

Testing the Effects of Selected Jury Trial Innovations on Juror Comprehension of Contested mtDNA Evidence

FINAL TECHNICAL REPORT

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We recruited several cast members for two separate tapings of the mock jury trial. The first shoot took place in Tempe, Arizona, at the Arizona State University College of Law. A second taping, made necessary by major changes in the mtDNA presentation in the case, occurred in Williamsburg, Arizona, at the College of William & Mary Law School. The Tempe cast included Leonard Ruiz, Deputy County Attorney; Susan Corey, Deputy Public Defender; Chad Pajerski, Deputy Public Defender; James Humphrey, Phoenix Police Department (Ret.); Katherine Dann, student, George Washington University; and Elliot Goldstein, Professor of Biology, Arizona State University. The videographer in Arizona was Manny Garcia of Manny Garcia Productions, Inc., in Phoenix. Attorney Mara Siegel consulted regarding the script.

The second mock trial was shot in Williamsburg, in Courtroom 21, at the Law School of the College of William & Mary. This version, the one used in the research project, included in the cast James Metcalf, Assistant U.S. Attorney, Norfolk, Virginia; Robert Moody, private attorney, Newport News, Virginia; Katherine Dann, student; John Shay, Williamsburg, Virginia; Micha Pigott, student at College of William & Mary, and Lizabeth Allison, Professor of Biology, College of William & Mary. Ray Foster and Wes Poole of the National Center for State Courts in Williamsburg supplied expert video and sound production and film editing.

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Abstract

Over the last decade, jury reform commissions, judges, and jury scholars have advocated the adoption of a variety of innovative trial procedures to assist jurors in complex trials. These include reforms as prosaic as juror notetaking through more controversial changes such as allowing jurors to ask questions of witnesses or permitting them to discuss the case together during the trial. Although reform groups have endorsed many of these innovations, there is only modest evidence about their impact in the courtroom. Research on the effects of the reforms on juror comprehension of complex scientific and statistical evidence is especially limited.

To study the effects of these trial innovations on jurors, NIJ Visiting Fellow and former Arizona trial judge B. Michael Dann, Professor Valerie P. Hans, professor of Sociology and Criminal Justice at the University of Delaware, and law professor David Kaye, Arizona State College of Law, partnered on this research project. The study, funded by the National Institute of Justice, examined the use of several jury reform techniques using a controlled mock jury approach. Mock juries composed of jury pool members watched a videotaped armed robbery trial, which featured conflicting expert testimony about mitochondrial DNA (mtDNA). Some mock juries simply watched the videotape and deliberated to a verdict. Others were permitted to take notes, ask questions about the scientific evidence, use a checklist, or refer to jury notebooks containing materials about the mtDNA in the case. A total of 60 mock trials were run, 10 for control purposes and 10 in each of the five experimental conditions.

Jurors reported that all four of the innovations enhanced comprehension and recall of the mtDNA evidence. A solid majority of jurors gave correct responses on most of the basic mtDNA knowledge questions. Use of juror notebooks, which included copies of the experts' PowerPoint slides and a glossary of mtDNA terms, terms, increased juror understanding of the mtDNA evidence.

The study provides a unique window into how laypersons understand and assess mitochondrial DNA evidence in court trials.

Chapter 1 – Introduction to the Research Project

American jurors generally receive high marks for their abilities to understand evidence and decide cases dealing with relatively familiar subjects and issues. However, many critics and some students of the jury question jurors' capacities to grasp, understand, remember, and properly weigh more complex evidence about more arcane subjects. Like many of us, jurors are said to have special difficulties understanding many forms of scientific and technical evidence. Statistical presentations are especially challenging to lay jurors.

Coincident with the increased use of DNA evidence in criminal trials, experts in jury decision-making have attempted to determine how well jurors understand DNA evidence. The statistical presentations that customarily accompany the experts' identification of a match between known and questioned samples have received particular attention. The results of the past decade's studies have not been encouraging.

While recognizing that jurors do not have to master the subjects of human genetics, microbiology and statistics, there is agreement that the jury needs to understand DNA testimony well enough to give the experts' testimony about the laboratory results their proper weight. Several experiments have been conducted in the past few years assessing mock jurors' understanding of the probabilistic evidence used to convey the meaning of DNA matches. Most of the participants involved in the previous studies were confused by and *undervalued* statistical representations of the significance of a match, whether expressed in terms of a frequency of occurrence of a given DNA profile (e.g., 1 out of 1,000,000) or as a probability that a randomly selected person from the same racial group would have the same DNA profile (0.0001%). In other studies, participants attributed too much weight to the probabilistic testimony. The value of forensic DNA testing is too important to our criminal justice system's twin searches for truth and justice to leave to the vagaries of jury confusion.

The jury trial reform movement that commenced during the same period offers the hope and potential of improving juror understanding of complex evidence. Starting in the mid-1990s, several states and many individual state and federal trial judges adopted or began to experiment with a number of important changes in the traditional trial format. The principal purpose of the reforms is to provide jurors with the tools needed to maximize their chances of understanding today's cases and trials. Many traditional trial procedures became the norm over 100 years ago, when civil disputes and criminal cases were much simpler.

Proponents of the innovations—e.g., juror note taking, allowing jurors to submit questions to the judge to put to witnesses and use of multi-purpose juror notebooks—have touted the potential of the reforms to enhance juror comprehension at trials. However, an impediment to wider adoption and use of these and other jury teaching and learning tools has been the relative lack of empirical research demonstrating the effects of the reforms on juror understanding of complex evidence. The present research project is intended to respond to that need.

This project constitutes the first known research to marry the need for scientifically reliable data regarding the effects of jury trial reforms to the ongoing search for ways to improve juror understanding of DNA evidence. Three of the four jury trial procedures chosen for experimentation were selected for their popularity among those considering new ways to help jurors and because of their relatively easy adaptation for courtroom use. They are: providing jurors the opportunity to take notes and the materials to do so; permitting jurors to put written questions to the judge intended for the expert witnesses; and providing each juror with a multi-purpose notebook which includes background materials on the DNA issues. The fourth, giving jurors checklists that list the principal questions about the DNA in the case, but leaving the answers to the jurors, has not been widely used. This innovation was included because of its potential to assist jurors in coping with complex scientific evidence.

All of the published jury-DNA research has dealt with evidence derived from nuclear DNA (nDNA). The methods of analyzing nDNA are well established and typically provide extremely powerful evidence of identity. This is the first study of forensic evidence involving mitochondrial DNA, or mtDNA. The mitochondria are found in every cell, but outside the nucleus where nDNA is found. MtDNA is maternally inherited; the father's DNA is not involved. When sufficient quantities of nDNA are not available for testing, mtDNA frequently can be used to help prove guilt or innocence. However, finding a match with mtDNA is rarely as compelling an indication of identity as is a match with nDNA.

The work reported here continues down the path laid by other researchers testing juror understanding of DNA presentations. For the first time, however, this project utilizes interventions based on procedural reforms of the traditional jury trial, and it tests decision-makers' comprehension of a type of DNA analysis that has not been considered in previous studies.

Chapter 2 – Literature Review

Concerns About Juror Understanding of DNA Presentations

The groundbreaking systematic jury research by Kalven and Zeisel, which resulted in the influential publication, The American Jury,¹ led to forty years of jury studies by social scientists who explored jury competence and decision-making.²

There is general agreement that criminal and civil jurors take their responsibilities seriously and work hard to come up with the “right” decision. Jurors also receive high marks for comprehension of evidence and law dealing with familiar events and occurrences. However, there is widespread concern among critics and some students of the jury that jurors frequently experience cognitive “static” when confronted by complexity.³ Many argue that jurors often fail to understand and properly evaluate statistical presentations in particular.⁴ Some, but not all, question whether jurors are capable of rationally deciding such cases.⁵

Coinciding with the increased use of forensic DNA in trials, the use of statistics and probabilities as trial evidence came under increased scrutiny. When experts present DNA evidence in the courtroom, it is common for them to present statistical information about the likelihood that DNA from a randomly selected person from the population would match the DNA profile in the sample. This information is referred to as a Random Match Probability, or RMP. Early on, two schools of thought emerged concerning fact-finders’ abilities to understand and evaluate statistics such as a Random Match Probability, neither of which was encouraging to the proponents.⁶ First, there were those who argued that jurors and judges, untrained in mathematical techniques, would likely be overwhelmed by the apparent certainty of statistical representations.⁷ An alternative view, discomfiting in another way, held that information processors are more comfortable with available qualitative information than with statistics and

¹ Harry Kalven, Jr. & Hans Zeisel, THE AMERICAN JURY (1966).

² Valerie P. Hans & Neil Vidmar, The American Jury at Twenty-Five Years, 16 *Law & Soc. Inquiry* 323 (1991).

³ See, for example, just some of the reports and commentaries of the past decade or so: Jeffrey Abramson, WE THE JURY: THE JURY SYSTEM AND THE IDEAL OF DEMOCRACY (1994); Stephen J. Adler, THE JURY: TRIAL AND ERROR IN THE AMERICAN COURTROOM 235-36 (1994); JURY COMPREHENSION IN COMPLEX CASES, 1989 A.B.A. Litig. Sec. Rep. [hereinafter “ABA Report on Jury Comprehension”]; Jane Goodman, Edith Greene & Elizabeth Loftus, What Confuses Jurors in Complex Cases, *Trial*, Nov. 1985, pp. 65-74; Phoebe C. Ellsworth & Alan Reifman, Juror Comprehension and Public Policy: Perceived Problems and Proposed Solutions, 6 *Psychol. Pub. Pol’y. & L.* 788 (2000) (discussing a quarter-century of research); Developments in the Law: The Civil Jury, 110 *Harv. L. Rev.* 1408, 1489-93 (1997).

⁴E.g., Brian C. Smith, Steven D. Penrod, Amy L Otto & Roger C. Park, Jurors’ Use of Probabilistic Evidence, 20 *L. & Hum. Beh.* 49 (1996); William C. Thompson, Are Juries Competent to Evaluate Statistical Evidence?, 52 *L. & Contemp. Probs.* 9 (1989).

⁵ E.g., John P. Cronan, Is Any of This Making Any Sense? Reflecting on Guilty Pleas to Aid Criminal Juror Comprehension, 39 *Amer. Crim. L. Rev.* 1187 (2002); Jeffrey W. Stempel, A More Complete Look at Complexity, 40 *Ariz. L. Rev.* 781 (1998); Richard O. Lempert, Civil Juries and Complex Cases: Taking Stock After Twelve Years, in VERDICT: ASSESSING THE CIVIL JURY SYSTEM 181 (Litan ed. Brookings Institution 1993).

⁶ David L. Faigman & A.J. Baglioni, Jr., Bayes’ Theorem In the Trial Process: Instructing Jurors on the Value of Statistical Evidence, 12 *L. & H. Beh.* 1, 2-3 (1988).

⁷ E.G., Lawrence H. Tribe, Trial by Mathematics: Precision and Ritual in the Legal Process, 84 *Harv. L. Rev.* 1328, (1971).

that “[t]he more realistic problem is presenting statistical evidence so that people will incorporate it into their decisions *at all*.”⁸ In a 1991 discussion of the then available major studies on juror comprehension of mathematical testimony, Kaye and Koehler observed that, “Given these views, it is important to know whether jurors can be trusted to evaluate properly ‘probability evidence’, and what decision aids might assist them in this task.”⁹

During the ensuing decade a number of scholars sought to answer these questions in the context of statistical representations of the significance of DNA findings of matching profiles. Six of the principal studies are represented in Table 2.1.

Table 2.1: Previous Work on Juror Comprehension of DNA Evidence

Investigators (Date)	DNA Match Evidence	Decision Aids	Jury Valuation of Results
Goodman (1992)	RMP* of 1:100,000	Illustrative Graphics	Undervalued
Koehler, et al. (1993)	RMP of 1:1 billion	None	Over weighted
Scklar & Diamond (1999)	RMP of 1:1 billion	Jury Instruction on Use of Statistics	Undervalued
Koehler (2001)	RMP of 1:2 million	None (Variety of RMP Presentation Methods)	Various
Nance & Morris (2002)	Frequency** of 4%	Jury Instruction on Use of Statistics	Undervalued
Lindsey, et al. (2003)	RMP of 0.0001%; true positive prob of 1; false positive prob of 0.001%	Expected Numbers of True and False Positives	Prob that D is the source is correct more often using numbers than probabilities

*Note. “RMP” stands for “random match probability.” That is, the chance that a randomly selected person in the relevant population will have a DNA profile that matches those found in the samples at hand.

**Note. “Frequency” is the number of persons in the relevant population one would expect to have the same DNA profile.

Of the six studies listed in Table 2.1, five found that mock jurors tended to discount the significance of DNA match statistics due to confusion regarding the statistics used by the expert witnesses.¹⁰ Of the five, the methodologies and results of the experiments in two deserve further mention for illustrative purposes.

⁸ Michael J. Saks, & Robert F. Kidd, Human Information Processing and Adjudication: Trial by Heuristics, 15 L. & Soc’y Rev. 123, 149 (1981)(emphasis added).

⁹ David H. Kaye & Jonathan J. Koehler, Can Jurors Understand Probabilistic Evidence?, 154 J. Royal Statist. Soc’y. Ann. (1991).

¹⁰ Jane Goodman, Jurors’ Comprehension and Assessment of Probabilistic Evidence, 16 Am. J. Tr. Advoc’y 361 (1992). Jonathan J. Koehler, Error and Exaggeration in the Presentation of DNA Evidence at Trial, 34 Jurimetrics J. 21 (1993). Jason Schklar & Shari Seidman Diamond, Juror Reactions to DNA Evidence: Errors and Expectancies, 23 L. & Hum. Beh. 159 (1999). Jonathan J. Koehler, When Are People Persuaded By DNA Match Statistics?, 25 L. & Hum Beh. 493 (2001). 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 1 (2002).

The 1999 report by Schklar and Diamond was based on mock jury trials involving 219 undergraduate psychology students. The students were randomly assigned to groups ranging in size from 7 to 15 people. They read a one-page scenario about an alleged sexual assault featuring evidence of a DNA match from semen and otherwise weak circumstantial evidence. Some juries were given a random match probability ratio of 1 to 1 billion together with an expected lab error (LE) rate of 2 in 100. The probabilities were reversed for other juries, i.e., a RMP of 2 to 100 and a LE rate of 1 in a billion. Some groups were instructed by an expert witness how to combine the RMP and LE estimates; some juries did without such aid. Among other things, the investigators found “systematic errors” in combining the two probability estimates, even when jurors were given a simple combination instruction.¹¹ The mock jurors were confused by and assigned the probability estimates too little weight compared to the norm. They persisted in misperceiving how the estimates should be combined whether or not they received the simple combination instruction.

Another study, by Lindsey et al., published in 2003, used 127 German law students and 27 professional judges in a series of mock trials to determine which presentation format of the same mathematical expression of 1 in 1 million—a random match probability of 0.0001% or a frequency of 1 out of 1 million—produced more accurate assessments by jurors. The trials involved charges of forcible rape. Unfortunately, the researchers varied not only the manner of the statistical expression, but they asked the jurors to combine two additional probabilities – the conditional probability of a true positive (said to be “practically certain”) and the conditional probability of a false positive (said to be 0.001%) to arrive at the probability that the defendant was the source of the DNA. Subjects in the “probability” condition were given percentages only. Those in the “frequency” condition were not only given the frequencies, but they also were told the number of true positives and number of false positives that would occur if the entire male population of Germany had been tested.

Questions were administered to measure the respondents’ understanding of the significance of the match in light of both the RMP and the risk of laboratory error. The investigators reported “far more correct answers in the frequency format than in the probability format.”¹² Among the law students, fewer than one percent gave correct answers following testimony using the random match probability and the conditional error probabilities. On the other hand, the students who were given the expected numbers of true and false positives answered correctly over 43% of the time. Of the judges responding, only 12.5% who read the RMP of 0.0001% and the figures for the conditional probabilities gave correct answers; those who received the expected numbers of true and false positives answered correctly at the rate of 68%.

Samuel Lindsey, Ralph Hertwig & Gerd Gigerenzer, *Communicating Statistical DNA Evidence*, 43 *Jurimetrics* 147 (2003).

¹¹ Schklar & Diamond, *supra* note 10, at 178.

¹² Lindsey, *et al.*, *supra* note 10, at 159.

