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ARTICLE

JURIES JUDGING SCIENCE

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Contemporary jury trials often include complex scientific evidence that can be challenging for lay jurors to understand and evaluate. This Article examines the capabilities of jurors to comprehend and apply scientific evidence in both criminal and civil trials. It begins by summarizing existing research on individual and collective jury decision-making competence, describing both the cognitive processes that jurors use to evaluate trial testimony and the contributions of group deliberation. The Article then explores the specific types of scientific evidence that are most challenging for jurors, including scientific research methods, statistical information, and probability estimates. It also examines the influence of factors such as the nature of the presentation of scientific evidence in court and jurors' pre-existing attitudes toward science. Finally, the Article proposes reforms to jury trials and the presentation of expert scientific testimony. These include active jury reforms such as juror notetaking, question asking, and discussions during trial, improved methods for presenting scientific evidence, and the use of tutorials to enhance juror comprehension. By addressing the challenges jurors face, these reforms aim to improve the accuracy and fairness of jury decisions in cases with scientific evidence.

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I. INTRODUCTION

Civil jury trials involving the weed killer Roundup have been making their way through the U.S. court system. Plaintiffs' lawsuits allege that the defendant Monsanto, the company that developed, marketed, and sold Roundup over decades, learned that its product could cause cancer in users and failed to warn users of the risk.[1] Dueling scientific experts have presented evidence concerning whether it caused plaintiffs' non-Hodgkin's lymphoma (NHL),[2] leaving the jury with the unenviable task of evaluating sharply conflicting scientific evidence. Some jury trials have ended in victories for the plaintiff, others in victories for the defendant.[3] One judge presiding over a Roundup trial remarked on the extraordinary difficulty of evaluating the science at the heart of the litigation:

> [T]he evidence presented at trial showed that Monsanto's approach to the safety of its product was indeed reprehensible, but there was mitigating evidence as well. While this jury concluded it was more likely than not that Roundup caused Mr. Hardeman's NHL, the

[1] *E.g.*, First Amended Complaint at 2, *In re*: Roundup Prods. Liab. Litig., No. 16-CV-0525-VC, 2019 WL 3219360 (N.D. Cal. July 12, 2019). Litigation over Roundup is ongoing; Bayer, the parent company of Monsanto, provides updated reports on litigation progress on its website. *Managing the Roundup™ Litigation*, BAYER (Jan. 10, 2025), https://www.bayer.com/en/managing-the-roundup-litigation. For additional Roundup materials, including some expert reports and scientific research papers, see *Monsanto Papers*, U.S. RIGHT TO KNOW (Mar. 23, 2025), https://usrtk.org/monsanto-papers/ [https://perma.cc/6N3F-FZ46].

[2] *See, e.g.*, *Hardeman v. Monsanto Co.*, 997 F.3d 941, 953-954 (9th Cir. 2021).

[3] *See supra* note 1, *Managing the Roundup™ Litigation*.

> metaphorical jury is still out on whether glyphosate causes NHL. The trial showed that there is credible evidence on both sides of the scientific debate . . . .[4]

Cases like the Roundup litigation that come before juries inevitably generate deep concern about the jury's ability to evaluate and weigh the scientific evidence. This is not a modern problem. Jury competence—even in ordinary criminal and civil litigation—has been a long-standing concern in the legal system. Legal sociologist Richard O. Lempert noted, "Read court decisions and commentaries from 100, or even five years ago, and you will find that experts and scientific evidence were causing problems then just as they are causing problems now."[5] Scientist and renowned document examiner Albert S. Osborn wrote in 1937 of his many observations of jury trials that "the jury system, in its proper field and when properly managed and controlled, is still a valuable instrument for the promotion of justice."[6] Yet he argued: "Even jurors can discover, however, that certain technical civil cases, and even some classes of criminal cases, never should be submitted to an inexperienced and untrained jury."[7] Judge Jerome Frank, writing in 1950, was more uniform in his critique: "To my mind a better instrument than the usual jury trial could scarcely be imagined for achieving uncertainty, capriciousness, lack of uniformity, disregard of the [legal rules], and unpredictability of decisions."[8]

Michael Saks and I observed that placing the responsibility for gatekeeping and evaluating expert scientific testimony in the hands of generalist judges and juries drawn from the general population results in a troubling paradox.[9] Judges and jurors in such cases require the expert testimony precisely because they lack the expert's knowledge, yet they also need to evaluate its soundness. As Judge Learned Hand famously inquired: "How can the jury judge between two statements each founded upon an experience confessedly foreign in kind to their own? It is just because they are incompetent for such a task that the expert is necessary at all."[10]

This Article examines how juries cope with the challenges of scientific evidence. I summarize the now-substantial body of scholarly research on the competence of individual juror decision making and collective jury decision making, both as a general matter and as they pertain to cases with scientific

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[4] *In re*: Roundup Prods. Liab. Litig., 385 F. Supp. 3d 1042, 1047 (N.D. Cal. 2019), aff'd sub nom. Hardeman v. Monsanto Co., 997 F.3d 941 (9th Cir. 2021).

[5] Richard O. Lempert, *The Jury and Scientific Evidence,* 9 KANSAS J. L. & PUBLIC POL'Y 22, 22 (1999).

[6] ALBERT S. OSBORN, THE MIND OF THE JUROR 6 (1937).

[7] *Id*. at 5.

[8] JEROME FRANK, COURTS ON TRIAL: MYTH AND REALITY IN AMERICAN JUSTICE 123 (1950).

[9] Valerie P. Hans & Michael J. Saks, *Improving Judge and Jury Evaluation of Scientific Evidence*, 147 *Daedalus* 164, 164-65 (2018).

[10] Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 HARV. L. REV. 54 (1901).

evidence. I also provide an account of potential biases that may arise in the jury's evaluation of scientific evidence. After describing the types of evidence that are most difficult for juries to comprehend, I discuss reforms of jury trials and jury trial procedure that can ameliorate the challenges that juries face in cases with complex scientific evidence.

II. INDIVIDUAL JUROR DECISION MAKING COMPETENCE: WHAT WE KNOW FROM RESEARCH

To understand the way that jurors process scientific evidence, it is useful to know more generally how jurors respond to trial testimony. As witnesses testify in a trial, jurors process the information. Cognitive psychologists have identified two broad types of information processing: System 1 and System 2. The System 1 approach is a fast, intuitive approach to processing information, sometimes referred to as peripheral or heuristic processing.[11] In contrast, a System 2 approach is a more thoughtful and deliberative approach to processing information.[12] Jury trial, with extended adversary presentations, judicial instructions, and the opportunity for deliberation, is set up to encourage System 2 thinking. But when trial testimony is confusing or difficult to grasp, there is a hazard that jurors may resort to more intuitive System 1 approaches, relying on superficial cues to assess the credibility of the evidence.[13]

As jurors process the trial evidence, rather than mechanically adding up the evidence for and against a trial litigant, they develop a running narrative account, or story, to make sense of the evidence as they hear it.[14] Jurors rely on their own knowledge about the world and their expectations about story structure to generate the narrative.[15] As the story develops, evidence that is consistent with that story may be readily incorporated into the narrative account, and evidence that is inconsistent may be disregarded.[16] As we discuss below, scientific, statistical, and probabilistic evidence is especially challenging, and jurors sometimes struggle to

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[11] DANIEL KAHNEMAN, THINKING, FAST AND SLOW 23 (2013) (referring to System 1 processing); Shari Seidman Diamond, *How Jurors Deal with Expert Testimony and How Judges Can Help*, 16 J.L. & POL'Y 47, 56-57 (2007) (referring to peripheral or heuristic processing and citing sources).

