, 48:553-571. DOI:10.1037/0003-066X.48.5.553.

Wells, Gary L., and Loftus, Elizabeth F. 2003. “Eyewitness Memory for People and Events.” In *Handbook of Psychology*, 149-160. Wiley.

Wells, Gary A., Steblay, Nancy K., and Dysart, Jennifer E. 2012. “Eyewitness Identification Reforms: Are Suggestiveness-Induced Hits and Guesses True Hits?” *Perspectives on Psychological Science*, 7:264-271.

Whitman, Glen, & Roger Koppl (2010). Rational bias in forensic science. Law, Probability and Risk, 9, 69-90.

Wolfe, C. R. (1995). Information seeking on Bayesian conditional probability problems: A fuzzy-trace theory account. Journal of Behavioral Decision Making, 8, 85-108.

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