The six studies listed in Table 2.1 shared some important limitations (frequently acknowledged by the investigators), almost all of which were considered in designing the current project. They include:

- (1) All of the studies except one used college students (Lindsey et al. included professional judges and law students) as mock jurors. Because the use of subjects with greater formal education than the typical jury could affect the level of juror comprehension of complex evidence, the present investigators chose to use randomly selected volunteers from an urban court's jury assembly room.
- (2) None of the jury trial innovations commonly being adopted or considered was utilized in any of the studies. Three of the four innovations subjected to study here—note taking, juror questions and juror notebooks—are among the mainstream of procedures being used or considered. The fourth innovation tested—the juror checklist, or “decision tree,” tailored to the DNA evidence—while not mainstream, can probably be used under current law as within the discretion of the trial judge.
- (3) All of the mock jurors in the seven previous studies read the facts and law of their “cases” from written summaries. The current experiment approached the realism of a live trial, with live witnesses, cross-examination, and oral instructions from the presiding judge. All of the subjects viewed the same videotaped mock trial.
- (4) Similar to real-life jurors in actual trials, the mock jurors in this project heard explanations of the science, procedures and statistics associated with the DNA match, and saw both experts' illustrative and explanatory slides, where most, if not all, of the mock jurors in the earlier studies were unable to benefit from such explanations.
- (5) Every mock juror in the present study, unlike all the mock jurors in the earlier studies, participated in jury deliberations and debated with fellow jurors to reach a unanimous verdict (except for the hung juries), lending further verisimilitude to the experience, since actual jurors' knowledge and understanding of the evidence is shaped in part by the give-and-take of jury deliberations.
- (6) Although not altogether clear from the previous studies, there is reason to question how many mock trials for each of the conditions—control and experimental—were conducted. Enough repetitions must occur to create a strong inference of reliability of the results obtained. For that reason, among others, 10 mock trials in each of the 6 conditions (a total of 60 trials) involving juries of uniform size (8 jurors each) were conducted here. A total of 480 jurors heard, saw, deliberated on and decided the same case.
- (7) Nuclear DNA technology, which led to the type of DNA evidence involved in the listed studies, has received such widespread use and publicity that it has become part of common lore and has gained widespread acknowledgment, if not

acceptance. For the first time, the mitochondrial DNA molecule was chosen for the trial in this project. MtDNA involves the same kind of mathematical presentations concerning the significance of a match. (The probabilities of random matches of mtDNA tend to be larger than the RMP's for nDNA.)¹³

Courts and commentators have identified other common mistakes that both lay people and many professionals make in reasoning about the probabilities used to describe the significance of a DNA match. Chief among them is one called the “fallacy of the transposed conditional” by statisticians and the “prosecutor’s fallacy” in legal circles.¹⁴ Assuming a case in which the expert testifies that the random match probability (RMP) is 1% (meaning that there is only a 1% chance that the DNA from a randomly selected person from the relevant general population would match the DNA profile in the crime-scene sample). The fallacy consists of concluding that because there only a 1% chance that an innocent person would match, the chance that the defendant is innocent also is 1%, and hence, there is a 99% chance that the defendant is guilty. This transposes the conditional probability that a person would match given that he is innocent into the conditional probability that the defendant is innocent given that he matches. This transposition is comparable to asserting that if the probability of a person speaking Arabic given that he is a follower of Osama Bin Laden is 99%, then the probability of a person being a follower of Osama Bin Laden given that he speaks Arabic also is 99%. Used in this way to prove defendant’s guilt, these transpositions exemplify the “prosecutor’s fallacy.”

Research has shown that the occurrence of the “prosecutor’s fallacy” is relatively rare compared to the frequency of another common misperception called the “defense attorney’s fallacy.”¹⁵ That occurs where, assuming the same RMP of 1%, the jury hears or concludes that since only 1% of the relevant population could have contributed the sample and that that number is, say, 100 people, then “the odds that the defendant supplied the DNA sample are only 1 in 100” and, therefore, that the evidence has virtually no value in linking the defendant to the crime.

Both inferences misconstrue the statistical probability commonly used in DNA-evidence presentations at trials.¹⁶ To measure the receptivity of our participants’ to the two fallacies under different circumstances, we had the prosecution expert and the prosecutor refrain from suggesting the “prosecutor’s fallacy” to the jury to see how many would, on their own, come to that mistaken conclusion. On the other hand, defense counsel explicitly argued the “defense fallacy” in asking for an acquittal.

¹³ A discussion of the actual case upon which this project’s mock trial was based upon is found at Note, Mitochondrial DNA Evidence in *State v. Pappas*, 43 *Jurimetrics* 427 (2003).

¹⁴ David H. Kaye & George F. Sensabaugh, Jr., Reference Guide on DNA Evidence, at 539 and 574, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 2d ed., 485 (Federal Judicial Center 2002.)

¹⁵ National Research Council Report: An Update, The Evaluation of Forensic DNA Evidence 198 (Committee on DNA Forensic Science 1996).

¹⁶ Kaye & Sensabaugh, *supra* note 15, at 538-39; National Research Council Report, *supra* note 16, at 198; and Norman Fenton & Martin Neil, The “Jury Observation Fallacy” and the Use of Bayesian Networks to Present Probabilistic Legal Arguments, *Mathematics Today* 180, 181 (December 2000).

The Recent Jury Trial Reform Movement: Tools that Enable Jurors to Better Understand and Evaluate Complex Science and Statistics?

The right to a jury trial in serious criminal and most civil cases is guaranteed to all Americans in federal and state constitutions. The institution of trial by jury continues to be viewed as almost sacred. The ideal of the jury trial has become a political, legal and social fixture in the public's consciousness. However, jury trial procedures have remained remarkably static over time notwithstanding significant changes in society, education, communications and the cases that juries are required to hear and decide.

Near the end of the twentieth century concerns arose over how juries functioned in fact. Most of the disquiet centered on issues of jury representativeness, jury competence, and conditions of service. Increased discomfort was fueled by recurring studies questioning jury competence in deciding cases of ever-increasing complexity. Critiques of the traditional trial format and public debate over jury verdicts in several high-profile criminal and civil cases have occurred as well. In response, jury reform efforts were undertaken in two states, New York and Arizona, in the 1990's. New York's initial efforts focused on jury representativeness and conditions of service; Arizona's on the trial itself. The successes in these two states sparked similar reform efforts in over half the states and in numerous individual state and federal courtrooms across the country.¹⁷

These and many other reform ideas, both from the pretrial and jury trial stages, are collected and discussed at length elsewhere.¹⁸ For present purposes, it is enough to list the principal suggested changes to the traditional trial format:

- (1) Mini-opening statements by attorneys to the entire jury panel, or array
- (2) Pretrial limits on parties' time at trial
- (3) Pre-instructions to jurors on the applicable law
- (4) Juror note taking
- (5) Individual juror notebooks
- (6) Juror questions for witnesses
- (7) Juror discussions of the evidence during trial
- (8) Plain English at trials and in instructions
- (9) Final instructions of law that are shorter, clearer and better organized
- (10) Final jury instructions prior to closing arguments
- (11) Suggestions for jurors regarding deliberations
- (12) Written copies of jury instructions for each juror
- (13) "Reclosing": A dialogue with juries at impasse in deliberations

¹⁷ G. Thomas Munsterman, *A Brief History of State Jury Reform Efforts*, 79 *Judicature* 216 (1996); Phoebe C. Ellsworth, *Jury Reform at the End of the Century: Real Agreement, Real Changes*, 32 *U. Mich. J. L. Reform* 213 (1999).

¹⁸ *JURY TRIAL INNOVATIONS* (G. Thomas Munsterman, Paula L. Hannaford & G. Marc Whitehead, eds.) National Center for State Courts 1997)[hereinafter "JURY TRIAL INNOVATIONS"]; *ENHANCING THE JURY SYSTEM: A GUIDEBOOK FOR JURY REFORM* (American Judicature Society 1999).

The primary purposes and goals of these reforms are to increase jurors' satisfaction with the trial generally and jurors' comprehension of the evidence and the law in particular.¹⁹ They break with the traditional legal model of enforced jury passivity in favor of encouraging those forms of juror activity that better facilitate learning and are consistent with the parties' rights to a fair trial.

To better understand this new paradigm and the theories and contentions of the reforms' proponents, it would be helpful to compare and contrast the older and newer "models" of the juror.²⁰ The traditional legal model of the juror (outlined in Table 2.2) manifests itself in long-standing jury trial rules, procedures and practices, yet is based in large part on outmoded or questionable assumptions about behavior.

Table 2.2: The Former "Legal Model" of the Juror and Resulting Practices

<u>Assumptions</u>	<u>Reinforcing Rules & Practices</u>
1. Passive, mere observer	No interaction with each other until deliberations or with trial "principals" except through verdict
2. Empty vessel to be filled	Pre-existing knowledge or belief usually disqualifying
3. Object of one-way, linear communication	No feedback or responses permitted before verdict
4. Complete and accurate recorder of information	No memory aids provided
5. Trial proceedings require and receive undivided attention	Note taking and written decision aids distracting
6. Necessarily considers all evidence	Limited rules of judicial review; harmless error rules
7. Withholds decision-making until end	Repeated reminders to do so; legal instructions at end
8. "Recency" principle dominates	Legal instructions occur at end of trial

Students of juries and jury trials report that the results of these assumptions and practices are juror confusion, loss of interest, distraction, boredom and impaired learning opportunities.²¹ Given the absence of juror feedback until the jury speaks through its verdict, court and counsel remain unaware, until it may be too late, whether jurors are confused, whether they need additional information about the evidence or the law, and whether they are even pursuing the appropriate issues.

¹⁹ Vicki L. Smith, How Jurors Make Decisions: The Value of Trial Innovations, in JURY TRIAL INNOVATIONS, *supra* note 19, at 15; Robert D. Myers, Ronald S. Reinstein & Gordon M. Griller, Complex Scientific Evidence and the Jury, 83 *Judicature* 150 (1999); B. Michael Dann, "Learning Lessons" and "Speaking Rights": Creating Educated and Democratic Juries, 68 *Ind. L.J.* 1229, 1249-53 (1993)[hereinafter "Dann"].

²⁰ The two "models" are fully discussed in Dann, *supra* note 20, at 1238-47.

²¹ See, e.g., CHARTING A FUTURE FOR THE CIVIL JURY SYSTEM: REPORT FROM AN ABA/BROOKINGS SYMPOSIUM SYMPOSIUM 16 (1992); ABA REPORT ON JURY COMPREHENSION, *supra* note 3, at 4 and 24-57; Saul M. Kassin & Lawrence S. Wrightsman, THE AMERICAN JURY ON TRIAL: PSYCHOLOGICAL PERSPECTIVES at 5 and 131 (1988); Molly Selvin & Larry Picus, THE DEBATE OVER JURY PERFORMANCE 45-46 (Rand Institute for Civil Justice 1987).

The traditional assumptions that jurors must and do remain cognitively passive in order to assure their objectivity and a fair trial lack empirical validation. Indeed, a leading authority on evidence law made this telling observation about the disconnect between legal theories and scientific validation: “In science a theory possesses a recognized provisional and tool-like character. If the empirical data collected do not support the theory, the theory is discarded. Since the law never collects any empirical data, it is spared the embarrassment of having ever to discard a theory on that basis.”²²

The traditional legal assumptions and beliefs about jurors are contradicted by current data and accepted psychological and educational theories. For example, while it has been long assumed that jurors simply store information as it is received at trial, remaining free from judgments until deliberations, behaviorists agree that jurors actively process information from the outset and are prone to molding the evidence into a plausible “story” based on their prior life experiences.²³ Permitting more active participation in the trial process, experts say, will lead to more effective learning experiences, greater attention to and satisfaction with proceedings and less confusion about the evidence and law.²⁴

For educators, the positive correlation between classroom interaction and effective learning has been an accepted truth for some time.²⁵ Among other things, appropriate forms of interaction evoke questions, elicit and provide information, focus attention, motivate, aid recall, allow listeners to benefit from the views of others and give instructors direction.²⁶

A different paradigm of the modern juror has emerged and strongly suggests changes to the traditional rules, procedures and customs followed at jury trials. The “behavioral/educational” model of the jury and recommended reforms are summarized in Table 2.3.

²² Edward W. Cleary, *Evidence as a Problem in Communicating*, 5 Vand. L. Rev. 277, 278 (1952).

²³ E.g., Valerie P. Hans & Neil Vidmar, *JUDGING THE JURY* 120-24 (1986); Irwin A. Horowitz & Thomas E. Willging, *THE PSYCHOLOGY OF LAW: INTEGRATIONS AND APPLICATIONS* 209-10 (1984); Reid Hastie, Steven D. Penrod & Nancy Pennington, *INSIDE THE JURY* 22-23 (1983); and Valerie P. Hans, *U.S. Jury Reform: The Active Jury and the Adversarial Ideal*, 21 St. Louis L. Rev. 85 (2002).

²⁴ E.g., Hans & Vidmar, *supra* note 26; ABA REPORT ON JURY COMPREHENSION, *supra* note 3; and Arthur D. Austin, *COMPLEX LITIGATION CONFRONTS THE JURY SYSTEM* 102 (1984).

²⁵ See Sara Delamont, *INTERACTION IN THE CLASSROOM* 17 (John Eggleston ed., 2d ed. 1983); Philip Gammage, *TEACHER AND PUPIL: SOME SOCIO-PSYCHOLOGICAL ASPECTS* 32-34 (1971); Judith W. Landfors, *CHILDREN’S LANGUAGE AND LEARNING* 286-91 (1980).

²⁶ Hugh Mehan *LEARNING LESSONS: SOCIAL ORGANIZATION IN THE CLASSROOM* 79-80 (1979).

Table 2.3: The Modern “Behavioral/Educational” Model of the Juror and Recommended Practices

Understandings	Reinforcing Rules & Practices
1. Active, mature participant in learning process; capable of multi-tasking	Needy and responsible user of learning tools and decision aids
2. Possesses pre-existing frames of reference; actively processes information	Acknowledge and focus attention with mini-openings to entire panel; early instructions on the law
3. Interactive instruction benefits learner	Allow appropriate means for feedback during trials, e.g., juror questions
4. Selective and imperfect recall	Note taking; questions by jurors; copies of instructions; juror notebooks
5. Judgment formation during evidence presentation	Pre-instruct on issues and law; copies of instructions during trial; juror notebooks
6. Conditioned to fast-paced factual presentations in small packets of information	Enforce time limits; encourage crisp testimony and arguments
7. “Instructors” should heed and respond to feedback from “students”	Provide answers to relevant juror questions and offer help when deliberations reach impasse
8. Group interaction may improve recall and comprehension	Permitting juror discussions of evidence during trial

For many of the proponents of the new paradigm and procedural reforms that afford jurors more of an opportunity to participate actively in and accept corresponding responsibility for the learning process at trial, the issue is also one of *trust*. “One inference drawn from these restrictions (which render the jury totally passive) is that the jury may be entrusted with the responsibility to decide important matters, but not how to define the parameters of the decision making process itself.”²⁷

The Innovations: Available Evaluative Research

Prior to the advent of the ongoing jury reform movement, only a modest amount of study and experimentation was undertaken and published regarding two of the innovations chosen for testing in the current project: juror note taking and allowing juror questions of witnesses. There is considerably less published work exploring the effects of using juror notebooks containing background material on the case. Virtually no evaluative research is available regarding jurors’ use of a checklist, or “decision tree” intended to guide them through the issues presented by complex scientific evidence. (One of the more controversial of the reforms—jury discussions of the evidence during trials—was not chosen for use in the current experimental work for the reasons discussed later in this report. However, the innovation has attracted the attention of jury scholars.²⁸)

²⁷ Steven J. Friedland, *The Competency and Responsibility of Jurors in Deciding Cases*, 85 Nw. U. L. Rev. 190, 208 (1990).

²⁸ Shari Seidman Diamond & Neil Vidmar, *Jurors Discussions During Civil Trials: A Study of Arizona’s Rule 39(f) Innovation* (State Justice Institute/National Science Foundation 2002); Paula L. Hannaford, Valerie P. Hans & G. Thomas Munsterman, *Permitting Jury Discussions During Trial: Impact of the Arizona Reform*, 24 L. & Hum. Beh.

Juror Note Taking

Juror note taking is now practiced in a majority of the nation's courtrooms. In some states, judges are required to inform jurors that those desiring to take notes may do so and the court must furnish jurors with the necessary materials.²⁹ Trial judges in most other state and federal courtrooms may permit juror note taking, or not, in the judge's discretion. Most do, but many still do not. The typical procedure for note taking is described in the encyclopedic Jury Trial Innovations, published by the National Center for State Courts in 1997.³⁰

"The judge instructs the jury about court policy about whether jurors may retain their notes when court is in recess and...about the purpose of juror note taking. Such instructions can include the following:

- Juror note taking is permitted, but not required;
- Note taking should not distract the jury's attention from the trial proceedings;
- Jurors' notes are confidential;
- Notes are for the private use of jurors and will not become an official document or part of the trial record;
- Jurors should use their notes to refresh their memory of evidence presented at trial but notes should not be relied upon as definitive fact;
- Notes have no greater weight than memory;
- In deliberation, note-aided and nonaided memory are of equal significance; and
- Jurors should not be influenced by another juror's notes."