[12] KAHNEMAN, *supra* note 11 (referring to System 2 processing); Diamond, *supra* note 11 (referring to central or systematic processing and citing sources).

[13] *See* Brian H. Bornstein & Edie Greene, *Jury Decision Making: Implications for and from Psychology*, 20 CURRENT DIRECTIONS PSYCH. SCI. 63, 65 (2011) (noting that while juries are capable of deliberate, systematic reasoning, they are also susceptible to heuristic and intuitive processing).

[14] Nancy Pennington & Reid Hastie, *A Cognitive Theory of Juror Decision Making: The Story Model*, 13 CARDOZO L. REV. 519, 520-521 (1991) (discussing the "Story Model" for describing jurors' cognitive strategies); NEAL FEIGENSON, LEGAL BLAME: HOW JURORS THINK AND TALK ABOUT ACCIDENTS 5 (2000) (noting that jurors can often view accident cases as "personality-driven melodramas").

[15] Pennington & Hastie, *supra* note 14, at 556.

[16] *Id.*

figure out the implications of such evidence for their story and for the verdict in the case. That sets up a situation in which scientific evidence may be underutilized.

Because jurors rely in part on their own world views to develop the story, there is room for bias. In evaluating scientific claims, for instance, jurors who trust scientific information as a general matter may interpret expert scientific testimony favorably and give it more weight, compared to jurors who doubt scientific information. In a mock jury experiment with community residents, my collaborators and I examined the relationship between attitudes toward science and comprehension; we predicted that jurors with more favorable views about science would be more motivated to understand it, and that those with more negative views would devalue it.[17] We found that holding reservations about science was linked to juror comprehension; jurors who were more concerned about science were less accurate in assessing the scientific evidence presented in the mock trial.[18] Interestingly, beliefs in the promises and potential of science were *not* related to comprehension; instead, concerns about the negative impact and dangers of science were.[19] Fears about the contamination of the scientific evidence used in the case (a sample of mitochondrial DNA evidence taken from hairs in a suspect's sweatshirt) were also negatively associated with comprehension.[20] Similarly, Jason Schklar and Shari Seidman Diamond found in their mock juror study that "participants' background beliefs about the possibility of laboratory errors and intentional tampering affected the weight participants afforded a DNA match report."[21] Thus, general attitudes and views about science—particularly negative views—are likely to be important predictors of how jurors will approach the evaluation of scientific evidence during a trial.

The psychological phenomenon of motivated cognition or motivated reasoning, in which jurors engage in biased processing and evaluation of evidence to support the outcome they favor, can affect juror decision making.[22] In a classic demonstration, Mark Alicke experimentally varied whether a speeding driver who caused an accident was speeding to hide his parents' anniversary present or to hide some cocaine.[23] Participants saw the driver who was speeding to hide the cocaine as more culpable for the accident than the driver speeding to hide the anniversary present, even though the circumstances of the accident were identical.[24] Avani Mehta Sood surveyed the research and provided numerous examples that show how

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[17] Valerie P. Hans, David H. Kaye, B. Michael Dann, Erin J. Farley & Stephanie Albertson, *Science in the Jury Box: Jurors' Comprehension of Mitochondrial DNA Evidence*, 35 LAW & HUM. BEHAV. 60, 62 (2010).

[18] *Id.* at 67-69.

[19] *See id.*

[20] *Id.*

[21] Jason Schklar & Shari Seidman Diamond, *Juror Reactions to DNA Evidence: Errors and Expectancies*, 23 LAW & HUM. BEHAV. 159, 159 (1999).

[22] Avani Mehta Sood, *Motivated Cognition in Legal Judgments—An Analytic Review*, 9 ANN. REV. L. & SOC. SCI. 307, 308, 310-11 (2013).

[23] Mark D. Alicke, *Culpable Causation*, 63 J. PERSONALITY & SOC. PSYCH. 368, 368 (1992).

[24] *Id.*

motivated cognition can affect the assessment of parties' purposes and judgments of legal blame.[25] Sood documented how overall views of a party's character or desires that a defendant be punished can shape the construal of evidence as more or less probative.[26]

Motivated cognition can also affect how jurors interpret research evidence. In an early study, researchers gave participants detailed descriptions of the methodology and results of two studies, one that found a deterrent effect of the death penalty, and one that did not.[27] Proponents of capital punishment found the study supporting its deterrent effect more convincing, and opponents of capital punishment found the other study more convincing.[28] What is more, exposure to mixed evidence actually created *more* attitude polarization, rather than creating more moderate views.[29] Similarly, a study with law students and state court judges examined their evaluations of the quality of social science evidence on the deterrent effect of the death penalty and the reliability of predictions of dangerousness for capital defendants.[30] Participants rated the social science evidence higher when the results matched their own attitudes toward the death penalty.[31] Recent research also suggests that scientifically literate people are not immune to motivated interpretation of scientific findings.[32] For example, in one study involving the polarizing topic of climate change, individuals who were more scientifically literate were also more biased when they evaluated scientific information about climate change.[33]

Thus, there are reasons why jurors may perform well in the serious, deliberative environment of the trial, yet also reasons why they may fall short, especially in cases with challenging scientific evidence. Thus far in the Article, I have described research on psychological phenomena that have relied on experimental studies. What about the real world that juries face? The next section describes what we know about jury competence from that body of work.

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[25] Sood, *supra* note 22, at 311-12 (legal blame), 312-14 (assessment of motives).

[26] *Id.* at 311-12 (describing study showing person's bad character drove judgments), 313-14 (describing study showing that desires to punish defendant drove legal judgments and assessments of police).

[27] Charles G. Lord, Lee Ross & Mark R. Lepper, *Biased Assimilation and Attitude Polarization: The Effects of Prior Theories on Subsequently Considered Evidence*, 37 J. PERSONALITY & SOC. PSYCH. 2098, 2100-2101 (1979).

[28] *Id.* at 2101.

[29] *Id*. at 2102-04.

[30] Richard E. Redding & N. Dickon Reppucci, *Effects of Lawyers' Socio-Political Attitudes on Their Judgments of Social Science in Legal Decision Making*, 23 LAW & HUM. BEHAV. 31, 31 (1999).

[31] *Id*. at 43-44.

[32] *See* Dan Kahan, Ellen Peters, Maggie Wittlin, Paul Slovic, Lisa Larrimore Ouellette, Donald Braman & Gregory Mandel, *The Polarizing Impact of Scientific Literacy and Numeracy on Perceived Climate Change Risks*, 2 NATURE CLIMATE CHANGE 732, 732 (2012); Rebecca K. Helm & James P. Dunlea, *Motivated Cognition and Juror Interpretation of Scientific Evidence: Applying Cultural Cognition to Interpretation of Forensic Testimony*, 120 PENN ST. L. REV. 1, 1 (2016).

[33] Kahan et al., *supra* note 32.

III. JURY COMPETENCE: THE RESEARCH EVIDENCE

Jury research has extensively examined the issue of jury competence. A central difficulty facing those who study jury competence is that in many cases there is no single correct verdict, even in cases with scientific experts. The jury's verdict may depend not only on the jury's ability to comprehend the scientific evidence, but also upon the jury's assessment of witness credibility and interpretation of facts. However, jury researchers have been creative in developing different approaches to assessing the competence of the jury. In one line of cases, researchers have asked judges presiding over jury trials to record the jury verdict in their case and also to provide the verdict they would have reached had they been deciding the case in a bench trial.[34] These projects have routinely found substantial verdict agreement between judges and juries in both criminal and civil cases.[35] Judges can be inaccurate, too, and agreement is no surefire guarantee of a correct verdict particularly in a case involving complex scientific evidence. Judges may have no more expertise in comprehending and applying scientific evidence than juries.[36] Researchers have found that judges rely on many of the same heuristics and biases that affect non-law-trained individuals.[37] Nonetheless, it is significant that the jury in most cases reaches the same conclusion that a knowledgeable and experienced legal expert would have reached.

Disagreements between juries' actual verdicts and judges' hypothetical verdicts do not appear to be driven by jury incompetence; instead, disagreements occur largely in cases with more ambiguous evidence such that either verdict can be justified.[38] In criminal cases, juries appear to require more evidence to convict defendants than judges do, resulting in an asymmetrical pattern where judges are more likely to convict when juries acquit than vice versa.[39] In civil cases,

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[34] *See* PAULA L. HANNAFORD-AGOR, VALERIE P. HANS, NICOLE L. MOTT & G. THOMAS MUNSTERMAN, ARE HUNG JURIES A PROBLEM? 30, 55-56 (2002) (describing study in four US state courts in which judges and juries completed post-trial questionnaires about felony trials; the judge's questionnaire included an item asking for the judge's hypothetical verdicts); Larry Heuer & Steven D. Penrod, *Trial Complexity: A Field Investigation of Its Meaning and Its Effects*, 18 LAW & HUM. BEHAV. 29, 29 (1994) (describing study of jury innovations that included a measure of judge-jury verdict agreement); HARRY KALVEN, JR. & HANS ZEISEL, THE AMERICAN JURY 55 (1966) (describing study in which judges evaluated jury trials and provided hypothetical verdicts).

[35] HANNAFORD-AGOR ET AL., *supra* note 34, at 55-56 (reporting substantial agreement); Heuer & Penrod, *supra* note 34, at 46-48 (showing substantial agreement); KALVEN & ZEISEL, *supra* note 34, at 58 (78% agreement in criminal jury trials), 63 (78% agreement in civil jury trials).

[36] Christa Laser, *Scientific Education Among U.S. Judges*, AM. U. L. REV. (forthcoming 2025) (manuscript at 1) (reporting the results of a study that only 7.35% of federal judges majored in science and technology fields in college).

[37] Chris Guthrie, Jeffrey J. Rachlinski & Andrew J. Wistrich, *Blinking on the Bench: How Judges Decide Cases*, 93 CORNELL L. REV. 101, 109 (2007).

[38] *See* Theodore Eisenberg, Paula L. Hannaford-Agor, Valerie P. Hans, Nicole L. Mott, G. Thomas Munsterman, Stewart J. Schwab & Martin T. Wells, *Judge-jury Agreement in Criminal Cases: A Partial Replication of Kalven & Zeisel's* The American Jury, 2 J. EMPIRICAL LEGAL STUD. 171, 185-89 (2005); KALVEN & ZEISEL, *supra* note 34, at 111-117.

[39] Eisenberg et al., *supra* note 38, at 185-89; KALVEN & ZEISEL, *supra* note 34, at 58.

disagreements are more evenly balanced; juries do not show a marked preference for plaintiff or defendant.[40]

One might ask whether the appropriate comparison is between the jury and the scientific expert, rather than the jury and the judge. The judge is the logical alternative to the jury and thus is the most appropriate comparison.[41] Additionally, to competently exercise their task, the jury and the judge only need to comprehend enough of the expert testimony to be able to apply it to the facts of the case. They do not need to comprehend it as fully and completely as an expert in the field would. For instance, Richard Lempert described a trade secrets case that involved complex chemistry that appeared to mystify the jurors in the case.[42] However, he noted that "the jurors' verdict preferences, with one exception, seem eminently sensible because a scientist's understanding of the evidence does not seem essential to the fair disposition of the case."[43]

Another approach has been to analyze the relationship between specific factors in a case and jury verdicts; these studies routinely find that the strength of the evidence, whether it is evaluated by the judge or by the jurors, is the single most significant determinant of jury verdicts.[44] One other finding from this line of research is relevant to our topic in this Article: Disagreement rates between judges and juries are similar in both less complex and more complex trials.[45] Jury comprehension problems should be more frequent in more complex trials, so if the jury's failure to grasp the evidence leads them to an inaccurate verdict, we would expect disagreement rates to be higher in more complex cases. That the disagreement rates are comparable suggests that judge-jury disagreement is not mainly the result of the jury's failure to grasp the evidence.

Shari Seidman Diamond and her colleagues took advantage of an unusual opportunity to examine jury processing of evidence in their study of fifty civil jury

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[40] KALVEN & ZEISEL, *supra* note 34, at 64.

[41] *See generally* NEIL VIDMAR & VALERIE P. HANS, AMERICAN JURIES: THE VERDICT 148-51 (2007).

[42] Richard Lempert, *Civil Juries and Complex Cases: Taking Stock After Twelve Years*, *in* VERDICT: ASSESSING THE CIVIL JURY SYSTEM 181, 194-95 (Robert Litan ed., 1993).

[43] *Id.* at 195.

[44] Eisenberg et al., *supra* note 38, at 196-98 (analyzing factors and verdicts and discovering that the perceived strength of evidence, whether evaluated by jurors or by judges, had the strongest relationship with the jury's verdict); Steven P. Garvey, Paula L. Hannaford-Agor, Valerie P. Hans, Nicole L. Mott, G. T. Munsterman & Martin T. Wells, *Juror First Votes in Criminal Trials*, 1 J. EMPIRICAL LEGAL STUD. 371, 380 (2004) (finding strength of evidence most important factor determining first votes of jurors); Dennis J. Devine, Jennifer Budenbaum, Stephanie Houp, Dennie P. Stolle & Nathan Studebaker, *Deliberation Quality: A Preliminary Examination in Criminal Juries*, 4 J. EMPIRICAL LEGAL STUD. 273, 273 (2007).