The arguments for and against allowing and facilitating juror note taking are also listed in Jury Trial Innovations.³¹ The advantages cited are:

- Note taking assists recall of evidence,
- Note taking keeps jurors more engaged;
- Note taking increases juror confidence and satisfaction.

The potential disadvantages to note taking are:

- Note taking may distract jurors;
- Jurors might give too much weight to other jurors' notes;
- Active note takers might dominate deliberations.

The published evaluative work on juror note taking has produced mixed results. On the one hand, psychologists predict that note taking will help jurors' cognitive functioning,³² and

359 (2000); Valerie P. Hans, Paula L. Hannaford & G. Thomas Munsterman, The Arizona Reform Permitting Civil Jury Trial Discussions: The Views of Trial Participants, Judges and Jurors, 34 U. Mich. J. L. Ref. 302 (1999).

²⁹ See, e.g., Arizona Rules of Criminal Procedure, Rule 18.6(d); Arizona Rule of Civil Procedure, Rule 39(p).

³⁰ JURY TRIAL INNOVATIONS, supra note 19, at 141-43.

³¹ Id., at 142.

³² ABA STUDY OF JURY COMPREHENSION, supra note 3, at 34-37; Kassin & Wrightsman, supra note 22, at 436-39.

some studies bear them out. For example, Flango³³ found from jurors' self-reports in four trials that being able to keep notes assisted jurors' recall of the evidence and increased satisfaction with the trial. In a subsequent and somewhat larger study (32 trials), Sand and Reiss cited jurors' reports that notes served as a memory aid and allowed them to mark testimony for later consideration or clarification.³⁴

On the other hand, the empirical work involving both actual and mock jurors has not always demonstrated that the predicted benefits occur. The work undertaken by Heuer and Penrod is the most-often cited on the subject. In 1988, they published a study of 67 jury trials from a single state, half of which permitted jurors to take notes, the other half not.³⁵ The investigators found "clear general indications" that the note taking experience for the two-thirds of jurors who decided to take notes was not a useful memory aid. Juror note taking did not result in increased participation in deliberations, improved recall or application of the judges' legal instructions, or jurors' confidence in their verdicts.³⁶ There was only a marginal increase in general satisfaction with the trial on the parts of note takers. Significantly, the data showed that the purported disadvantages of note taking advanced by opponents of the innovation did not materialize. That is, the data revealed that note taking was not a distraction, that the notes were not inaccurate, did not favor one side over the other, did not give note takers an unfair advantage over non-note takers during deliberations and did not extend deliberations.³⁷

Six years later, the same investigators reported on a study of note taking and allowing jurors question of witnesses, this time in 160 civil and criminal trials conducted in 33 states.³⁸ Relying again on self-reporting by jurors, Heuer and Penrod found "no significant differences" between note takers and non-note takers with respect to recall of evidence or satisfaction with the trials or verdicts, even though 87% of jurors in the note taking conditions opted to take notes.³⁹ Similar to their findings from 1988, they concluded that the data did not support the arguments against note taking by jurors: the notes were accurate, they were not accorded undue weight, note takers kept up with the trial, note taking did not distract jurors, those who took notes did not wield undue influence in deliberations, the notes did not favor one party or the other and the procedure did not consume too much time.⁴⁰ Heuer and Penrod have qualified the significance of some of their findings by noting that their data resulted from field studies where each jury heard a different case and where they relied on jurors' self-reporting.⁴¹

More recent studies, using mock jury trials, including control groups and replications, have led to different findings. For example, Rosenhan, Eisner and Robinson staged a series of

³³ Victor E. Flango, Would Jurors Do a Better Job if They Could Take Notes?, 63 *Judicature* 436 (1980).

³⁴ Leonard B. Sand & Steven A. Reiss, A Report on Seven Experiments Conducted by District Court Judges in the Second Circuit, 60 *N.Y.U.L. Rev.* 423, 442-46 (1985).

³⁵ Larry Heuer & Steven Penrod, Increasing Jurors' Participation in Trials: A field Experiment with Jury Notetaking and Question Asking, 12 *L. & Hum. Beh.* 231 (1988).

³⁶ *Id.*, at 245-47.

³⁷ *Id.*, at 247-51.

³⁸ Larry Heuer & Steven Penrod, Juror Notetaking and Question Asking During Trials: A National Field Experiment, 18 *L. & Hum. Beh.* 121 (1994).

³⁹ *Id.*, at 136-37.

⁴⁰ *Id.*, at 137-40.

⁴¹ *Id.*, at 149.

mock jury trials involving 128 college students, where each jury saw and heard the same case.⁴² Utilizing objective recall measures, these investigators found “statistically significant, but not robust” support for a finding that note taking increased recall of trial information and enriched note takers’ subjective experiences. On recall measures, note takers did score higher on recall measures than non-note takers (modal score of 39 for note takers, only 10 for non-note takers.⁴³ Note takers also scored higher in attentiveness, involvement in the trial and ability to keep up with the proceedings.⁴⁴

In the most recent study, ForsterLee and Horowitz found that note taking in a series of mock trials of complex tort cases using jury-eligible adults improved jurors’ performances at “several levels,” including memory and understanding of the evidence and overall satisfaction with the trial process.⁴⁵ They report:

We found that note-taking juries were able to better organize and construct the evidence and, importantly, this in turn led to improved and more efficient (focused on the evidence) deliberations.... Note-taking juries believed they were more efficient, and they expressed greater satisfaction with the trial process as compared to their non note-taking jury counterparts. Lastly, note-taking juries were more likely to recognize case-related facts and reject ‘lures’ (statements that were not actually in the trial) than were non note-taking juries.⁴⁶

Jury reform commissions at the state level have conducted pilot programs testing various trial innovations, including note taking. Social scientists have been enlisted to evaluate and report on the results. For example, Ohio’s Jury Service Task Force conducted a field experiment involving 49 judges from 31 counties and 1,420 jurors from civil and criminal trials.⁴⁷ Ninety-eight percent (98%) of the pilot program judges who were surveyed about their experiences supported note taking. at the rate of 98%. The 289 attorneys polled agreed, adding there were no significant evidence that any of the purported negatives in fact materialized. A solid majority of the jurors found note taking helpful.

A similar project in Tennessee undertaken as part of that state’s jury reform effort surveyed judges and jurors from 45 trials.⁴⁸ All of the participating judges supported note taking by jurors. Eighty percent (80%) of jurors said their notes were helpful during jury deliberations. A 2001 summary of a year-long field experiment in Massachusetts, in which a number of innovations were tested in civil and criminal trials involving 1,590 participants,⁴⁹ reported a

⁴² David L. Rosenhan, Sara L. Eisner & Robert J. Robinson, Notetaking Can Aid Juror Recall, 18 L. & Hum. Beh. 53 (1994).

⁴³ Id., at 58.

⁴⁴ Id., at 59.

⁴⁵ Lynne ForsterLee & Irwin Horowitz, The Effects of Jury-Aid Innovations on Juror Performance in Complex Civil Trials, 86 Judicature 184 (2003).

⁴⁶ Id., at 188-89.

⁴⁷ James Frank & Tamara Madensen, Survey to Assess and Improve Jury Service in Ohio, Appendix B to Report and Recommendations of the Supreme Court of Ohio Task Force on Jury Service (2004).

⁴⁸ Neil P. Cohen & Daniel R. Cohen, Jury Reform in Tennessee, 34 Memphis L. Rev. 1 (2003).

⁴⁹ Paula L. Hannaford & G. Thomas Munsterman, Final Report for the Massachusetts Project on Innovative Jury Trial Practices (National Center for Citizen Participation in the Administration of Justice 2001).

“general consensus” among participating judges that jurors in all Massachusetts trials ought to be able to take notes. Almost all of the jurors (96%) responded that note taking was “somewhat to very helpful.”

The current work was undertaken against this background of these conflicting findings about the effects of juror note taking. We proposed that it be done under controlled conditions using randomly selected jury-eligible mock jurors, and that contested DNA evidence be used as the challenging material.

Juror Questions of Witnesses

The practice of permitting juror questions of witnesses (submitted to the judge in writing for screening) is growing. A 2004 decision of the Supreme Court of Vermont observed that the “vast majority” of states and all ten federal circuits that have considered the issue permit juror questions of witnesses in criminal cases at the discretion of the trial judge.⁵⁰ The practice usually follows that outlined by the Vermont trial judge:

“During this trial you may also seek to have questions of your own asked of any witness after the attorneys have finished asking questions of that witness. Please keep in mind however that the prime responsibility for presenting evidence rests with the attorneys; therefore, please exercise this opportunity sparingly and only if you believe that your question will not or cannot be answered by some other witness likely to be called.

“Your questions should only be about the facts, such as if you are confused or did not understand something a witness said and would like the matter clarified. Please do not state an opinion in your question or even write down the reason you are asking the question.

“It is important to keep in mind that you not let yourselves become aligned with either side in the case. Your questions should not be directed at helping or responding to either side. Rather, you must remain neutral and impartial and not assume the role of investigator or advocate.

“The process by which you may present questions for a witness will be as follows: Once the attorneys have completed their questioning of each witness, I will ask whether any juror has a question that you would like to ask that witness. If so, you will be asked to write that question down on a piece of paper and your pad, not to sign or identify yourself on the paper, then fold the paper and pass it to the court officer who will give it to me. I may decide that some of the questions you submit should not be asked or should only be asked in some modified form. Please do not be offended if this happens.

“Although I will not have a chance to explain to you, at the time, why I have not asked or have modified one of your questions, my decision not to ask a question will have nothing to do with the quality of the question. There are written rules of evidence which must be

⁵⁰ State v. Doleszny, 844 A.2d 773 (Vt. 2004).

followed and applied to all questions, whether from the attorneys or from you, and no one expects you to know those rules when proposing a question.

“I may decline to ask a question if it appears another witness will be testifying later and will deal with the matter raised by your question. There may be other reasons that questions are not asked. Although I will review each question proposed with both attorneys, the decision on whether to ask the question will be mine; therefore, please do not speculate on why a question was not asked or what the answer might have been. Do not count my decision to ask or not ask your question for or against the State or the defendant. And lastly, please do not give any more or less weight to a question as to the witness solely because it was asked by a juror.”⁵¹

The purported advantages and disadvantages of allowing juror questions are listed in Jury Trial Innovations:⁵²

The advantages cited include the following:

- Juror questions can enhance understanding and weighing of witness testimony;
- The procedure may engage the jury in proceedings and increase overall juror satisfaction; and
- Questions from the jury can alert the judge and attorneys to juror confusion or interest in additional information.

Disadvantages cited include the following:

- Jurors may use questions to become advocates of their views;
- Jurors may draw adverse inferences from the judge’s failure to allow some questions;
- Failure to ask a juror’s question may lead to offense, even anger; and
- The process will interrupt and prolong the trial.

The available empirical research on the effects of allowing juror questions is not as robust as that found on juror note taking. Generally speaking, jury professionals support the notion that the advantages of a carefully controlled process for allowing jurors to put questions to the court or to witnesses outweigh the feared risks, and that the procedure is an important device for permitting needed juror participation in the truth-seeking process.⁵³

Among the leading studies of allowing jurors to question witnesses are those of Heuer and Penrod.⁵⁴ In their 1988 field study of 77 trials in Wisconsin, they found that juror questions enhanced juror satisfaction with the trial process and their confidence that they had enough information to decide the case, and that the process created some useful feedback for the attorneys.⁵⁵ However, there is insufficient evidence to support the claims that the process will

⁵¹ 844 A2d. at ____.

⁵² JURY TRIAL INNOVATIONS, *supra* note 19, at 144-46.

⁵³ E.g., TOWARD MORE ACTIVE JURIES: TAKING NOTES AND ASKING QUESTIONS (American Judicature Society 1991); Kassin & Wrightsman, *supra* note 22, at 129-31; Sand & Reiss, *supra* note 35, at 443-44.

⁵⁴ Heuer & Penrod, *supra* notes 36 and 39.

⁵⁵ 12 L. & Hum. Beh. 231, 252.

uncover important evidence or lead to greater overall juror satisfaction with the trial.⁵⁶ Conversely, the data did not bear out the concerns that permitting juror questions would be unduly disruptive, would prolong the trial, would unfairly surprise the lawyers, burden the judge or staff or that jurors' questions would be "inappropriate."⁵⁷ The authors concluded that the innovation deserved "serious consideration" by policy-makers.⁵⁸

The subsequent and larger field study by Heuer and Penrod of 160 trials from 33 states, also compared self-reports from jurors in two groups—those told they could submit questions and those not so instructed.⁵⁹ Jurors who were told they could ask questions submitted one or more questions in 51 of the 71 trials. These jurors reported that the process was helpful in clarifying evidence and assisted in getting at the truth. They felt somewhat better informed as a result.⁶⁰ But, there was "little evidence" to support claims that the process alerted court or counsel regarding issues, that note takers were more satisfied with the trial or felt that their verdicts were fairer than those rendered by non-note takers.⁶¹ Significantly, and like their earlier work on juror questions, Heuer and Penrod concluded that the evidence did not support the fears advanced by opponents of juror questions. To the contrary, they concluded that jurors' questions were appropriate, that attorneys felt free to object to jurors' questions, that jurors did not become advocates because of the procedure, did not over-emphasize the answers to their own questions and there was no observable prejudicial effect on the overall fairness of the trial.⁶² The authors reviewed their earlier research and restated these same conclusions in a more recent article.⁶³

A 1999 pilot project in Los Angeles County Superior Court in which judges experimented with a number of jury innovations reported that 92% of the jurors told they could ask questions had "very positive" opinions about the procedure.⁶⁴ The "overwhelming majority" of jurors felt that being allowed to put their questions to witnesses improved their role as decision-makers and made them feel more involved in the trial. Ninety-three percent (93%) of the judges said the process did not unduly prolong trials.

Following a Massachusetts field test of juror questions, 96% of the judges who received juror questions thought the procedure was helpful and worthwhile.⁶⁵ Over 88% of the Ohio judges who participated in its pilot program testing the procedure approved of allowing jurors to ask questions.⁶⁶ None of the purported risks of allowing jurors to put questions materialized. Over three-fourths of surveyed jurors reported that question asking helped them remain attentive, and 63% said that the answers to their questions aided their decision-making.

⁵⁶ *Id.*, at 252-53.

⁵⁷ *Id.*, at 254-56.

⁵⁸ *Id.*, at 256.

⁵⁹ 18 L. & Hum Beh. 121 (1994).

⁶⁰ *Id.*, at 142.

⁶¹ *Id.*, at 143-44.

⁶² *Id.*, at 144-48.

⁶³ Steven Penrod & Larry Heuer, Tweaking Commonsense: Assessing Aids to Jury Decision Making, 3 Psychol. Pub. Pol'y. & L. 259 (1997).

⁶⁴ Jacqueline A. Connor, Los Angeles Trial Courts Test Jury Innovations, 67 Def. Counsel J. 186 (2000).

⁶⁵ See text accompanying note 49, supra.

⁶⁶ See text accompanying note 47, supra.

In an extensive field experiment involving juror questions in 239 criminal trials in Colorado, researchers administered questionnaires to the judges, attorneys and jurors who participated, concluding “Overall, the results reveal that juror questioning has little negative impact on trial proceedings and may, if fact, improve courtroom dynamics.”⁶⁷ Regarding the oft-heard complaint that juror questions will help the prosecution meet its burden of proof, only 16% of judges and 23% of attorneys felt that jurors’ questions assisted in meeting the burden of proof. Almost three-fourths of both groups answered “No” or “No Opinion” to the question. Almost 80% of judges favored jury questioning in criminal cases. Prosecutors and defense counsel were divided: 90% of prosecutors favored allowing jury questions; only 30% of defenders did so (although opposition to the procedure decreased by 50% among defense counsel after their experience in the pilot program). The Tennessee pilot program⁶⁸ of allowing juror questions in trials reported similar juror support for the procedure—89%.

At least one researcher has completed a study of a large number of juror questions to discover *what* jurors are asking.⁶⁹ Nicole Mott, conducted a content analysis of 2,271 juror questions from 164 actual trials, both criminal and civil. A median number of 7 questions were asked per trial. She concluded that jurors used their questions to clarify previous testimony of both lay and expert witnesses and to inquire about common practices of relevant professionals. Occasionally, jurors asked the judge for guidance regarding the legal instructions or deliberations. Overall, Mott found that jurors exercised the privilege of asking questions in responsible ways, i.e., to enhance the quality of decision-making. Lastly, she concluded that the process was not detrimental to the adversarial trial.⁷⁰ These latter conclusions coincide with the earlier findings from a national study by the American Judicature Society.⁷¹

This report builds on these studies by testing the effects of juror question in criminal cases under controlled circumstance using contested scientific and statistical evidence to challenge juror comprehension.