[45] Eisenberg et al., *supra* note 38, at 190-92 (rates of judge-jury disagreement not strongly linked to case complexity); Heuer & Penrod, *supra* note 34, at 46-48 (no effect of case complexity on judge-jury agreement); KALVEN & ZEISEL, *supra* note 34, at 157 (judge-jury disagreement similar in easy and difficult cases).

deliberations in real cases in the state of Arizona.[46] In Arizona, jurors are permitted to ask questions during the trial.[47] She and her colleagues examined the frequency of juror questions to experts who testified during their trial.[48] If jurors asked few questions to the experts, or if their questions dealt with heuristic factors like credentials or experience, that would suggest that jurors were engaging in peripheral or System 1 processing of expert evidence. In contrast, if jurors posed substantial numbers of questions to experts and focused instead on the substantive content of the testimony, that would suggest that jurors were engaged in central or System 2 processing of expert evidence. Over the fifty trials, jurors posted 257 questions to experts, with just 5.8% of them being about credentials or experience. Instead, a full third of the questions to experts dealt with causation, and others probed the basis for the expert's conclusions. Diamond concluded that "the questions as a group reflect a picture consistent with central rather than peripheral processing."[49]

The videotaped deliberations of Arizona civil juries also reflected serious engagement with the substance of expert testimony. As Diamond recounted:

> [Jurors] consider credentials and expertise, but are actively engaged with the content and attempt to assess the accuracy of what the experts say. Although the jurors vary in their understanding of the evidence, jurors who appear to have greater mastery of the evidence assist the others and tend to be most influential. Thus, juries draw on the expertise of their most competent member to assess the strength of the evidence.[50]

Richard Lempert took up the issue of jury decision making competence in complex cases through a case study approach.[51] He identified thirteen jury trials that he defined as complex because of their length or subject matter, in which scholars or journalists had undertaken a serious exploration of jury competence in the case.[52] Among the cases were a trade secrets case, a case that relied on epidemiological studies as well as conflicting scientific evidence about ground

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[46] Shari Seidman Diamond, Neil Vidmar, Mary R. Rose, Leslie Ellis & Beth Murphy, *Juror Discussions During Civil Trial: Studying an Arizona Innovation*, 45 ARIZ. L. REV. 1, 4-5 (2003) (describing the study).

[47] While the Arizona Rules of Civil Procedure have since been amended, the rules allowing for jury questions remain largely identical. ARIZ. R. CIV. P. 40(i)(2) ("Before deliberations begin, jurors may submit to the court written questions directed to witnesses or to the court. Counsel must be allowed to object to such questions on the record and out of the jury's presence. For good cause, the court may prohibit or limit jury questions to witnesses.")

[48] Shari Seidman Diamond, Mary R. Rose, Beth Murphy & Sven Smith, *Juror Questions During Trial: A Window into Juror Thinking*, 59 VAND. L. REV. 1927, 1930 (2006).

[49] *Id*. at 1963.

[50] Diamond, *supra* note 11, at 62. Diamond and Casper also observed in their mock jury research that the individuals with relevant knowledge were more likely to be leaders on the jury. Shari Seidman Diamond & Jonathan D. Casper, *Blindfolding the Jury to Verdict Consequences: Damages, Experts and the Civil Jury*, 26 LAW & SOC'Y REV. 513, 550-551 (1992).

[51] Lempert, *supra* note 42, at 181.

[52] *Id.* at 183.

water contamination, an asbestos trial that included expert testimony about a plaintiff's exposure to the substance asbestos and their subsequent development of the lung disease of asbestosis, a case about junk bonds, and antitrust cases that required a jury to understand the operation of markets. [53] The topics and scientific evidence varied tremendously, but all relied on difficult and often conflicting scientific expert testimony presented to the juries.

Lempert rated the jury verdicts as high, moderate, or low on their defensibility and concluded that although eleven verdicts were highly or moderately defensible, two of the thirteen jury verdicts were low on defensibility.[54] In sum, "most jury verdicts seem defensible; they are close to the verdicts that judges would have rendered or they seem fair and reasonable."[55] He concluded that even when juries did not thoroughly comprehend all the scientific and technical evidence, they could usually understand a sufficient amount to engage in rational decision making.[56]

What is more, in the cases in which jury verdicts were lower in defensibility, he pointed to two types of problems that had more to do with the actions of other actors than with the deficiencies of the jury. The first problem arose through misleading or inadequate trial strategy.[57] For example, in the asbestos litigation, which included multiple plaintiffs with varying degrees of asbestosis, the plaintiff's expert testified that asbestosis was a progressive disease.[58] The jury subsequently awarded damages to each plaintiff with the expectation that all would become as seriously ill as the lead plaintiff, who was very ill.[59] However, the defense did not call witnesses to explain the variable nature of asbestosis, leaving jurors with the incorrect view that all the plaintiffs would eventually suffer as much as the lead plaintiff.[60]

A second problem was with confusing verdict forms.[61] For example, in one case involving ground water pollution, after the jury asked the judge to explain what one of the questions on the verdict form meant, the judge responded with a confusing answer.[62] The baffled jury attempted to interpret what the question at issue meant. That interpretation was incorrect, however, and led them to give inconsistent answers to the verdict form questions, resulting in the jury decision being overturned.[63]

A final point about the factors that influence jury competence: Jury deliberation can enhance understanding of scientific evidence and promote jury competence. As

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[53] *Id.* at 185-89 tbl.6.1.

[54] *Id*.

[55] *Id*. at 194.

[56] *Id*. at 234.

[57] *Id.* at 200 (discussing the Johns Manville trial).

[58] *Id.*

[59] *Id.*

[60] *Id.*

[61] *Id*. at 196-97 (describing problems with the verdict forms in the W. R. Grace litigation).

[62] *Id.* at 196.

[63] *Id.* at 196-97

jurors discuss the case, the deliberation presents an opportunity for those with greater knowledge about the scientific evidence to share their knowledge with others. In the mitochondrial DNA study described earlier, my collaborators and I tested jurors' knowledge of the scientific evidence both before and after the mock jurors engaged in their jury deliberation and reached a verdict.[64] Jurors with lower levels of formal education, whose pre-deliberation understanding was lower than jurors with higher levels of formal education, benefited the most from the deliberation process.[65] The study results illustrate the value of jury deliberation.

Taken together, the research described above, with real juries deciding real cases, including complex cases, offers some reassurance that in most cases, jurors generally understand the evidence, reach verdicts that are in line with the trial evidence, and tend to agree with the expert judge. Jurors may misunderstand scientific evidence at times and struggle to evaluate competing experts. And sometimes the explanation for juror misunderstanding is more properly attributable to actions of the trial judge or trial strategies of the attorneys. However, to the extent that we can detect the effects of these misunderstandings in jury verdicts, erroneous decisions by juries because of failure to comprehend the evidence, even in complex cases involving difficult scientific evidence, appear to be infrequent.

IV. SCIENTIFIC EVIDENCE: WHAT IS MOST CHALLENGING FOR JURORS?

Although the jury verdict studies offer some reassurance, juror surveys and experimental research have identified the types of scientific evidence that jurors find most challenging. Jurors who are surveyed report that scientific, technical, and economic evidence, especially evidence that includes statistical calculations and probability estimates, as some of the most challenging aspects of their task.[66] Comprehension of scientific evidence, such as the types of scientific studies presented in the Roundup litigation, requires some basic understanding of scientific methodology and the ability to grasp the significance of study results, which often are presented as statistical information and probability estimates. For example, experts in the Roundup cases spoke about animal experimental studies in which rodents were or were not exposed to Roundup,[67] about epidemiological research in which the case histories and exposures of individuals with and without non-Hodgkins' lymphoma were analyzed,[68] and meta-analyses of Roundup research

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[64] Hans et al., *supra* note 17, at 63-64.

[65] *Id*. at 68.

[66] For summaries of the research, see generally Joseph S. Cecil, Valerie P. Hans & Elizabeth C. Wiggins, *Citizen Comprehension of Difficult Issues: Lessons from Civil Jury Trials*, 40 AM. U. L. REV. 727 (1991); Neil Vidmar & Shari Seidman Diamond, *Juries and Expert Evidence*, 66 BROOK. L. REV. 1112 (2001); Sanja Kutnjak Ivković & Valerie P. Hans, *Jurors' Evaluations of Expert Testimony: Judging the Messenger and the Message*, 28 LAW & SOC. INQUIRY 441 (2003).