Juror Checklists or “Decision Trees”

Juror checklists, sometimes called “decision trees,” are written lists of questions to assist the jury in reaching a conclusion about certain evidence in the trial. Their use has been suggested in the United States and other common law countries in cases involving complex scientific evidence, including DNA.⁷² The devices are viewed as “jargon-free flow charts of the logical pathway followed by a forensic scientist in drawing conclusions from laboratory tests.”⁷³ The list of written questions and options for the jury can vary depending on the type of complex evidence under consideration, but the jurors are instructed that they should answer all the questions in the affirmative before accepting an expert’s final conclusion.

⁶⁷ Mary Dodge, Should Jurors Ask Questions in Criminal Cases? A Report to the Colorado Supreme Court’s Jury System Committee (2002).

⁶⁸ See text accompanying note 11, *supra*.

⁶⁹ Nicole L. Mott, The Current Debate on Juror Questions: “To Ask or Not to Ask, That is the Question.”, 78 Chi. Kent L. Rev. 1099 (2003).

⁷⁰ *Id.*, at 1113-21.

⁷¹ TOWARD MORE ACTIVE JURIES: TAKING NOTES AND ASKING QUESTIONS (1991).

⁷² Anthony J. Bocchino, James M. Dobson & Samuel H. Solomon, What Juries Want to Hear II: Reverse Engineering the Verdict, 74 Temp. L. Rev. 177, 187-88 (2001); David U. Strawn and G. Thomas Munsterman,

This procedural innovation was chosen for experimentation despite the fact that its use as an aid to jurors' understanding of a complex body of evidence is rare. It was included because of its potential to assist jurors in assessing and assigning weight to especially challenging evidence in the case. Limiting the instrument's use to evaluating a discrete category of evidence while avoiding any pretense of steering the jury's decision on the ultimate question of guilt or innocence arguably insulates the technique from the constitutional objections that use of special verdicts and interrogatories to the jury have encountered in criminal cases.⁷⁴ Indeed, the use of the inference chart procedure regarding scientific evidence "assists jury members to...reach their own conclusions about the testimony of experts, thus helping to restore to the members of the jury their prerogative of deciding matters of fact."⁷⁵ Although not discussed in the literature, there are risks that such checklists could further complicate an already difficult cognitive task or even overwhelm jurors, causing jurors to disregard the instrument.

Commentators on juror comprehension of complex scientific evidence have encouraged judicial instructions focusing the jury's attention on the logical merits of experts' presentations.⁷⁶ This device can be seen as responding to that call. (The "mtDNA Evidence Checklist" used in this study is reproduced in Appendix B of this report.)

Juror Notebooks

Based on anecdotal reports from judges and attorneys and given the recent spate of journal articles on the technique, providing jurors with individual multi-purpose notebooks for their use during the trial and their deliberations appears to becoming more popular, especially in complex cases and lengthy trials.⁷⁷

Helping Juries Handle Complex Cases, 65 *Judicature* 444 (1982); David U. Strawn, Raymond W. Buchanan, Bert Pryor & K. Phillip Taylor, Reaching a Verdict, Step by Step, 60 *Judicature* 383 (1977); Richard C.C. Peck, Jury Aids, Sec. 16.5 (2001) (Canadian practice); and Eric Magnusson & Ben Selinger, Jury Comprehension of Complex Scientific Evidence: The Inference Chart Concept, 14 *Crim L.J.* 389 (1990) (Australian practice).

⁷³ Magnusson & Selinger, *supra* note 65, at 390.

⁷⁴ See United States v. O'Looney, 544 F.2d 385, 391-92 (9th Cir. 1976); United States v. Spock, 416 F.2d 165, 182-83 (1st Cir. 1969). See generally, Kate H. Nepveu, Beyond "Guilty" or "Not Guilty": Giving Special Verdicts in Criminal Jury Trials, 21 *Yale L. & Pol'y. Rev.* 263 (2003).

⁷⁵ Magnusson & Selinger, *supra* note 65, at 390.

⁷⁶ E.g., Richard O. Lempert, The Jury and Scientific Evidence, 9 *Kan. J.L. & Pub. Pol'y.* 22, 25 (1999).

⁷⁷ E.g., Neil P. Cohen, Better, Happier Juries: Jury Reform in Tennessee, 39 *Tenn. Bar J.* 16 (2003); Peter Lauriat, Judicial Perspectives on the Presentation of Medical Evidence, 36 *New Eng. L. Rev.* 615 (2002); Gregory P. Joseph, Innovative Comprehension Initiatives Have Enhanced the Ability of Jurors to Make Fair Decisions, 73 *N.Y. St. Bar J.* 14 (2001); and Nancy S. Marder, Juries and Technology: Equipping Jurors for the 21st Century, 66 *Brook. L. Rev.* 1257 (2001).

The preparation and use of notebooks for jurors is addressed in Jury Trial Innovations⁷⁸ and by some court rules.⁷⁹ In the pretrial stage, the trial judge and the attorneys decide whether juror notebooks would likely assist jurors and, if so, settle on a list of items to be provided by the parties and the court for inclusion. The judge closely supervises their preparation to ensure that the notebooks help jurors without overloading them. If the parties do not stipulate to the contents, the judge must resolve their differences. Once approved, enough copies are made for all jurors, alternate jurors, the parties, the judge and the court record.

Some contents are standard; others are determined by the demands of the case and evidence. The notebooks can include:

- (1) paper for juror note taking;
- (2) forms for juror questions (if questions are allowed);
- (3) preliminary jury instructions;
- (4) a list of witnesses by name together with identifying information;
- (5) copies of key exhibits;
- (6) a glossary of technical terms;
- (7) juror checklist (if used);
- (8) a seating chart of trial participants; and
- (9) ultimately, the court's final instructions of law and verdict forms.

The purported advantages and disadvantages of using juror notebooks have also been collected and discussed.⁸⁰ Among the advantages: Notebooks can assist decision-makers in organizing, understanding, recalling and evaluating large amounts of trial information and reduce juror stress in lengthy proceedings. The concerns that have surfaced concerning notebooks include the time and effort required to prepare them and the danger of overloading jurors both physically and cognitively.

Research regarding the use and value of juror notebooks is extremely limited. In her study of trial complexity,⁸¹ Nicole Mott also asked jurors who had use notebooks about their experiences. In addition to noting the utility of having copies of the important documents in evidence and a seating chart of trial principals, jurors expressed concerns that the tendency to place too much information in the notebooks can make them impractical to use if not overwhelming.⁸²

The state jury committees that have investigated the effects of supplying jurors with notebooks have reported positive reactions by trial participants:

⁷⁸ JURY TRIAL INNOVATIONS, supra note 19, at 109-11.

⁷⁹ E.g., Arizona Rules of Civil Procedure, Rule 47(g) (1996); Arizona Rules of Criminal Procedure, Rule 18.6 (D) (1996).

⁸⁰ JURY TRIAL INNOVATIONS, supra note 19, at 110; ABA REPORT ON JURY COMPREHENSION, supra note 3 at 34-37.

⁸¹ Mott, supra note 62.

⁸² Nicole L. Mott, How Civil Jurors Cope with Complexity: Defining the Issues 167, 188-89 (2000)(doctoral dissertation; copy on file with grantee).

California: Responses of 200 jurors in LA County pilot study made clear that notebooks containing copies of key exhibits, among other things, made it easier to locate needed information during deliberations.⁸³

Ohio: Surveyed judges and jurors who participated in pilot study⁸⁴ trials where notebooks were furnished jurors. 72% of jurors found notebooks helpful; 50% “very helpful.” 67% of the judges thought the notebooks helped the parties’ presentations; 72% said the notebooks assisted jurors in understanding exhibits.

Tennessee: When 418 jurors were asked about multi-purpose notebooks, 90% responded that they were useful in performing their tasks. All attorneys in the same cases, with just one exception, gave the notebook experiences a positive rating.⁸⁵

Massachusetts: *All* of the judges that oversaw preparation of and furnished notebooks to jurors reported that they were helpful and worthwhile.⁸⁶

The potential of this innovation to contribute to juror understanding of a contested presentation of novel DNA technology prompted the NIJ Advisory Committee to this project to recommend that the investigators include a jury notebooks condition in the experiment. The concerns about the danger of juror overload during a mock trial deliberation lasting only three to four hours led us to limit the contents to paper for juror note taking, a glossary of DNA terms, copies of the slides used by the two experts, a list of trial participants by name and affiliation, and, depending on the experimental condition, a DNA checklist.

Conclusion

The previous work done in the two fields—improving jury comprehension generally through the use of jury trial reforms and assessing ways to improve jury understanding and weighing of DNA matching evidence in particular—contributed to the design and conduct of the experimental work reported here. By marrying the two currents of concerns and previous work, the investigators decided to use a newly emergent DNA technology (mtDNA) to test whether use of selected jury trial reforms, or innovations, affected jury-eligible mock jurors’ understanding and valuation of critically important forensic evidence.

⁸³ See text accompanying note 14 *supra*.

⁸⁴ See text accompanying note 10 *supra*.

⁸⁵ See text accompanying note 6 *supra*.

⁸⁶ See text accompanying note 7 *supra*.

Chapter 3 – Research Design and Methodology

Research Design

The mock jury study included one control condition (Condition 1), in which no juror trial reform techniques were used, and five experimental conditions with different combinations of jury trial reform techniques. Four specific techniques – notetaking, question asking, using a checklist, and jury notebooks – were chosen by the research team with the advice of the National Institute of Justice Advisory Committee for the project. A basic reform, juror notetaking, was permitted in all but the control condition, because more advanced techniques such as juror question asking, checklists, and jury notebooks were unlikely to be employed in the absence of juror notetaking. Therefore, jury notetaking was permitted in Conditions 2, 3, 4, 5, and 6. Mock jurors in Conditions 3 and 6 were permitted to ask questions of the experts. In Conditions 4 and 6, jurors were given a decision checklist to follow in assessing the mtDNA evidence. Finally, jurors were provided with a jury notebook in Conditions 5 and 6. Condition 6, then, combined all four of the jury trial reform techniques.

To test whether use of selected jury trial reforms enhance jurors' understanding of complex and challenging scientific evidence, we employed a case with DNA evidence for two reasons. First, NIJ has assigned a high priority to the more effective use of DNA in jury trials. Second, previous studies and anecdotal reports indicate that lay jurors are indeed challenged by presentations of DNA matches and related statistics, suggesting that this form of technical evidence would prove sufficiently difficult for the mock jurors. Mitochondrial DNA (mtDNA) evidence was chosen on the advice of project consultant David Kaye as well as NIJ staff members Lisa Forman and Kim Herd. They argued persuasively that because the use of mtDNA at trials was relatively new, employing it in the mock jury experiment would contribute to the currency of the research. In addition, all of the prior studies of jury comprehension of DNA technology involved the more widely used form, nuclear DNA. The project's Advisory Committee concurred in the selection of mtDNA.

Study Procedure

We received permission from the judiciary of Delaware's Superior Court, the trial court of general jurisdiction, to conduct the study at the New Castle County Courthouse, in Wilmington, Delaware, employing members of the jury pool who were not needed for jury duty. Henry duPont Ridgely, then the President Judge of the Superior Court of Delaware (now Associate Justice of the Delaware Supreme Court), New Castle County Superior Court Resident Judge Richard Cooch, and Superior Court Judge William Carpenter, assigned to supervise the New Castle County courthouse's jury pool, all gave permission and supported the research effort.

Obtaining Volunteers for the Study

Typically, jurors checked in to the Jury Assembly Room and began the morning by watching a short jury orientation film. Then, one of the jury office staff members provided an overall description of what was likely to occur during their time at the courthouse, and answered questions. Oftentimes, a judge from Superior Court also addressed the jury pool, underscoring the importance of jury service and the court's gratitude for their public service.

At a convenient point in the morning jury selection, one of the researchers addressed the jury pool in the Jury Assembly Room. We had the opportunity to describe our study and the chance for individuals from the jury venire to participate in the study. Judge Dann or Professor Hans spoke to prospective jurors waiting to be called for jury selection about the opportunity to participate in our study later in the day, including the purpose of the study, the approximate time commitment, the fact that they would be asked to complete questionnaires and deliberate with other mock jurors, the fact that the group discussions would be videotaped, and the fact that they would receive financial remuneration.

Most days, following our presentation, the jury office staff member called roll, and asked jury pool members to indicate whether they were interested in participating in the study should they not be needed for jury service that day. The volunteer rate was high. We assessed the volunteer rate on four separate days, calculating the proportion of volunteers to the total number of jurors present. The volunteer rate was 74%, ranging from a low of 64% to a high of 97%.

The jury pool staff then proceeded to select potential jurors for regular trials. When the required number was met for the day, and it was clear that no more jurors or only a small number of jurors would be needed for actual trials, jury pool staff members randomly selected a set of jurors from their master list of the remaining jurors who had previously volunteered for the mock jury study. The timing of the selection of these study participants was quite variable, as it depended on the size of the pool, the number and type of cases potentially needing jurors (criminal juries, for example, required greater numbers of potential jurors because of a greater number of peremptory challenges), and the speed at which cases settled during the morning. On some days, very few cases or no cases went to jury trial and the volunteers never went through the jury selection process. On other days, most of the remaining jurors had gone through at least one jury selection and had not been selected.

Jury staff called the names of the selected volunteers, and informed them that they had been randomly selected from the volunteer group to participate in the research study. On most days, we had sixteen volunteers, enough for two eight-person mock juries. Occasionally, we had only enough volunteers to form one eight-person mock jury.

The volunteers came forward to receive further details about the study, including the likely time commitment and the amount of compensation for participation. These jurors who were still interested in participating in the study (we had no drop-outs at this point) were given a juror badge, were randomly divided into two groups of mock jurors, and were taken to a conference room on the 10th floor of the courthouse, within the Judges' Chambers area.

The Mock Jury Procedure

Two conference rooms in the Judges' Chambers area of the New Castle County Courthouse were set aside for the jury study. Each contained a rectangular table and eight chairs, a TV/VCR, and camera equipment for recording mock jury deliberations. Before beginning each day, research assistants set up two conference rooms for the mock juries, pre-loading the videotaped trial, setting up the camera equipment, and putting out consent forms, pens, and the relevant questionnaires and reform materials for each condition.

Once in the conference room, the mock jurors took seats around a conference table. The research assistant again described the overall nature of the study, and distributed the consent forms. (See Appendix A for Juror Consent Form.) Mock jurors reviewed the consent forms, and were able to ask any questions about the study prior to agreeing to participate. No one refused to participate at this point.

Each juror was given a juror number, ranging from 1 (the seat around the table that was on the farthest left from the perspective of the camera viewfinder) to 8 (the seat on the farthest right). They were instructed to use that juror number on all of the research questionnaires.

Mock jurors then filled out the initial juror questionnaire asking for individual views about the reliability of different types of testimony and attitudes toward science. (See Appendix A for Initial Juror Questionnaire.) Once all jurors finished completing the initial questionnaire, depending on condition, the researcher distributed steno pads, paper, a checklist, and/or juror notebooks, and briefly explained their ability to use these reform techniques in the study. The judge in the videotaped trial also gave instructions about the use of the particular reforms. (See Appendix B, at 1-3, for the judge's instructions to juries about the innovations.)

Materials provided to mock jurors in each of the conditions were as follows:

- (1) Control condition – no additional materials.
- (2) Notetaking – steno pads for notetaking.
- (3) Notetaking and Question asking – steno pads for notetaking; sheets of paper for questions.
- (4) Notetaking and Checklist – steno pads for notetaking, and copy of checklist for each juror.
- (5) Notetaking and Jury notebooks – Jury notebooks, with paper for notetaking, and supportive material including a witness list, glossary of DNA terms, and copies of the expert witnesses' slides.
- (6) All – Jury notebooks with paper for notetaking and questions to experts; checklist, and supportive material, including a witness list, glossary of DNA terms, and copies of the expert witnesses' slides.

If jurors requested materials or aids outside their condition (e.g., Control Condition jurors who asked if they could take notes or had questions), they were informed that it was not possible to do so.

The videotaped trial was then played for the jury. There were two breaks during the playing of the tape, one after the prosecution expert witness and the other after the defense expert witness. These breaks gave participants who were allowed to ask questions of the experts a period of time to do so. Jurors also were able to take restroom or lunch breaks. Jurors were instructed that they should not discuss the case with one another during the breaks.

In the two conditions in which questions for the experts were permitted, the judge in the videotaped trial instructed the jurors on the procedure for expert questions. The research assistants repeated the instructions and invited questions after each of the scientific experts testified. If a juror had a question, he or she wrote the question on a sheet of notepaper and turn it in to the research assistant. Judge Dann ruled on the admissibility of all questions. If the question was ruled admissible, Judge Dann or Professor Hans then called one of the DNA experts who had previously agreed to field calls and obtained a verbal response to the question. Judge Dann or Professor Hans wrote down the response verbatim and returned it to the jury at the next opportunity.

At the time of the second break, in the checklist and jury notebooks conditions, mock jurors were offered additional time to review material before completing the videotape.

Once the tape was finished, research assistants distributed a second questionnaire, tapping individual views of the evidence and mtDNA material and asking about the use and helpfulness of the specific reforms. There was a specific questionnaire for each condition as items about the individual reforms differed from condition to condition. (See Appendix A for Questionnaire Following the Presentation of the Trial Evidence, Condition 6 (All Innovations) version, which includes the questions pertaining to all four trial reform techniques.)

After all mock jurors had completed the second questionnaire, the researcher provided each jury with a Jury Verdict form, instructing the jury to select a foreperson or presiding juror, who would complete the form with the jury's unanimous verdict and notify the research assistant that the jury had reached a verdict. (See Appendix A for Jury Verdict Form.)

The research assistant then turned on the video camera, left the room, and waited outside the deliberation room until called in by jurors.

Some mock juries called in the research assistant to say that they had reached an impasse. Judge Dann was called into the jury room and gave each jury a modified *Allen*⁸⁷ instruction encouraging the jurors to continue to attempt to reach a unanimous verdict. The instruction reminded the jurors that their verdict had to be unanimous, that a verdict was both preferable and desired, that nothing in the remarks should be taken as an attempt to coerce any jurors to abandon strongly-held verdict views, that none of the jurors should be unduly invested in any earlier vote or poll and should be open to the views of other jurors, that they should allow each juror to repeat their reasons for preferring one verdict over another or for remaining undecided, and that jurors should change their positions and votes only if they were convinced on the merits to do so.

⁸⁷ *Allen v. United States*, 164 U.S. 492 (1896). Most courts have modified the charge in *Allen*. For example, see *United States v. Nichols*, 820 F.2d 508, 511-512 (1st Cir. 1987).

Once the mock jury had reached a unanimous verdict or declared itself hung, mock jurors completed a final questionnaire, asking for reactions to the jury's verdict, their own individual views, mtDNA questions, and support for different jury reforms. (See Appendix A for Post-Jury Deliberation Questionnaire.) A set of questions was added to this final questionnaire after a highly publicized mtDNA evidentiary hearing that occurred during the study, to determine participants' exposure to the hearing and any impact. On October 29, 2003, and subsequent days, scientific experts for the prosecution and the defense testified about mitochondrial DNA evidence in a California case, *State v. Peterson*.

Following completion of the final questionnaire, the mock jurors received a check for \$50.00 and signed vouchers. They were debriefed about the study's purpose in evaluating how different techniques might help to improve jury comprehension of difficult expert evidence. We invited participants to provide their names and addresses on a list (separate from their questionnaires) to receive the results of the study at a later date. That concluded the study. Jurors proceeded to the Jury Assembly Room to receive their certificates of jury duty.

Data collection began on October 14, 2003, and finished on December 16, 2003. A total of 480 jurors participated in the study. There were ten mock juries of eight persons apiece in each of the six conditions.

The Mock Trial: *State v. Jones*

Rather than construct a mtDNA case from scratch, we reviewed a number of reported cases in which mtDNA was admitted at trial and chose to base the mock trial on the issues, fact pattern, and transcripts of testimony from an actual trial. The case selected for these purposes was *State v. Pappas*,⁸⁸ the first appeal in Connecticut from a successful prosecution relying on mtDNA evidence. In addition to reading the reported decision of the Connecticut Supreme Court upholding both the admission of the mtDNA evidence and the defendant's conviction, we obtained the trial transcript to learn more about the FBI's method of presentation of mtDNA in the trial.⁸⁹

The mock trial videotape included introductory instructions by a judge, opening statements by a prosecutor and a defense attorney, witness testimony, including competing experts who discussed mtDNA evidence, closing arguments, and final legal instructions by the judge. (See Appendix B for All Innovations Condition transcript, *State v. Jones*.)

The videotaped mock trial consisted of an armed robbery of a bank by a lone, masked gunman. After entering the bank, the robber vaulted the tellers' counter, held the bank employees at bay with his handgun and emptied two cash drawers, taking about \$5,000 in addition to the "bait money." Although masked, teller Blessing noticed a distinctive red scar on the robber's face when he wiped his face with his gloved hand. Immediately after the robbery,

⁸⁸ 256 Conn. 854, 776 A.2d 1091 (2001). The case is fully discussed in Marlan D. Walker, *Mitochondrial DNA Evidence in State v. Pappas*, 43 *Jurimetrics* 427 (2003).

⁸⁹ Pappas, the defendant in the case, called a defense expert at the pretrial hearing on the admissibility of the mtDNA evidence, but did not present an expert at trial.

local police found the robber's discarded blue sweatshirt and one glove, along with some of the discarded cash (including some bills from the bait money packet) near the bank. No suspect was found that day. Laboratory examination of the discarded sweatshirt revealed two human head hairs in the hood.

An anonymous call directed the police to the defendant Kevin Jones, who at about the time of the robbery had been observed by co-employees at a local fast-food restaurant flashing a large roll of currency. Defendant's acquaintances also told police that Jones owned a blue hooded sweatshirt, had a distinctive scar on his cheek and had no plausible explanation for possessing so much money. When interviewed by a detective, the defendant denied ever having been in the bank before, assumed he had been at work that day and said a friend had repaid a loan. The police collected a sample of his head hair. The two samples of hair were sent to the FBI crime laboratory for DNA analysis. The defendant was arrested and charged upon learning that his mtDNA matched that found in the sweatshirt hairs.

In the actual *Pappas* case, the jury heard only from the prosecution's expert witness regarding the mtDNA evidence that was introduced. Pappas did not present an expert as part of the defense case. The jury in the original case convicted the defendant. We modified the non-scientific factual evidence so that it was more ambiguous, making the mtDNA evidence more crucial to the jury's decision. David Kaye revised the prosecution's expert witness testimony concerning the mtDNA evidence, and added testimony from a defense expert witness who disputed the prosecution expert on several points. He adapted PowerPoint slides developed by Dr. Constance Fisher, a scientific expert working at the FBI. She has employed these slides in evidentiary hearings on the admissibility of mtDNA. Professor Kaye also generated slides for the defense expert. The prosecution and defense expert slides were shown in the videotape during the experts' testimony in all conditions. Copies were provided for jurors in the Jury Notebooks condition. (See Appendix B for Expert PowerPoint Slides.)

The mock trial was filmed at Courtroom 21 at William & Mary Law School, in Williamsburg, Virginia.⁹⁰ Judge Dann presided as the judge in the mock trial. Assistant United States Attorney James A. Metcalfe played the prosecutor in the trial; similarly, a Virginia defense attorney, Robert Moody IV, played the role of the defense attorney in the trial. Professor Kaye and William & Mary biology professor Lizabeth A. Allison played the prosecution and defense expert witnesses, respectively. The other witnesses were actors; some had little or no professional training or acting experience whereas others had participated in local theater productions.

The Mock Jury Sample: Demographic Characteristics

The jury pool in New Castle County is governed by the Petit Jury Plan of the Superior Court of the State of Delaware, which specifies that the source list for potential jurors is the current list of the county's registered voters maintained by the Department of Elections,

⁹⁰ See www.courtroom21.net for a description of the Courtroom 21 Project, which showcases the use of technology in the courtroom.

supplemented by the current list of drivers' licenses and identification cards maintained by the Division of Motor Vehicles.⁹¹

To enable us to compare our mock jury participants to the jury pool, the Jury Manager provided us with a Juror Demographic Report of the jurors who reported for jury duty during the period of our study, from October 14, 2003 through December 16, 2003. A total of 3,381 jurors reported for jury duty during that time period.

Table 3.1: Demographic Characteristics of Jury Pool and Mock Jury Participants

	Jury Pool (Percentages)	Mock Jury Participants (Percentages)
Gender		
Female	52.7	51.5
Male	47.1	47.9
No Information	0.1	0.6
Race		
White	77.3	78.5
Black	16.3	15.0
Hispanic	2.1	2.9
Asian	1.9	1.3
Other	1.3	1.5
No Information	0.9	0.6
Education*		
< High school graduate	5.2	2.1
High school graduate	49.2	24.4
Some college		30.3
College graduate	33.1	29.2
Post-grad college	11.7	14.0
No information	0.7	0.2
Total Number	3,381	480

*Note. Educational categories were different in the jury pool questionnaire and our study questionnaire. There was no option to indicate "some college" in the jury pool questionnaire.

Tables 3.1 and 3.2 compare the demographic profiles of the jury pool and the mock jury participants. They are remarkably similar, with only a few exceptions. Women, for example, comprise 52.7% of the jury pool, and 51.5% of our mock jurors. Whites are 77.3% of the jury pool contrasted to 78.5% of the mock jury sample. The representation of specific age ranges for the two samples are all within one to two points of each other.

⁹¹ See Petit Jury Plan of the Superior Court of the State of Delaware, located at <http://courts.state.de.us/Courts/Superior%20Court/?governance.htm>), adopted June 6, 2002.

Table 3.2. Age Characteristics of Jury Pool and Mock Jury Participants

	Jury Pool (Percentages)	Mock Jury Participants (Percentages)
Age Range		
Under 25	7.5	7.1
25-34	18.6	20.4
35-44	27.6	26.9
45-54	24.8	26.3
55-64	15.1	14.2
65-69	5.0	3.3
70+	1.4	1.5
No Information		0.4
Total Number	3,381	480

The only observable difference appears to be in the educational background of the participants. A Chi Square analysis finds that the jury pool and the mock jury participants are significantly different (Chi Square (4 d.f.) = 14.46, $p = .002$).⁹² People of varying educational backgrounds might well have had differential interest in participating in our study, and that cannot be discounted as a possibility. Given the link typically found between education and income, the payment for participation might have been more of an inducement to poorer and less educated jurors. A more compelling explanation, though, is that the response categories on the jury questionnaire and the mock jury questionnaire differ.

People without a high school degree are less likely, by about 3 percentage points, to participate in our study, and those with post-graduate work are about 2 percentage points more likely to participate. However, the larger differences come in the high school and college categories, and here, high school graduates appear more likely to participate and college graduates are less likely. The jury pool questionnaire and the mock jury study questionnaire used different response options to obtain educational attainment. The jury pool questionnaire asked for “Education Completed” and offered four options: less than high school, high school, college, and post grad. The mock jury study asked participants, “How many years of school have you completed?” and provided the following options: less than four years of high school; high school graduate/GED; some college; college graduate; and post-graduate work. Participants who had taken some college classes would thus be classified differently under the two systems. The overall similarity of the two groups on all other demographic characteristics suggests that the apparent educational difference reflects the divergent ways that the jury pool and our questionnaire asked about educational attainment.

⁹² Because the educational categories offered as responses to the jury pool and the mock jury are different, we labeled those mock jury participants with “some college” as high school graduates for the purposes of our comparative analysis.

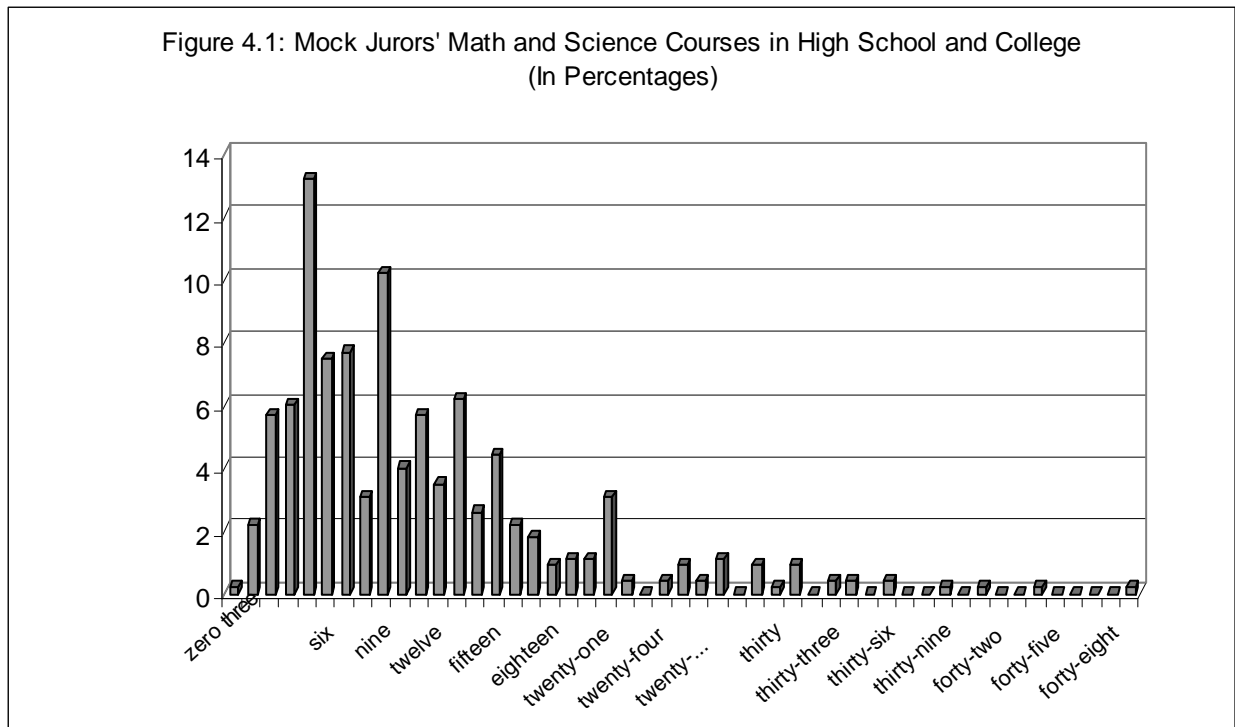
In sum, the mock jury sample constitutes a close reflection of the jury pool in New Castle County, Delaware. Like the jury pool, it is predominantly white, about half female, and includes a good range of educational backgrounds and ages.

Chapter 4 – Study Participants’ Science Backgrounds and Attitudes

Because of the centrality of scientific knowledge to the mock jury project, it is important to examine the background and experience that mock jurors have had with scientific issues and DNA prior to participating in our study. It is also relevant to examine their pre-existing views and attitudes about science, as these may affect both their views of the reliability of scientific evidence and their judgment of its importance to the case. This chapter provides information about these aspects of our mock jurors.

Mock Jurors’ Science and Mathematics Background

Study participants’ backgrounds in science and math were explored through questions about high school and college courses in science and math, as well as relevant job experience. Figure 4.1 shows the results. Most mock jurors have had at least some high school courses in science and math. Combining math and science courses taken in both high school and college, the average number is 9.72 courses taken. The mode or most frequent report is 4 courses. The range is relatively wide, stretching from zero to 48 courses.



Not surprisingly, the number of courses is significantly linked to overall educational attainment ($F(4, 452) = 46.57, p = .001$), with a direct relationship between amount of formal schooling and the number of math and science courses.

A substantial proportion (43%) of the mock jurors report some job experience that is math or science related. A total of 196 jurors say they have some math or science related job experience, but most of them (119) say they have only a small amount of such job experience. A total of 77 jurors say they have moderate to substantial job experience that is math or science related.

Some of the relevant job experience reported by our study participants includes: insurance/risk management work; chemistry; biotechnology work; electrical engineering; science and math teaching; dirt grade calculations and ground water contamination studies; medical technologist; testing on new drugs; cardiac surgeon; scientist at large research organization; computer programmer; registered nurse; and laboratory technician doing research and development in monoclonal antibodies. A few explain how their non-scientist jobs specifically involve math and science: “I am a Pilot. I fly a corporate jet. Math + Science governs every aspect of my job.” “Real estate paralegal-prepare settlement sheets with #'s, calculate mtg. costs, etc.” and our favorite, “I am a hair stylist with experience in the structure of hair and chemicals. Knowing how the molecules from chemicals affect the strands.”

Study participants with higher overall educational attainment and larger numbers of math and science courses are more likely to have science and math job experience.

Participants’ Attitudes Toward Science and Technology

The initial questionnaire administered to jurors in the study included seven items dealing with attitudes toward science and technology. These items were taken from the National Science Foundation’s Science and Engineering Indicators 2002.⁹³ Four of these items deal with the promise of science, while the other three focus on examining reservations about science.