[67] Pretrial Order No. 45: Summary Judgment and *Daubert* Motions at 41, *In re*: Roundup Prods. Liab. Litig., 385 F. Supp. 3d 1042 (N.D. Cal. 2019) (No. 16-md-02741-VC, MDL No. 2741).

[68] *Id.* at 49.

projects, including some research sponsored by its producer, Monsanto.[69] Interpreting the expert testimony required some basic understanding about the conduct of scientific research and the meaning of statistical results. Interpretation can also be affected by the jurors' confidence in science. This section discusses the relevant work.

A. Confidence in Science

The National Science Foundation regularly publishes *Science and Engineering Indicators,* which summarizes survey data about public knowledge and perceptions of science and technology.[70] The 2024 report documents the favorable view that the majority of the American public holds about science and technology and the substantial confidence that Americans have in scientists acting in the best interests of the public.[71] Confidence in science varies by education and by income; persons with more education and higher income showed more confidence in science.[72]

However, a Gallup poll comparing confidence in science in 1975 and 2021 found that confidence in science has diverged over time for Republicans and Democrats, with Republicans becoming less confident and Democrats more confident in science.[73] Pew Research Center surveys in 2023 and 2024 confirmed the partisan differences.[74] The reports note that different reactions across the political spectrum related to the coronavirus epidemic appear to have contributed to the partisan divide, because sharp Republican declines in confidence occurred in the first two years of the COVID-19 pandemic.[75] There could be other factors; as

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[69] *Id.* at 50.

[70] Science and Engineering Indicators, NAT. CTR. SCI. & ENG'G STATS., https://www.nsf.gov/statistics/seind/ [https://perma.cc/TA7K-J24W] (last visited Mar. 28, 2025).

[71] BRIAN G. SOUTHWELL & BENJAMIN SCHNEIDER, NAT. SCI. FOUND., NSB-2024-4, SCIENCE AND TECHNOLOGY: PUBLIC PERCEPTIONS, AWARENESS, AND INFORMATION SOURCES 8-11 (2024) [hereinafter NSF SCIENCE AND TECHNOLOGY REPORT] (general perceptions of science and technology); *id.* at 12 (confidence in scientists to act in the best interests of the public) .

[72] *Id*. at 12-13.

[73] Jeffrey M. Jones, *Democratic, Republican Confidence in Science Diverges*, GALLUP (July 16, 2021), https://news.gallup.com/poll/352397/democratic-republican-confidence-science-diverges.aspx [https://perma.cc/X7P8-NAYT].

[74] BRIAN KENNEDY & ALEC TYSON, PEW RSCH. CTR., AMERICANS' TRUST IN SCIENTISTS, POSITIVE VIEWS OF SCIENCE CONTINUE TO DECLINE 5-6 (Nov. 14, 2023), https://www.pewresearch.org/wp-content/uploads/sites/20/2023/11/PS_2023.11.14_trust-in-scientists_REPORT.pdf [https://perma.cc/RQ52-LUPZ] [hereinafter KENNEDY & TYSON, AMERICAN'S TRUST IN SCIENTISTS]; ALEC TYSON & BIAN KENNEDY, PEW RSCH. CTR., PUBLIC TRUST IN SCIENTISTS AND VIEWS ON THEIR ROLE IN POLICYMAKING 8-9 (Nov. 14, 2024), https://www.pewresearch.org/wp-content/uploads/sites/20/2024/11/PS_2024.11.14_trust-in-science_REPORT.pdf [https://perma.cc/S3F9-6NRX].

[75] Jones, *supra* note 73; KENNEDY & TYSON, AMERICANS' TRUST IN SCIENTISTS, *supra* note 74, at 5-6.

Gallup notes, "Republicans have expressed doubts about the scientific consensus on climate change, something Democrats widely accept."[76]

B. Knowledge and Comprehension of Scientific Research Methods

Grasping the importance of scientific methods can be difficult for jurors who have little exposure to science. Knowledge about the actual practice of science is variable; for example, 60% of American adults were able to correctly identify the value of a control group in a scientific study, and 50% could recognize a scientific hypothesis, leaving a significant portion of the public unable to identify the importance of these key elements of the scientific enterprise.[77] And Americans on average do not have much direct engagement in science-related activities.[78] This has the potential of leaving jurors vulnerable to adversarial misrepresentation of the significance of scientific research findings.

Lora Levett and Margaret Bull Kovera have examined whether jurors are sensitive to variations in the quality of scientific research, and whether methods that lawyers have available to educate jurors can help jurors better differentiate low- and high-quality research.[79] In one mock juror experiment, Levett and Kovera had community members read a case summary with defense expert testimony that was either low or high in quality; some participants also heard an opposing expert, while others did not.[80] The presence of an opposing expert led mock jurors to be more skeptical of expert testimony generally, even in the condition in which the defense expert gave high-quality evidence.[81] The researchers concluded that the opposing expert did not sensitize the mock jurors to deficiencies in the low-quality expert's

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[76] Jones, *supra* note 73. Jones also mentions Republican support for creationism over evolution and conservative charges of liberal bias in colleges and universities. *Id.* In addition, the changing demographic makeup of voters who identify with the Democratic or Republican parties may help to explain the longer-term decline in Republican support, a point made by Symposium participant Richard Lempert. A 2024 Pew survey found that "[t]he Republican party now holds a 6 percentage-point advantage over the Democratic party (51% to 45%) among **voters who do not have a bachelor's degree**." PEW RSCH. CTR., CHANGING PARTISAN COALITIONS IN A POLITICALLY DIVIDED NATION 15 (April 9, 2024), https://www.pewresearch.org/wp-content/uploads/sites/20/2024/04/PP_2024.4.9_partisan-coalitions_REPORT.pdf [https://perma.cc/W6RF-JU6A] (bold in original). This represents a change over time: "More than six-in-ten White voters who do not have a four-year degree (63%) associate with the Republican Party, which is up substantially over the past 15 years. White college graduates are closely divided; this was not the case in the 1990s and early 2000s, when they mostly aligned with the GOP." *Id.* at 6.

[77] NSF SCIENCE AND TECHNOLOGY REPORT, *supra* note 71, at 24. For these items, better knowledge of science was related to more trust in science. *Id.* at 24-25.

[78] *Id*. at 32-33.

[79] Lora L. Levett & Margaret Bull Kovera, *The Effectiveness of Opposing Expert Witnesses for Educating Jurors about Unreliable Expert Evidence*, 32 LAW & HUM. BEHAV. 363, 365 (2008).