⁹³ The National Science Board’s 2002 Science and Engineering Indicators may be found on the web at <http://www.nsf.gov/sbe/srs/seind02/c7/c7s2.htm>. Figures for the national sample were derived from the Appendix Table 7-12, Science and Engineering Indicators – 2002. For more recent national data, see the National Science Board’s 2004 report at <http://www.nsf.gov/sbe/srs/seind04/c7/c7s3.htm>.

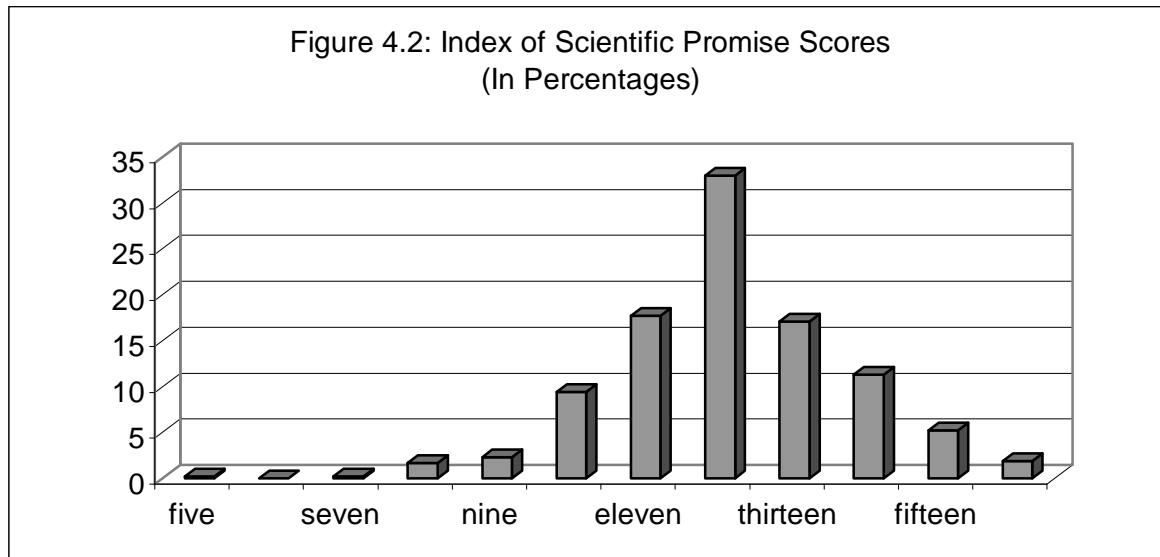
Table 4.1. Attitude Items toward Science and Technology Included in the Index of Scientific Promise and Index of Scientific Reservation

Item	Strongly Agree %	Agree %	Disagree %	Strongly Disagree %
PROMISE OF SCIENCE				
Science and technology are making our lives healthier, easier, and more comfortable.	26	69	4	1
Most scientists want to work on things that will make life better for the average person.	12	77	10	1
With the application of science and technology, work will become more interesting.	10	64	25	1
Because of science and technology, there will be more opportunities for the next generation.	29	53	18	1
RESERVATIONS ABOUT SCIENCE				
We depend too much on science and not enough on faith.	7	33	54	7
It is not important for me to know about science in my daily life.	3	16	55	27
Science makes our way of life change too fast.	3	27	62	8

Note. Entries show percentage agreeing or disagreeing with each statement.

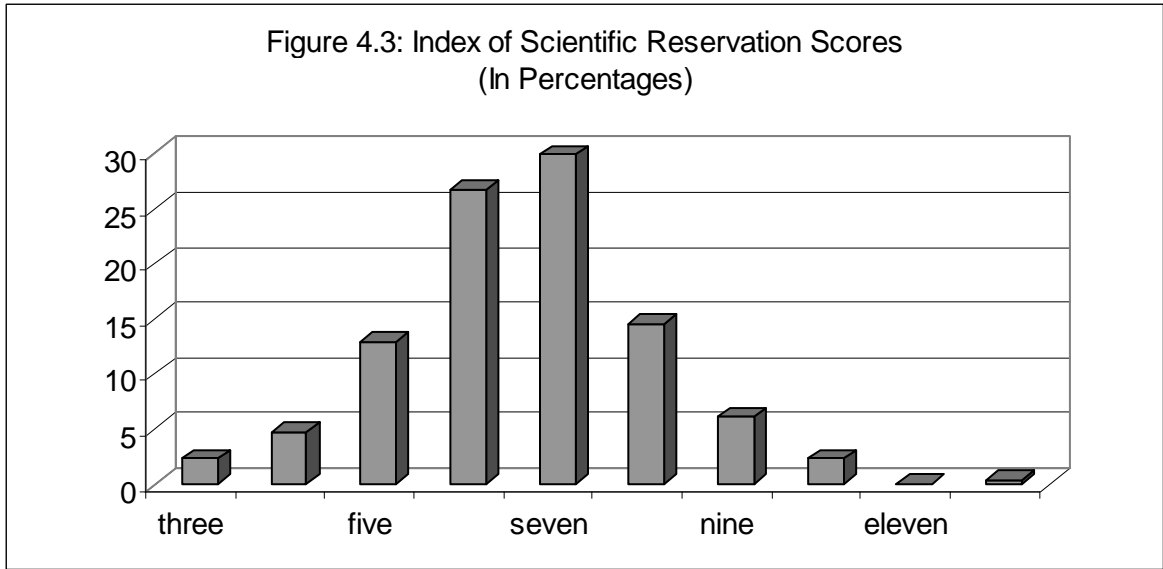
The National Science Foundation Science and Engineering Indicators discovered that most Americans hold very positive general views toward science and technology, and the same held true for our mock jury sample. For instance, in 2001, 89% of a national sample agreed that “Science and technology are making our lives healthier, easier, and more comfortable.” A comparable 85% of our mock jurors agree with that statement. Similarly, 85% of a 2001 national sample and 82% of the mock jurors agree with the statement, “Because of science and technology, there will be more opportunities for the next generation.” The NSF survey also found that a significant proportion of Americans holds some reservations about science, and that is also true of our sample, although the negative views are somewhat attenuated in the mock jury sample. Thirty-eight percent of the 2001 national sample, for instance, agreed that “Science makes our way of life change too fast,” compared to 30% of our mock jurors. In the 2001 national sample, 51% agreed that “We depend too much on science and not enough on faith,” compared to 40% of our sample.

The four items dealing with the promise of science were recoded so that higher numbers indicated more positive views about science, and scaled together to form an Index of Scientific Promise, with a mean of 12.1 and a Cronbach's alpha of .58. The index ranges from a potential low of 4 to a high of 16. One can observe from the high mean response and the figure below our participants' predominantly positive views about science.



The other three items, dealing with negative views about science, were recoded so that higher numbers indicated more reservations about science, and combined into an Index of Scientific Reservation, with a mean of 6.6 and a Cronbach's alpha of .49.⁹⁴ The index has a potential low of 3 and a high of 12. The mean and overall shape of the distribution of responses indicate that a minority of our participants possess reservations about science.

⁹⁴ Analysis showed that deleting one item ("It is not important for me to know about science in my daily life") slightly improved Cronbach's alpha to .51, but the item was retained in the Index of Scientific Reservation for comparability to national data concerning the index.



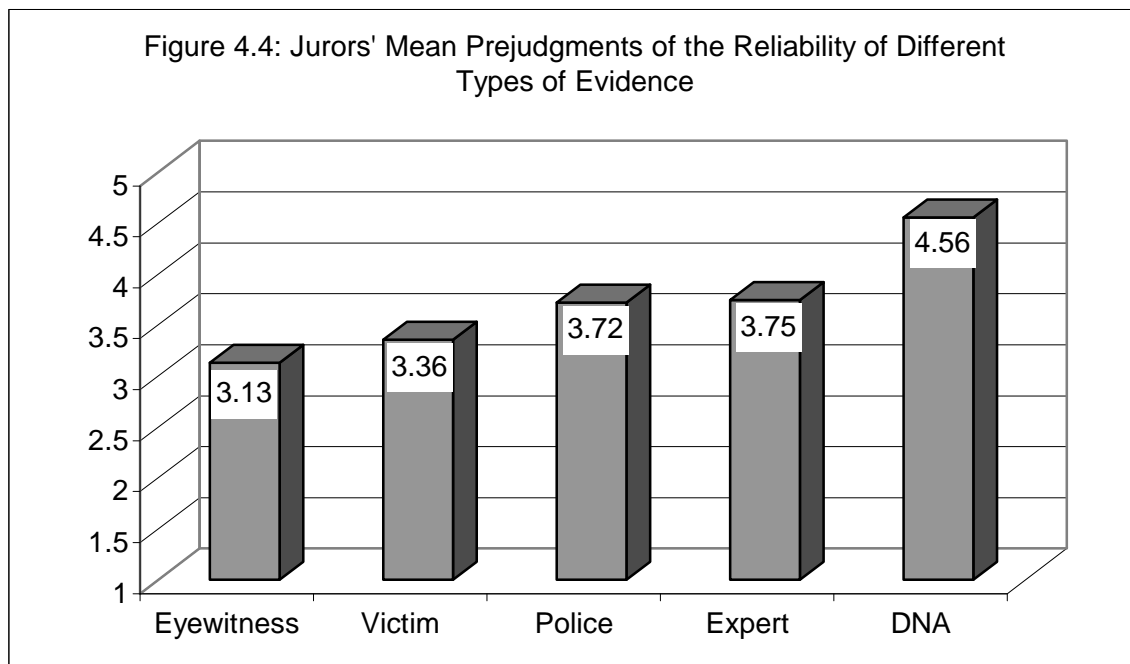
While the numbers for each scale's coherence are not as high as we would desire, we consider them acceptable in that the items derive from a national research project and the indices use a relatively small number of items. Though the Promise and Reservation indices do seem to represent two distinct constructs, they are negatively correlated ($r = -0.110$, $p = .016$).

The Index of Scientific Promise is unrelated to educational attainment ($F(4, 477) = .16$, ns) but educational attainment is significantly and negatively related to the Index of Scientific Reservation ($F(4, 477) = 6.15$, $p = .001$). Those with more education have fewer reservations about science. Similarly, white participants do not differ on the Index of Scientific Promise but have significantly fewer reservations about science compared to nonwhite participants ($F(1, 475) = 13.95$, $p = .001$). A regression using the Index of Scientific Reservation as the dependent variable and both education and white versus nonwhite race as independent variables showed that both education and race contribute significantly to reservations about science. Finally, the participant's age is unrelated to the Index of Scientific Promise, but is positively correlated to the Index of Scientific Reservation ($r = .12$, $p = .008$). Older participants have more reservations about science. Men and women do not differ on either index.

In sum, most jurors have taken at least some math and science courses in high school or college and about a fifth of the sample has substantial math or science experience on the job. Their views about science are quite similar to those reported in national surveys, with widespread positive views about the benefits of science along with a significant minority who express concerns about science. Participants' age, race, and education are all related to concerns about the negative impact of science.

Participants' Preexisting Views about the Reliability of Scientific and DNA Evidence

On the initial questionnaire, we asked participants to provide their general views about the reliability of different types of evidence, including eyewitness evidence, evidence provided by crime victims, police evidence, expert evidence, and DNA evidence. They rated the reliability of evidence on a five-point scale, where 1 corresponded to “not at all reliable” and 5 indicated “extremely reliable.” As shown in Figure 4.4, before hearing the evidence in the mock trial, participants judge the reliability of DNA evidence to be very high, in fact, highest of all categories of evidence provided to them. A total of 64% of the mock jurors rate DNA evidence as extremely reliable. It is judged to be much more reliable than any of the other forms of evidence. For example, just 14% of jurors rate expert evidence as extremely reliable.



Prior to participating in our study, only a minority of the mock jurors had heard about mitochondrial DNA analysis. We chose mtDNA evidence for that reason, as we wanted to assess how comprehension of a new scientific concept might be enhanced through selected jury reforms.

A few weeks into our study, in October of 2003, the judge in the highly publicized case of *State v. Peterson* in California held an evidentiary hearing about the admissibility of mitochondrial DNA evidence.⁹⁵ The substance of the evidentiary hearing was reported on television, radio, in the newspapers, and on the web. Therefore, it became important to gauge exactly how much our participants had already learned about mtDNA from other sources.

⁹⁵ Mitochondrial DNA Evidentiary Ruling, *People v. Scott Lee Peterson*, No. 1056770, Superior Court of California in Stanislaus County, November 18, 2003, A. Girolami, J.

We added a set of questions to the final questionnaire, obtaining responses from the 75% of our mock jurors who participated after the evidentiary hearing began. Most of them had heard nothing or very little about mtDNA prior to being in our study, as Table 4.2 shows.

Table 4.2. Study Participants’ Prior Exposure to mtDNA

Amount Participants Had Heard about mtDNA Prior to Study	Number	Percentage
Nothing	188	52%
Small amount	99	28%
Moderate amount	57	16%
Substantial amount	15	4%

Of the 359 participants who responded to the question, over half say they had heard nothing about mtDNA evidence before the study. Interestingly, although most of the mock jurors say they have heard at least a few news stories about the *Peterson* case (just 12% report they have heard nothing about the case), only one in five recalls that there was any DNA evidence in the case. Of these, just 32 participants specifically recall that there was mtDNA evidence in the *Peterson* case.

In Chapter 5, we will discuss participants’ overall knowledge and comprehension of the mtDNA evidence presented in the mock trial. Comparisons of the responses of all mock jurors who were in the study before and after the *Peterson* hearing show no significant differences in their overall knowledge of mitochondrial DNA, as judged by the juror comprehension scale scores given before and after the deliberations. However, those who say they watched a larger number of news stories about the *Peterson* case have more accurate knowledge of mtDNA.⁹⁶

To summarize, our study participants reflect a wide range of scientific backgrounds, from those who have taken only a modest amount of math and science courses in high school to those who have had a substantial amount of math and science education and who work in a scientific field. Their views about science are comparable to the views of national survey population, with generally positive views about the promise of science but an identifiable minority who express concerns about science. Most see DNA evidence as extremely reliable but have heard little or nothing about the form of DNA evidence we feature in the mock trial, mitochondrial DNA analysis.

⁹⁶ For example, on 8 basic mtDNA knowledge items the participants answered before deliberation, those who say they watched no news stories about the *Peterson* case answer on average 4.9 questions correctly, those who have watched a few to a moderate number answer 5.6 to 5.7 correct, and those who have watched a large number answer 6.0 correct. $F(3, 359) = 3.83, p = .01$. The effect persists after deliberation.

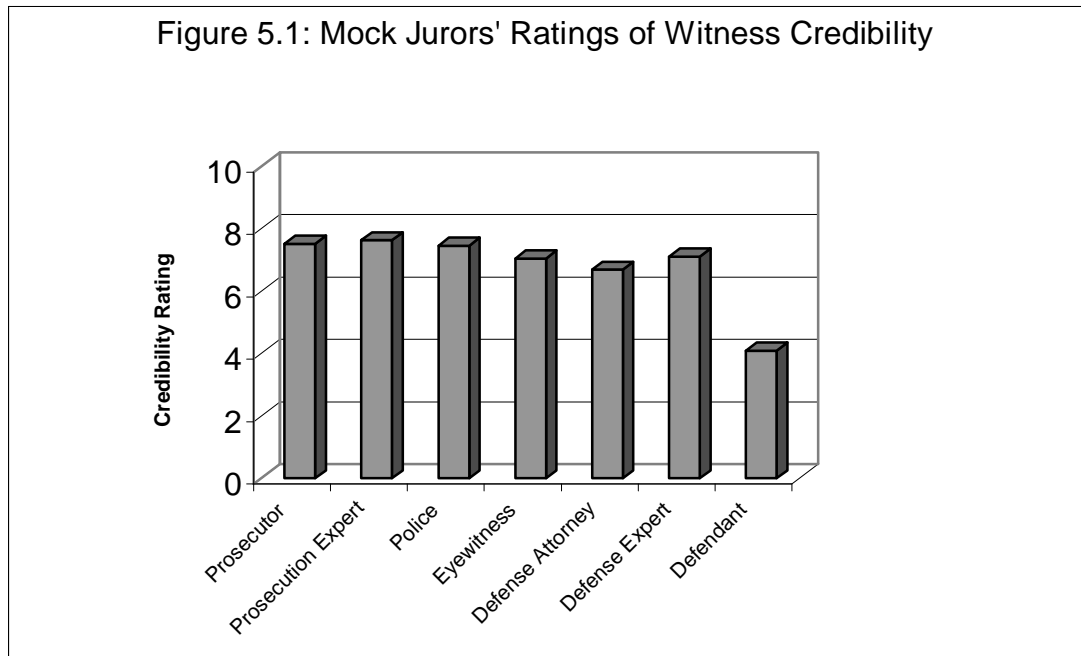
Chapter 5 – Juror Comprehension of mtDNA

Our study examined the comprehension and use of mitochondrial DNA evidence within the context of a mock trial of robbery charges. In this chapter, we first examine how the study participants evaluate the evidence for the two sides in the case, paying particular attention to how jurors evaluate the expert witnesses for the prosecution and the defense. Then we turn to their assessments and comprehension of the mtDNA evidence.