[80] *Id.*

[81] *Id.* at 371.

testimony.[82] However, the mock jurors did recognize the difference between low- and high-quality evidence.[83]

In contrast to the Levett and Kovera research, Gregory Mitchell and Brandon Garrett found that opposing expert testimony in which a defense expert either said crime scene fingerprint evidence was of such poor quality that a definitive judgment could not be made, or said that the fingerprint evidence excluded the defendant, were both effective in neutralizing the prosecution's fingerprint evidence.[84] Defense expert testimony that discussed methodology and noted substantial error rates in fingerprint evidence was not as effective.[85] However, in another study, a defense rebuttal witness who testified about research studies showing the limitations of firearms examinations was successful in reducing the impact of a prosecution firearms examiner.[86]

C. Comprehension and Use of Statistical and Numerical Evidence

A substantial body of empirical research has examined how individuals perceive and interpret statistical, numerical, and probabilistic information—this is exactly the type of information likely to be presented by scientific experts at trial.[87] Jurors must understand the meaning and significance of this information to be able to apply it in the case at hand.[88] The expert's presentation of statistical evidence at trial can have a major impact on how it is interpreted. In a survey of research on how jurors handle numerical information, my coauthors and I pointed out several consequences of presentation choices.[89]

When it is presented by experts at a trial, DNA evidence is typically accompanied by information about the statistical likelihood of a match between

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[82] *Id*. In another experiment, Kovera and her collaborators found that cross-examination did not increase the sensitivity of the mock juror participants (undergraduate students at a university) to quality issues in the expert's testimony. Margaret Bull Kovera, Bradley D. McAuliff & Kellye S. Hebert, *Reasoning about Scientific Evidence: Effects of Juror Gender and Evidence Quality on Juror Decisions in a Hostile Work Environment Case*, 84 J. APPLIED PSYCH. 362, 372 (1999).

[83] Lovett & Kovera, *supra* note 79, at 370.

[84] Gregory Mitchell & Brandon L. Garrett, *Battling to a Draw: Defense Expert Rebuttal Can Neutralize Prosecution Fingerprint Evidence*, 35 APPLIED COGNITIVE PSYCH. 976, 980-82 (2021).

[85] *Id.* at 982.

[86] Brandon L. Garrett, Richard E. Gutierrez & Nicholas Scurich, *The Impact of Defense Experts on Juror Perceptions of Firearms Examination Testimony*, 64 JURIMETRICS J. 223, 242-43 (2024).

[87] *See, e.g.*, Michael J. Saks & Robert F. Kidd, *Human Information Processing and Adjudication: Trial by Heuristics*, 15 LAW & SOC'Y REV. 123, 149 (1981); David H. Kaye & Jonathan J. Koehler, *Can Jurors Understand Probabilistic Evidence?*, 154 J. ROYAL STAT. SOC'Y ANN. 75, 75 (1991) (studying jury comprehension of probabilistic evidence); William C. Thompson, *Are Juries Competent to Evaluate Statistical Evidence?*, 52 LAW & CONTEMP. PROBS. 9 (1989) (reviewing studies on jury comprehension of statistical evidence).

[88] Rebecca K. Helm, Valerie P. Hans & Valerie F. Reyna, *Trial by Numbers*, 27 CORNELL J. L. & PUBLIC POL'Y 107, 108 (2017).

[89] *Id*.

DNA from a crime scene and the suspect's DNA.[90] In DNA cases, jurors are often presented with a random match probability (RMP), which is the probability of a match with an individual who is randomly sampled from a reference group.[91] If the RMP is low, rendering a match unlikely, the defendant is more likely to be the source of the crime scene DNA.[92] The RMP does affect juror judgments; jurors have been shown to differentiate between lower and higher RMPs.[93]

How the RMP is presented, however, affects how it is perceived. The likelihood of a DNA match can be framed as a frequency (for example, a 1 in 1,000 chance of a random match) or a probability (for example, a .001 chance of a random match).[94] People find RMP probabilities more impressive than RMP frequencies, perhaps because they neglect the denominator in the frequency and focus their attention on .001 and 1.[95] However, RMP probabilities do appear to help jurors better differentiate between weak and strong cases compared to verbal equivalents.[96]

People make two types of common errors when they interpret probabilistic information about a match like the RMP.[97] In the criminal case context, one such error is labeled the "prosecutor's fallacy."[98] If a scientific expert testifies that the RMP is 1%—which means the probability that DNA from a random person from the population would be a match to the crime scene DNA—people have a tendency to flip that number and say if the RMP is 1% then the chance of the defendant's guilt is 99%.[99] But that's a fallacy (favoring the prosecution) because it does not take into account the other evidence in the case.[100] On the other hand, with that same RMP of 1%, a defense attorney could argue that the information should be ignored because many other people in the population could also be a DNA match.[101]

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[90] *See id*. at 111-16; *see also* Dale A. Nance & Scott B. Morris, *An Empirical Assessment of Presentation Formats for Trace Evidence with a Relatively Large and Quantifiable Random Match Probability*, 42 JURIMETRICS J. 403, 403 (2002); Dale A. Nance & Scott B. Morris, *Juror Understanding of DNA Evidence: An Empirical Assessment of Presentation Formats for Trace Evidence with a Relatively Small Random Match Probability*, 34 J. LEGAL STUD. 395, 395 (2005); Schklar & Diamond, *Juror Reactions to DNA Evidence, supra* note 21, at 159; Brian C. Smith et al., *Jurors' Use of Probabilistic Evidence*, 20 LAW & HUM. BEHAV. 49, 49 (1996).

[91] Helm et al., *supra* note 88, at 111.

[92] *Id.*

[93] *Id*. at 112.

[94] *Id*. at 113.

[95] *Id*. at 127.

[96] *Id*. at 114 (citing Kristy A. Martire, Richard I. Kemp, Ian Watkins, Malindi A. Sayle & Ben R. Newell, *The Expression and Interpretation of Uncertain Forensic Science Evidence: Verbal Equivalence, Evidence Strength, and the Weak Evidence Effect,* 37 LAW & HUM. BEHAV. 197, 205 (2013)).

[97] *See* VIDMAR & HANS, *supra* note 41, at 180-182 (discussing RMP errors).

[98] William C. Thompson & Edward L. Schumann, *Interpretation of Statistical Evidence in Criminal Trials: The Prosecutor's Fallacy and the Defense Attorney's Fallacy*, 11 LAW & HUM. BEHAV. 167, 170-71 (1987) (describing the prosecutor's fallacy).

[99] *Id.*

[100] *Id.*

[101] *Id.* at 171 (describing the defense attorney's fallacy).

That is also an error (favoring the defense); instead, a juror should combine the DNA evidence with other information in the case to judge the defendant's guilt.[102] Thus, sometimes juries may be inclined to give too much weight to probabilistic information, and other times they may give too little weight to it.

A participant's numeracy—their ability to handle numbers—is related to whether they are affected by the framing effects just discussed. Ellen Peters and her collaborators gave people who were low or high in numeracy a number of scenarios in which they tested the participants' ability to understand numerical principles.[103] They found, not surprisingly, high numeracy people were better able to resist framing effects. One scenario asked them to estimate the risk of releasing a psychiatric hospital patient; half the people were given a frequency statement about the likelihood of a patient's violence (10 out of 100) whereas the other half were given a percentage statement of the likelihood of the patient's violence (10%).[104] Compared to high numeracy people, low numeracy people were less likely to recognize the equivalency of "10 out of 100" and "10%."[105]

This overview has summarized just some of the ways in which statistical and numerical evidence generate demanding interpretation issues for jurors. The challenges are even greater when jurors are asked to assess conflicting scientific evidence. The possibility that jurors might default to System 1 peripheral or heuristic thinking when faced with these challenges is real. So, we now turn to what lawyers, courts, and policymakers could do to ensure more thoughtful, deliberative approaches.