Mock Jurors' Views of Witness Credibility and Evidence Strength

Initially, before discussing the case with others, about half the mock jurors (48% overall) say their preliminary verdict is guilty, and a third (34%) give a preliminary verdict of not guilty. The rest are unsure at this point. Those proportions are about the same in each of the experimental conditions. Ultimately, after jury deliberations, 33% of the juries reach a unanimous guilty verdict, 43% of the juries acquit, and 23% prove unable to reach a unanimous decision and declare themselves hung. Although the hung jury rate in our study is higher than the estimated 6% of criminal cases nationwide, it is typical of mock jury studies where there is less real world pressure to arrive at a unanimous decision.⁹⁷

Figure 5.1 shows the mock jurors' ratings of witness credibility.

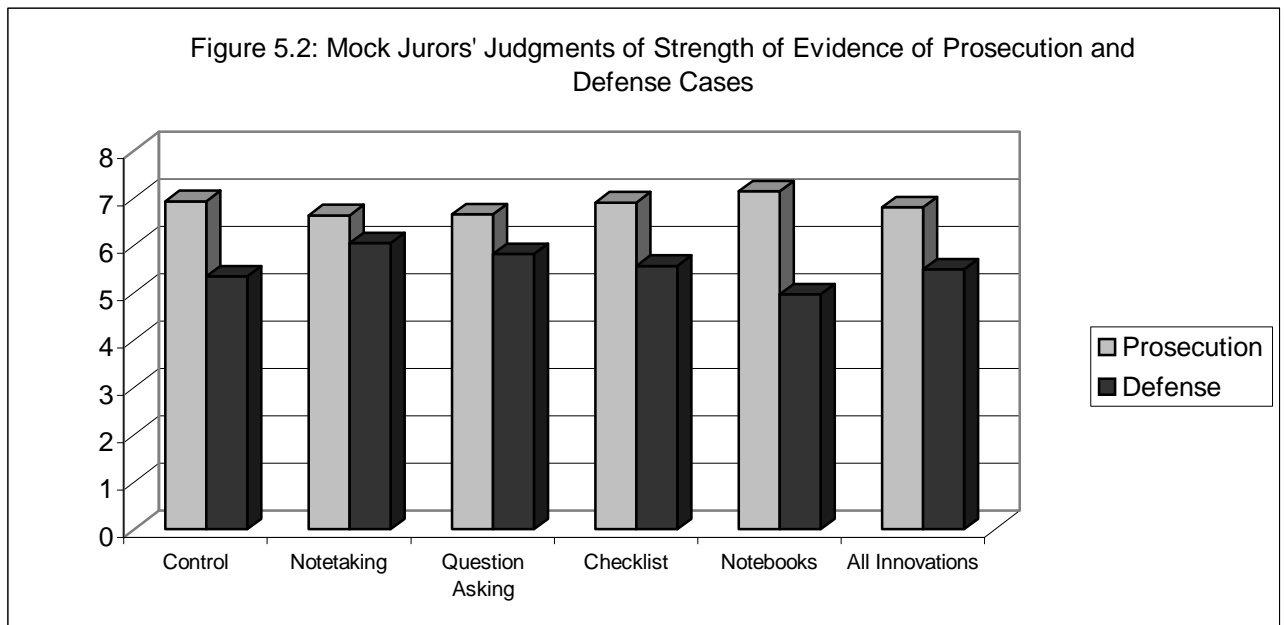


⁹⁷ Devine et al., *Jury Decision Making: 45 Years of Empirical Research on Deliberating Groups*, 7 *Psychology, Pub. Pol'y & L.* 622, 673 (2001); Paula L. Hannaford-Agor et al., *Are Hung Juries a Problem?* (National Center for State Courts Sept. 30, 2002); Valerie P. Hans et al., *The Hung Jury: The American Jury's Insights and Contemporary Understanding*, 39 *Crim. L. Bull.* 33 (2003).

The mock jurors generally give the prosecution, and prosecution witnesses, higher marks compared to the defense and the defense witnesses. The prosecutor has an advantage of about one point (on a 10 point rating scale) over the defense attorney. Both experts are highly rated, but the FBI expert has a slight advantage over the defense expert (7.62 to 7.10 respectively). The defendant is the lowest rated witness by far.⁹⁸

We did not have strong a priori expectations that specific jury innovations would shift verdicts or perceptions of the strength of the prosecution’s or the defense’s case in a particular direction. Both sides included expert evidence about mtDNA, and our major interest is in evaluating how jury innovations affect comprehension and views about the mtDNA evidence.

Figure 5.2 compares the mock jurors’ preliminary ratings of the strength of the two sides. The prosecution is rated more highly, and about the same, in all of the conditions. However, the defense side is rated somewhat differently across the experimental conditions, and a few of the contrasts reach statistical significance.⁹⁹



⁹⁸ Unexpectedly, the credibility of the bank teller, who is an eyewitness, is rated more highly in the Control Condition and in the Notebooks condition (overall $F(5, 477) = 2.24, p = .049$). Thus the slight but significant advantage of the prosecution in the Notebooks condition observed below may be mostly due to the differential credibility of the bank teller.

⁹⁹ The overall effect of condition is statistically significant ($F(5, 476) = 2.19, p = .05$). Post-hoc contrasts show that the Notebooks condition differs significantly from the Notetaking and Question Asking conditions, and the Control Condition is statistically different from the Notetaking Condition. Comparing those who had access to notebooks and those without access, the comparison is also statistically significant: $F(1, 476) = 4.41, p = .036$.

As Figure 5.2 shows, the biggest gap between the prosecution and the defense appears in the Notebooks condition. Mock jurors who are able to refer to notebooks rate the defense as somewhat weaker compared to the other mock jurors. However, there are no differences across conditions in the ratings of the two experts.

Comprehension of mtDNA Evidence

We asked a number of questions about jurors' comprehension of the mtDNA evidence. After listening to the expert presentations about mtDNA within the mock trial context, the majority of jurors report that it is not difficult to follow the testimony. In fact, 40% say that it is easy. Fully 47% say they understand the mtDNA evidence well or very well after hearing about it, as shown in Tables 5.1 and 5.2 below.

Table 5.1: How Easy Or Difficult Was It For You To Follow The Expert Testimony About mtDNA Evidence?

5-Point Scale	Percent
Very Easy	9
Easy	31
Neutral	39
Difficult	20
Very Difficult	2

Table 5.2: How Well Do You Feel You Understand The mtDNA Testimony At This Point?

5-Point Scale	Percent
Not at all	2
Slightly	9
Somewhat	43
Well	38
Very Well	9

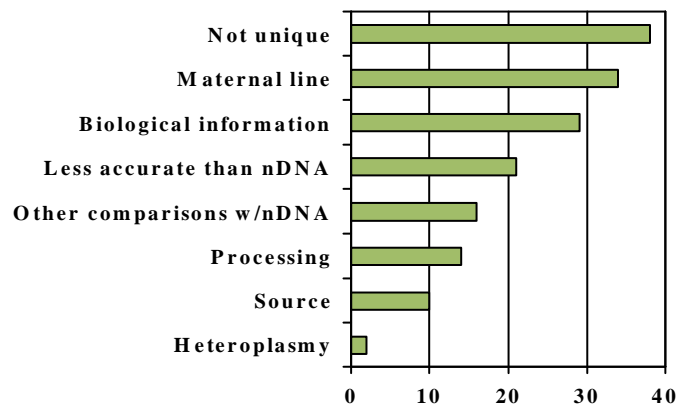
Not surprisingly, those with more formal education are more likely to say they understand the mtDNA evidence ($r(N = 476) = .21, p < .001$); the same goes for jurors with more mathematics and science courses ($r(N = 450) = .33, p < .001$). Most mock jurors state, then, they can follow the expert testimony. Those who say they are having trouble following some evidence are apt to identify mtDNA or DNA evidence; about half of those who report they're having trouble specifically mention the mtDNA or DNA evidence.

To examine juror comprehension in more detail we asked jurors to provide a definition of mitochondrial DNA evidence after they listened to the mock trial but before they deliberated. The question asked, “In your own words, what is mitochondrial DNA (mtDNA) evidence?” The complete set of 480 responses is reproduced in Appendix C: Study Participant Responses.

We attempted to develop a coding system to reflect the accuracy and completeness of these written definitions. We were also interested in seeing the most typical content of juror definitions. We arrived at a coding system that evaluated each response in two ways. First, we counted all correct and all incorrect statements. We generated a 5 point scale, from - 1 to + 3, in which points for correct statements were added and points for errors were subtracted. Two raters coded half of these accuracy judgments, with an acceptable level of 72% agreement. Each participant’s definition was also coded for the presence or absence of eight content categories. Half the participants’ statements were coded, and the reliability for these statement codes was 83%. Thus, each participant had a definition accuracy code, and each statement made by the participants was coded for content.

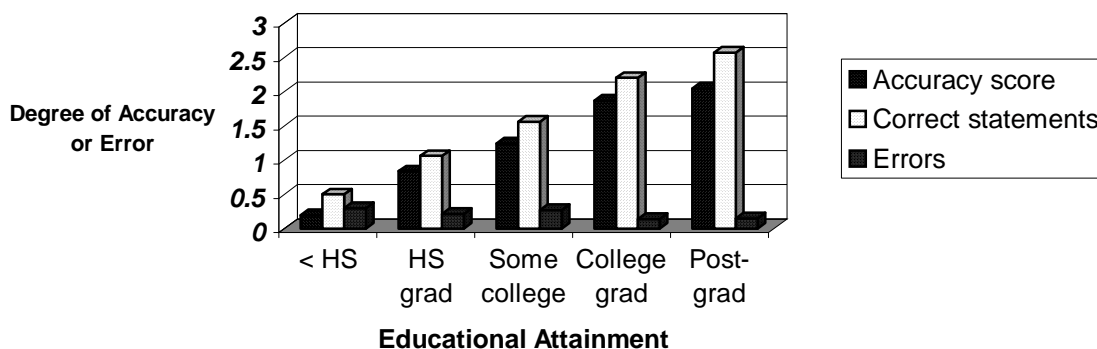
Figure 5.3 shows the proportion of jurors who include statements about different issues in their definitions of mitochondrial DNA evidence. The most common information jurors include, mentioned by 38% of all jurors, is the fact that mtDNA is not unique to an individual, an important issue that the experts and the attorneys discuss in the mock trial. Second most frequent, noted by 34% of jurors, is the maternal inheritance of mtDNA. Twenty-nine percent of the jurors provide other basic biological information about mtDNA (for example, that mitochondria are found outside the cell nucleus). About a fifth of the jurors make accuracy comparisons with nuclear DNA. The other content categories, including other types of comparisons with nDNA, the hairs as the source of the mtDNA, and heteroplasmy, are mentioned by relatively few study participants. Just 2% mention heteroplasmy, a major focus of the defense expert testimony.

**Figure 5.3. How Do People Define mtDNA ?
Proportion of Jurors Including Statement about Topic**



Looking at the correct and incorrect statements in the mtDNA definitions, we find that 82% of the participants make at least one correct content statement about mtDNA. Nineteen percent make one or more errors in defining mtDNA. The average response on the accuracy scale is 1.42, indicating that most participants are able to provide one to two accurate statements about mitochondrial DNA. The overall accuracy scale, and the number of correct statements, are significantly related to the mock juror's education level ($F(4, 478) = 20.24, p < .001$ for accuracy scale; $F(4, 478) = 25.88, p < .001$ for number of correct statements). Incorrect statements are only marginally ($p = .11$) related to juror education. Figure 5.4 shows the relationships.

Figure 5.4. Jurors' Educational Levels and mtDNA Definition Accuracy



After providing their own open-ended definitions of mtDNA, jurors answered a series of true-false questions about mtDNA. We attempted to generate knowledge questions that could be answered if mock jurors followed the testimony of the prosecution and defense expert witnesses. In addition, we developed questions to examine responses to the prosecutor's and the defense attorney's adversarial claims about the meaning and relevance of the mtDNA evidence.¹⁰⁰

Responses to specific mtDNA knowledge questions show that as a group the mock jurors have good comprehension of certain aspects of mitochondrial DNA, although they make some errors or indicate they don't know.

Virtually all mock jurors, for example, are able to respond correctly to the basic question, "Do mtDNA and nuclear DNA (nDNA) have the same ability to prove identity, or is one better than the other?" Both of the expert witnesses, the prosecutor, and the defense attorney in the trial made this point, and it was obviously communicated well to the mock jurors. One can observe from Table 5.3, below, that even before deliberation, 89% are able to correctly identify

¹⁰⁰ For example, we examined the "defense attorney's fallacy" that the mtDNA information was completely irrelevant because many others could also be the source of the hairs. See discussion of this and other fallacies in David H. Kaye & George F. Sensabaugh, Jr., *Reference Guide on DNA Evidence*, at 539 and 574, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 2d ed., 485 (Federal Judicial Center 2002); William C. Thompson, Are Juries Competent to Evaluate Statistical Evidence? 52 LAW & CONTEMP. PROBS. 9, 25-35 (1989).

nuclear DNA as the better source; just 3% say mtDNA is better; and the remainder say they are the same or do not know. The numbers are very similar after deliberation – 89% again correctly identify nuclear DNA as superior.¹⁰¹

Table 5.3. Do mtDNA and nDNA Have the Same Ability to Prove Identity, or Is One Better than the Other? (Pre-Deliberation)

Option	Frequency	Percentage
mtDNA better	16	3%
nDNA better (correct response)	427	89%
Both are the same	18	4%
Don't know	18	4%
No answer	1	0%

Table 5.4 shows other key mtDNA knowledge questions. Mock jurors could respond true, false, or don't know to these questions. There is a solid majority of correct responses on most of the basic knowledge items. Well over half of the mock jurors know, after hearing the experts, that mitochondria are found outside the nucleus of the cell, that the sequencing of base pairs is important, that about 600 base pairs are analyzed, and that a match is the same mtDNA sequence in two samples.

¹⁰¹ Analyses reveals that mock jurors in the Questions condition did worse on this particular question, but apparently because of their lower levels of formal education compared to mock jurors in conditions that did not permit questions.

Table 5.4: Responses to Specific Knowledge Questions about mtDNA

Item	% Correct Before Deliberation	% Don't Know Before	% Correct After Deliberation	% Don't Know After
Mitochondria are found inside the nucleus of every cell.*+ [false]	70	7	67	7
A match is the same mtDNA sequence in two samples.*+[true]	59	15	66	13
When mtDNA evidence is analyzed, about 600 base pairs are compared.*+ [true]	58	20	68	16
Heteroplasmy means that the same individual has mtDNA with different base pairs at certain points.*+[true]	68	22	69	19
The sequence of base pairs in mtDNA is important.*+[true]	84	10	83	8
A person's mtDNA comes from both the mother and the father.*+[false]	84	2	89	2
The mtDNA evidence in this case is completely irrelevant because a substantial number of other people could also be the source of the hairs.*+[false—defense attorney's fallacy]	51	10	51	9
The mtDNA evidence in this case excludes at least 99% of the population as the source of the hairs.+ [true]	69	8	69	7
The mtDNA evidence in this case shows there is about a 1% chance that someone else besides the defendant committed the crime.+ [false—prosecutor's fallacy]	43	8	32	8
The mtDNA evidence in this case could have come from the defendant's brother, if the two had the same father but different mothers. [false] [asked post-deliberation only]	--	--	90	3
The mtDNA evidence in this case could have come from the defendant's brother, if the two had the same mother but different fathers. [true] [asked post-deliberation only]	--	--	90	4
Even though the defendant did not have heteroplasmy, the possibility of heteroplasmy is still important to consider in calculating the likelihood of a match. [true] [asked post-deliberation only]	--	--	65	22

Note. Missing data are included in calculation of % correct.

Starred items (*) are included in the Juror Comprehension Scale.

Items with a plus (+) are included in the Expanded Juror Comprehension Scale.

There is also good understanding by a majority of participants about the maternal lineage of mtDNA and the implications of maternal inheritance. This issue was discussed by both experts and by both lawyers. We included in the defendant's testimony a "red herring" half-brother who has the same father but not the same mother. Both experts talk about the maternal inheritance of mtDNA. However, the experts are not questioned about and do not discuss the exclusion of the half-brother. Neither attorney mentions the half-brother. We wanted to see whether mock jurors, on their own, might be lured into believing the half brother was the source of the mtDNA. If they did not fully comprehend the implications of the maternal inheritance of mtDNA, they might conclude that the brother was the source of the mtDNA. But, our gambit did not work! As Table 5.4 shows, even before deliberation, most people (84%) correctly note that mtDNA does not come from both mother and father, and after deliberation that proportion rises to 89%. Fully 90% correctly reject post-deliberation the suggestion that the mtDNA evidence could have come from the defendant's brother if the two had the same father but different mothers.