V. REMEDIES

In *Improving Judge and Jury Evaluation of Scientific Evidence*, Michael Saks and I laid out several strategies that courts and lawyers could take to enhance the abilities of judges and jurors to understand and apply scientific evidence.[106] With respect to the strategies for jurors, the list included reforms to jury selection—who sits on the jury in a complex case[107]—and what tools could be given to jurors to make their task of understanding scientific evidence easier, including educating juries and ensuring diverse juries and robust deliberation.[108] We considered (but warned against) the recommendation some have made to use special juries chosen for their knowledge or educational attainment, rather than juries randomly selected from the community.[109]

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[102] *Id.*

[103] Ellen Peters, Daniel Vãstfjãll, Paul Slovic, C. K. Mertz, Ketti Mazzocco & Stephan Dickert, *Numeracy and Decision Making*, 17 PSYCH. SCI. 407, 407 (2006).

[104] *Id.* at 409.

[105] *Id.* at 409-410

[106] Hans & Saks, *supra* note 9, at 169.

[107] *Id.* at 174.

[108] *See id.* at 169-173.

[109] *See id.* at 175 (discussing caveats about special juries, including persistent cognitive biases, expert juror influence, and reduced jury diversity).

Beyond selecting and educating juries, we pointed out several ways that the jury trial and the expert evidence could be modified to increase juror understanding. Such modifications include, for example, presenting expert evidence to boost comprehension, restructuring the trial to maximize understanding, and implementing trial procedure reforms,[110] in particular "active jury" reforms, that promote understanding.[111]

A. Jury Selection in Cases with Scientific Evidence

Lawyers litigating a case in which scientific evidence will be an important part of the trial often try to assess how prospective jurors' individual backgrounds or experiences will likely shape their evaluation of the scientific evidence. For some lawyers, having well-educated jurors who can appropriately interpret scientific evidence would be helpful, whereas other lawyers may be concerned about the disproportionate influence of a knowledgeable juror and the danger of turning the deliberation into a one-person discussion. To what extent do background factors matter in scientific evidence cases?

We have already discussed ways in which individuals differ in their confidence and trust in science, and how these attitudes toward science appear to affect the weight and interpretation of scientific evidence in a jury trial. Thus, it can be useful to probe attitudes toward science during voir dire.

The jury questionnaire in Edwin Hardeman's lawsuit against Monsanto included questions about the prospective juror's own educational background, and also asked: "Do you, or does a family member or anyone close to you, have any training, experience, or expertise in the following areas?"[112] Areas listed included agriculture/farming, biology, chemistry, chemical engineering, and environmental science.[113] Other areas clearly pertained to the prospective juror's ability to knowledgeably evaluate research, as the question also listed epidemiology, risk assessment, statistics, and toxicology.[114] Interestingly, no questions addressed the prospective juror's overall trust and confidence in science.

There is a lively debate over whether, in highly complex jury trials, the court should forgo selecting a jury from the general population and instead select a special jury chosen from a group of individuals with more formal education or more specialized knowledge and training. After all, much research shows that individuals with higher educational attainment are better able to understand scientific evidence.[115] However, the research on motivated cognition described earlier

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[110] *Id.* at 169.

[111] *Id.* at 171.

[112] Pretrial Order No. 70, Final Juror Questionnaire, Hardeman v. Monsanto Co., 997 F.3d 941 (9th Cir. 2021). The juror's educational background is probed in question 9, *id.* at 3, and the training and experience question is question 15, *id.* at 5.

[113] *Id.* at 5.

[114] *Id.*

[115] Hans et al., *supra* note 17, at 66-69.

suggests that highly educated individuals may be particularly adept at interpreting scientific evidence consistent with their preferred outcomes.[116]

In both England and the U.S., special juries were routinely used for many years.[117] However, they have fallen into disuse as lawmakers have increasingly come to value a jury drawn from a cross-section of the population, which is better able to reflect the full community's views in its decisions.[118]

A substantial body of research has documented the value of representative, diverse juries.[119] Higher quality fact finding and more robust deliberations are associated with diverse juries.[120] Amanda Nicholson Bergold and Margaret Bull Kovera conducted two mock jury studies in which they varied jury diversity along different dimensions and examined deliberation quality; they reported that in both studies, "jurors deliberating in diverse juries out-performed jurors deliberating in nondiverse juries, as evidenced by their more frequent high-quality contributions to jury deliberations.[121] One might think that juries with educational diversity might perform worse in cases with complex scientific evidence. However, the mitochondrial DNA mock jury research study described earlier showed that deliberation improved the scientific understanding of jurors with less formal education.[122] In sum, then, although it makes sense to use voir dire to assess whether prospective jurors are worried about science or hostile to scientific evidence, it is also valuable to aim for diverse juries.

B. Conducting the Trial to Maximize Juror Understanding

We should consider how to restructure the jury trial to maximize juror understanding. Scientific evidence should be presented in such a way as to facilitate juror comprehension and the appropriate use of the evidence. Scholars have suggested that, instead of having scientific experts for both sides appear in separate parts of a trial, the judge schedule back-to-back expert witness testimony. Shari Seidman Diamond points out the likely benefit: "to facilitate ease in comparing the

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[116] Kahan et al., *supra* note 32, at 733.

[117] VIDMAR & HANS, *supra* note 41, at 68.

[118] *Id.* at 68-69; *see generally* JAMES OLDHAM, TRIAL BY JURY: THE SEVENTH AMENDMENT AND ANGLO-AMERICAN SPECIAL JURIES 127-233 (2006) (tracing the history of the special jury in England and the United States). However, special juries have never been held to violate the U.S. Constitution. VIDMAR & HANS, *supra* note 41, at 69.

[119] Shari Seidman Diamond & Valerie P. Hans, *Fair Juries*, 2023 U. ILL. L. REV. 879, 884-86 (2023) (summarizing evidence of the value of representative, diverse juries).

[120] *Id*.

[121] Amanda Nicholson Bergold & Margaret Bull Kovera, *Diversity's Impact on the Quality of Deliberations*, 48 PERSONALITY & SOC. PSYCH. BULL. 1406, 1416 (2022); *see also* Claudia L. Cowan, William C. Thompson & Phoebe C. Ellsworth, *The Effects of Death Qualification on Jurors' Predisposition to Convict and on the Quality of Deliberation*, 8 LAW & HUM. BEHAV. 53, 73 (1984) (finding, in a mock jury research project that varied the composition of groups that were either all death-qualified or included some death penalty opponents, that the mixed juries remembered more of the evidence accurately).

[122] Hans et al., *supra* note 17, at 68.

testimony of opposing experts who would otherwise testify days or even weeks apart."[123]

B. Michael Dann, a beloved Arizona trial judge and a huge fan of juries, wrote an inspired piece in 1993 about how to optimize a jury trial to make it a more educational experience for jurors.[124] In his article, Judge Dann pointed out that jurors would better be able to follow the evidence and apply the law if they were able to take notes, ask questions of the witnesses themselves, and learn about the law they were going to apply at the start rather than the conclusion of the trial.[125] He pioneered in Arizona a constellation of such trial practices, and research has backed up their value in increasing juror comprehension.[126]

Judge Dann and I collaborated with others to test the efficacy of several of the active jury procedures in the mitochondrial DNA study mentioned earlier.[127] Jurors watched a trial video, which included conflicting expert testimony about the mitochondrial DNA evidence.[128] We varied whether jurors could take notes, whether they could ask the expert follow-up questions, whether they had jury notebooks with the experts' slides and a glossary of scientific terms, and whether they had a checklist that provided decision-making guidance.[129] Jurors who were able to use some of these options, especially the jury notebooks and the checklists, performed better.[130] Notetaking and question asking often show comprehension benefits as well, but in this study, with a one-hour trial and two experts, it did not.[131] The ABA's *Principles for Jurors and Jury Trials* draws on the body of empirical evidence to recommend the use of active jury reforms.[132] They should be especially valuable in complex jury trials with scientific evidence.

The benefits of the checklist in the mitochondrial DNA study suggest that the format of the verdict sheet given to juries could be an important way in which the court is able to facilitate the process of group decision making during deliberation and is worth studying. There is only a modest amount of systematic research on jury verdict forms.[133] Avani Mehta Sood surveyed stakeholders across the U.S.

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[123] Diamond, *supra* note 11, at 65.

[124] B. Michael Dann, *"Learning Lessons" and "Speaking Rights": Creating Educated and Democratic Juries*, 68 IND. L.J. 1229 (1993)

[125] *Id.* at 1247-54.

[126] *See* B. Michael Dann, Valerie P. Hans & David H. Kaye, *Can Jury Trial Innovations Improve Juror Understanding of DNA Evidence?* 90 JUDICATURE 152, 155-156 (2007).

[127] *Id*. at 152-154.

[128] *Id.* at 153.

[129] *Id.* at 152.

[130] *Id.* at 155.

[131] *Id.*

[132] *See* AM. BAR. ASSN., PRINCIPLES FOR JURORS AND JURY TRIALS 118 (2024).

[133] *E.g.*, Kayla A. Burd & Valerie P. Hans, *Reasoned Verdicts: Oversold?*, 51 CORNELL INT'L L. J. 319, 329-31 (2018) (describing verdict form options); Avani Mehta Sood, *What's So Special about General Verdicts? Questioning Verdict Format Preferences in U.S. Criminal Trials*, 22 THEORETICAL INQUIRIES IN L. 55, 55-56 (2021) (arguing in favor of special verdicts); Avani Mehta

about their views of special verdicts, in which the jury answers specific questions, as opposed to rendering a general verdict, in criminal cases.[134] Most stakeholders thought that special verdict questions would help jurors understand and apply the criminal law and would assist them in thinking through and discussing the case with other jurors.[135] However, one concern is that the expansion of the judge's role in crafting special verdict questions would diminish the role of the jury.

C. Improving Expert Scientific Presentations

We now know much more about the types of presentations of scientific and statistical evidence that jurors find most demanding and that can lead to misunderstanding. In our article *Trial by Numbers*, Rebecca Helm, Valerie Reyna, and I recommended that experts routinely use visual displays that help even innumerate people avoid framing effects that lead to erroneous conclusions about statistical evidence.[136] As illustrations, we suggested using tables to prevent the prosecutor's fallacy, to guide jurors in combining probabilities, and to properly interpret RMPs.[137] Lawyers have a role to play as well, in providing cues to jurors alerting them of likely processing errors with statistical information, for instance by observing that a 1 in 10 risk is equivalent to a 10 in 100 risk.[138] Of course, this requires some lawyers to overcome their own discomfort or even resistance to dealing with numbers.[139]

Sometimes more in-depth exposure might be necessary. The *Reference Manual on Scientific Evidence* provides background information about scientific disputes for judges.[140] Judges in patent cases routinely take advantage of tutorials, typically arranged by the parties, to get them up to speed on the scientific and technical issues in the case prior to hearing the adversary experts testify.[141] What about tutorials for jurors, organized to provide background information about the scientific questions in the case they have been selected to hear?

Sood, *Reaching a Verdict: Empirical Evidence on the Crumbling Conventional Wisdom on Criminal Verdict Format*, 98 N.Y.U. L. REV. 1265, 1301-1303 (2023) [hereinafter Sood, *Reaching a Verdict*] (surveying stakeholders and finding support for special verdicts in criminal cases); Elizabeth C. Wiggins & Steven J. Breckler, *Special Verdicts as Guides to Jury Decision Making*, 14 LAW & PSYCH. REV. 1, 1 (1990) (varying verdict forms and observing their impact on decision making).

[134] Sood, *Reaching a Verdict, supra* note 133, at 1301.

[135] *Id*. at 1316 tbl.5.

[136] Helm et al., *supra* note 88, at 127-28, 133-39 (illustrating through tables and figures how confusion can be reduced, and interpretation of statistical information can be maximized).

[137] *Id*. at 138-39 tbl.2, 3 & 4.

[138] *Id*. at 132.

[139] When I teach Learned Hand's formula in my Torts class, I introduce the class with a slide saying: "I was told there would be no math!" It always gets a laugh.

[140] FEDERAL JUDICIAL CENTER, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE (3d ed. 2011).

[141] Hans & Saks, *supra* note 9, at 172.

A small number of research studies suggest that tutorials and targeted training can help people understand statistical concepts and scientific causation.[142] One study tested the impact of a Federal Judicial Center tutorial for potential use in patent jury trials,[143] but so far as we know, it is not routinely employed. The tutorial was intended to provide background information about the patent process generally, rather than the scientific issues that would be examined in a specific case.[144] However, some patent lawyers objected to the use of the tutorial, arguing that it presented a pro-patent office perspective on patent disputes and might bias jurors as a result.[145] A small research study did confirm, however, that the video dramatically increased knowledge.[146] It can be done.

D. Ensuring Thorough Deliberation

The beneficial effects of deliberation on scientific understanding suggest that we should pay attention to factors that create robust and thorough discussion among jurors. As I reported earlier, diverse juries typically engage in more robust deliberation than juries that are more homogeneous.[147] In addition, jury size and decision rule affect the quality of deliberation. Twelve-person juries better represent the community and are better fact finders compared to the six-person juries so common in state civil cases or the eight-person civil juries that are most common in federal courts.[148] And requiring that jurors be unanimous in their verdicts—required in criminal but not civil cases—also promotes more rigorous deliberation.[149]

VI. CONCLUSION

The Roundup cases are just one example of the types of challenging scientific disputes that American juries confront every day. This review identified the issues that can arise as ordinary jurors confront sophisticated experts and conflicting science and are asked to comprehend enough of that testimonial evidence to be able to decide the case before them. Juries on the whole do a good job in the vast majority of civil and criminal cases, and that is reassuring, but we know from

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[142] *See id.* (summarizing research regarding the positive effect of tutorials and training on statistic and scientific comprehension)

[143] *Id.* at 173-74 (describing the study in John Gilleland, *The Debate is On: Is the Federal Judicial Center's Patent Tutorial Video Too Pro-Plaintiff?*, SECTION NEWSL. (Ill. St. Bar Assn., Springfield, Illinois), March 2012)

[144] *Id.* at 173.

[145] *Id.*

[146] *Id*.

[147] Diamond & Hans, *supra* note 119, at 884-86 (summarizing evidence of the value of representative, diverse juries).

[148] Steven S. Gensler, Patrick Higginbotham & Lee Rosenthal, *Better by the Dozen: Bringing Back the Twelve-Person Civil Jury*, 104 JUDICATURE 47, 52-53 (2020).

[149] See arguments and research evidence summarized in Brief of Law Professors and Social Scientists as Amici Curiae in Support of Petitioner at 5-13, Ramos v. Louisiana, 590 U.S. 83 (2020) (No. 18-5924).

systematic research where problems of interpretation are likely to arise. We also know how we can improve the jury's performance. Science presents challenges for jury trials, but jury science can address them.