One of the more complicated issues presented by the mtDNA experts, and a major focus of the defense expert, is that the FBI's estimate of the percentage of matching people ignores the fact that due to heteroplasmy, men who differ at a single base pair cannot be excluded as possible matches. About two-thirds of the participants are able to identify a correct and basic definition of heteroplasmy.

Although our major focus is on the jurors' factual comprehension, we also wanted to explore whether mock jurors would fall for the attorneys' adversarial exaggerations and fallacies about the implications of the mtDNA evidence. The defense attorney, for instance, claims that the mtDNA evidence in this case is completely irrelevant because a substantial number of other people could also be the source of the hairs. In fact, it is relevant, even though its probative value might be debatable, or might differ depending on whether heteroplasmy is considered in assessing the likelihood of a match. About half (51%) reject the defense attorney's argument that the mtDNA evidence is completely irrelevant, however, and that number does not increase after deliberation.

The subject of heteroplasmy also allowed us another test of whether people could resist an adversarial and arguably false claim. The prosecutor claims, in his closing argument, that heteroplasmy is irrelevant because the defendant himself was not shown to be heteroplasmic. However, as the defense expert notes, whether the defendant is heteroplasmic is beside the point; one must still consider the possibility of heteroplasmy in calculating the likelihood of a match. About two-thirds of the mock jurors, responding after deliberation, assert it is still necessary to consider heteroplasmy even though the defendant is not heteroplasmic, which is correct. Thus, they reject the prosecutor's claim.

The mtDNA evidence, according to both experts, excludes at least 99% of the population as the source of the hairs, and 69% of the mock jurors agree with that conclusion. What does it mean in terms of the defendant's guilt, however? Earlier, we discussed the ways that prosecutors and defense attorneys may make claims about their cases conflating the DNA match statistics and the likelihood of guilt. So for example, if the expert testifies that the random match probability (RMP) is 1%, the so-called prosecutor's fallacy is that "there is a 99% chance that the

defendant is guilty.” As discussed earlier, this conclusion is not generally valid because it confuses the conditional probability of a match in the mtDNA given an innocent suspect with the conditional probability of innocence given a match.

In our study, 48% of the mock jurors agree that the DNA evidence shows there is about a 1% chance that someone else besides the defendant committed the crime, suggesting that many jurors fallaciously equate the probability of a match given innocence with the probability of the defendant’s innocence given a match. If they combine the mtDNA match probability with the probabilities for other evidence pointing toward guilt or innocence, the probability of innocence could be either above or below the 1% figure. We did not ask jurors specific questions about their subjective probabilities for other evidence, so we cannot evaluate the extent to which they over rely or under rely on mtDNA match statistics.¹⁰² However, the jury deliberations included some discussions about combining probabilities, which we discuss in Chapter 7.

Discussing probabilities, it is worth noting that a majority of jurors think that the likelihood that the defendant is the robber is fairly high. Before deliberation, jurors say on average the probability is 69%, with a median of 80%. The range is wide – from zero to one hundred. Not surprisingly, it is related to the participant’s initial verdict choice. As Table 5.5 shows, those who initially vote guilty on average judge the likelihood at 90%. Those who vote not guilty rate the probability on average at 42%; those who are unsure fall in between at 64% ($F(2, 478) = 211.49, p = .0001$). Other judgments about probability linked to the mtDNA evidence and arguments are also associated with verdict choice, as illustrated in Table 5.5.¹⁰³

¹⁰² Other studies that have examined this question have asked about the participants’ subjective probabilities of guilt based on different pieces of evidence prior to learning about DNA analysis results, but this artificial approach was not appropriate for our study. See Chapter 2, Literature Review, for a discussion of these studies. See David H. Kaye & George F. Sensabaugh, Jr., Reference Guide on DNA Evidence, at 539 and 574, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 2d ed., 485 (Federal Judicial Center 2002). Because we have no measure of each juror’s prior odds, we cannot be certain of how many of the jurors who report that the probability of innocence is about 1% actually misinterpret the conditional probability of a match given innocence $[P(M|I)]$ as the conditional probability of innocence given a match $[P(I|M)]$. If, given the other evidence in the case, a juror believes the prior odds of innocence are 1, and if the juror believes that the probability of laboratory error is zero, then according to Bayes’ theorem, the posterior odds of innocence are given by the likelihood ratio $P(M|I)/1$. Using the prosecutor’s figure of 1% for $P(M|I)$, the posterior odds are then 1/100, corresponding to a posterior probability, $P(I|M)$, of 1/101, which is “about 1%.” In other words, some jurors could arrive at the 1% figure without committing the prosecutor’s fallacy.

¹⁰³ The average probability, the 1% chance, and the 1 in 57 items are all significantly related to verdict choice; the 99% probability question is related at the .055 level of statistical significance.

Table 5.5 Probability Judgments and Initial Verdict Choices

	<u>Guilty</u>	<u>Not Guilty</u>	<u>Unsure</u>
Average probability that defendant is robber	90%	42%	64%
The mtDNA evidence in this case excludes at least 99% of the population as the source of the hairs.	74% agree	62% agree	72% agree
The mtDNA evidence in this case shows there is about a 1% chance that someone else besides the defendant committed the crime.	46% agree	47% agree	60% agree
The mtDNA evidence in this case shows that there is only a 1 in 57 chance that the defendant committed the crime.	38% agree	57% agree	54% agree

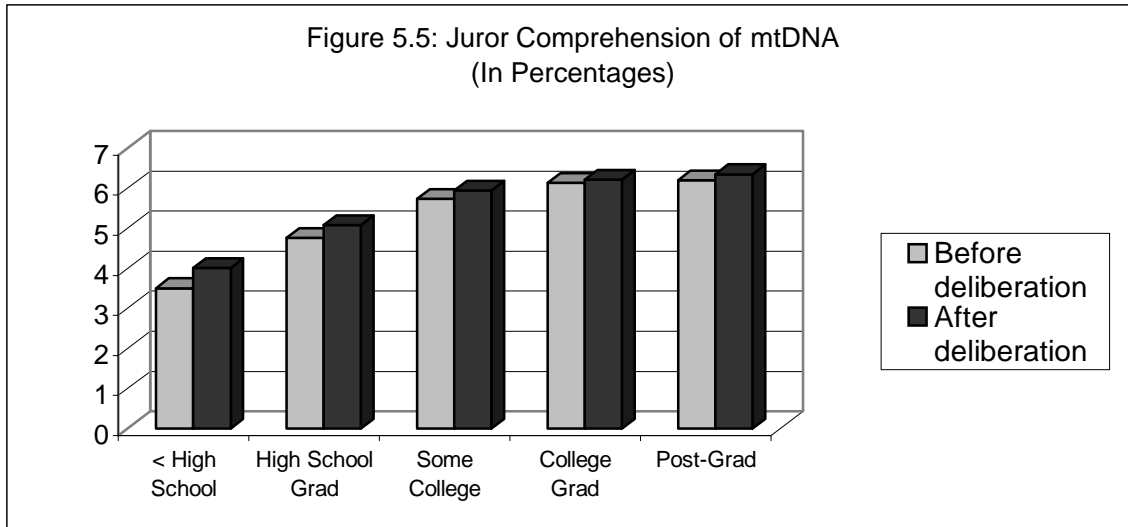
The probability judgments are associated with better overall understanding of the mtDNA evidence. Jurors who do better in defining mtDNA and in responding to other factual questions about mtDNA judge the probability that the defendant is the robber to be higher.¹⁰⁴

Juror Comprehension Scale

We combined 8 factual knowledge items about mtDNA (see starred items in Table 5.4, and the mtDNA versus nDNA proof of identity item displayed in Table 5.3) to develop an overall measure of juror comprehension of mitochondrial DNA. Each correct answer on an individual item contributed 1 point; incorrect and don't know responses and failures to respond were given no points. The Juror Comprehension Scale could range from 0, no correct answers, to 8, all correct answers. Before deliberation, the Juror Comprehension Scale mean score was 5.6 (standard deviation = 1.69). On average, between 5 and 6 items were answered correctly. Before deliberation, three people in our study got no correct answers; 62 people got all 8 answers correct. After deliberation, the Juror Comprehension scale scores increased slightly but significantly (scale M = 5.8, s.d. = 1.59).

As expected, mock jurors with higher levels of formal education did better on the jury comprehension items, both before and after deliberation. See Figure 5.5.

¹⁰⁴ The relationship between the mtDNA definition accuracy and probability judgments is statistically significant ($F(4, 479) = 5.30, p = .001$). Those who are unable to provide any correct statements about mtDNA, for instance, on average rate the probability that the defendant is the robber at 55%, while those who include two or more correct statements in their mtDNA definitions rate the probability at 74%. There is also a significant positive relationship with the 8-item Juror Comprehension Scale discussed in the following section ($r = .27, p = .001$); the better the understanding of mtDNA, the higher the probability judgment.



In a repeated-measures analysis of variance, using the before-and-after 8-item comprehension scale scores as a within-subjects factor and the juror’s educational level as a between-subjects factor, we find both deliberation and education significantly improve juror comprehension of mtDNA (Deliberation $F(1, 474) = 7.72, p = .006$; Education $F(1, 474) = 20.37, p < .001$). Education has the strongest effect; as formal education rises, so do the comprehension scores.

Likewise, people who report a larger number of science and mathematics courses in high school and college have higher scores on the Juror Comprehension Scales (Science and Math Courses $F(1, 450) = 33.30, p < .001$) even when the juror’s overall education level is included in the repeated measures analysis. Mock jurors who say they have had job experience in math or science also perform better ($F(1, 475) = 8.27, p = .004$ in a repeated measures analysis, controlling for overall education level), but once the number of math and science courses is entered as a covariate, the job experience is no longer statistically significant.

We used a repeated-measures analysis of the Juror Comprehension Scales before and after deliberation to examine the possible role of other demographic variables. The mock jurors’ race had the strongest impact. Nonwhites have lower scores than whites, controlling for juror’s age, education, gender, and the number of math and science courses ($F(1, 444) = 32.15, p < .001$). The juror’s age and gender are not statistically significant in the analysis of juror comprehension.

After analyzing the set of 8 basic knowledge questions, we added two probability items to the 8 existing items to form an Expanded Juror Comprehension Scale.¹⁰⁵ Data analysis of this expanded scale once again reveals the strong and continuing impact of the juror’s educational level, the number of mathematics and science courses, and science-relevant job experience. Nonwhites again have lower scores than whites, controlling for the juror’s age, education,

¹⁰⁵ The two items are: “The mtDNA evidence in this case excludes at least 99% of the population as the source of the hairs” and “The mtDNA evidence in this case shows there is about 1% chance that someone else besides the defendant committed the crime.”

gender, and the number of math and science courses. However, jury deliberation, which produces a significant improvement in scores on the 8-item scale, does not increase overall juror performance on the expanded set of items.

General views about science are related to performance on the juror comprehension scales. People who have concerns about science do more poorly on the tests, both before and after deliberation, and on both the basic and expanded comprehension scales.¹⁰⁶

Concerns about Reliability and Contamination of mtDNA

The defense expert in *State v. Jones* questioned the reliability of the mitochondrial DNA analysis during her testimony. She observed, as did the prosecution expert, that mtDNA is not as accurate an identifier as nuclear DNA. Furthermore, purposeful or accidental contamination of DNA evidence has been the subject of a large number of news stories. Even if jurors have good comprehension of mtDNA scientific issues, they may have worries about scientific imprecision, laboratory error, or police or laboratory misconduct that may translate into low estimates of the reliability of mitochondrial DNA. Therefore, we examined mock jurors' judgments of the general reliability of the mtDNA evidence and beliefs about the likelihood of contamination in the present case. We did not ask questions about these matters prior to deliberation to avoid alerting participants to reliability and contamination issues.

The post-deliberation responses about perceptions of reliability may be found in Table 5.6.

Table 5.6: Juror Perceptions of mtDNA Reliability

5-Point Scale	Percent
Not at all reliable	7
Slightly reliable	22
Somewhat reliable	37
Very reliable	32
Extremely reliable	3

Table 5.6 shows an interesting range of views about the reliability of the scientific evidence. A total of 28% of the study participants see the mtDNA evidence as not at all or only slightly reliable. Another 37% think it is somewhat reliable. A little over a third (35%) assert that it is very or extremely reliable. Recall the initial views of this group of participants described in Chapter 4; DNA evidence is identified as very or extremely reliable by 94% of the sample. By contrast, mitochondrial DNA evidence, at least that offered in *State v. Jones*, is a poor cousin.

¹⁰⁶ The correlations between the Jury Comprehension Scale scores and the Index of Scientific Reservation scores are statistically significant, ranging from -.26 to -.35, showing that the more concerns people express about science, the worse they tend to do on the mtDNA comprehension questions. The Index of Scientific Promise is unrelated to juror comprehension scores.

Views about the reliability of mtDNA evidence are related to the juror’s educational level ($F(4, 477) = 4.75, p = .001$), and the total number of math and science courses they have had ($F(4, 451) = 4.06, p = .003$). Those with more formal schooling and more math and science courses see the mtDNA evidence as more reliable. Higher scores on the juror comprehension scales (the 8-item scale and the expanded version) are also associated with more positive judgments of the reliability of mtDNA (for the 8-item scale, before deliberation: $F(4, 478) = 7.98, p < .001$); after deliberation $F(4, 478) = 17.17, p < .001$). Somewhat surprisingly, general views about science, as measured by the Index of Scientific Promise and the Index of Scientific Reservation, are not significantly related to views about the reliability of mtDNA in the case.

Table 5.7 shows the responses to a related question tapping views of contamination of the mtDNA evidence.

Table 5.7: Juror Beliefs About mtDNA Contamination

5-Point Scale	Percent
Not at all likely	38
Slightly likely	38
Somewhat likely	19
Very likely	4
Extremely likely	1

Asked how likely it is that the mtDNA evidence in the case is contaminated, three-quarters of the study participants report that the likelihood of contamination is nonexistent or only slight. However, 19% rate it somewhat likely, and another 5% say that contamination is very or extremely likely. Who are the people who are most likely to believe that the mtDNA evidence is contaminated? People with fewer years of formal education ($F(4, 478) = 4.56, p = .001$), including fewer math and science courses ($F(4, 452) = 4.32, p = .002$), are more apt to worry about contamination. The Index of Scientific Reservation score is also related to these views. Those who have more negative views about science generally are also more likely to perceive mtDNA contamination ($F(4, 478) = 4.12, p = .003$). The Index of Scientific Promise, however, is not related to estimates of contamination.

As before, we examined the possible role of demographic factors on assessments of the reliability and contamination of the mtDNA evidence. A regression using the reliability judgment as the dependent measure and the juror’s gender, race, and educational attainment as predictor variables shows significant effects for education (Beta = .14, $t = 3.13, p = .002$) and white versus nonwhite race (Beta = -.15, $t = -3.40, p = .001$). Similar results are found with judgments that the mtDNA evidence is likely to be contaminated (education Beta = -.16, $t = -3.57, p < .001$; nonwhite versus white race Beta = .18, $t = 4.05, p < .001$). Whites and those with more education are most confident in the reliability of the mtDNA evidence. Gender is not a significant predictor of these judgments about mtDNA reliability.

Summary

Overall, the study participants report feeling generally comfortable with the scientific presentation of mitochondrial DNA in the mock trial. Indeed, they do fairly well on the

comprehension tests given both before and after deliberation. Some issues are easier to comprehend and better mastered than others, of course. The question of mtDNA's maternal inheritance, which was discussed by both experts, presented in slides, and commented upon by the attorneys, is understood by about 90% of our mock jurors. There is, predictably, more difficulty with how the mtDNA match statistics relate to the defendant's likelihood of guilt.

A number of factors affect juror comprehension of mtDNA. Education, and particularly the number of mathematics and science courses the juror has taken, has a statistically significant effect. So does having a job that includes mathematics and science experience. Participating in jury deliberation improves juror comprehension. Race also affects comprehension of mtDNA, controlling for educational differences.

We also found important concerns about the reliability of the mtDNA evidence and the possibility of its contamination. Our study participants, who are enthusiastic about DNA evidence in general, rating it very or extremely reliable, rate the mtDNA in the mock trial as much less reliable. The Index of Scientific Reservation, which taps concerns about science, is significantly linked to worries about contamination. Nonwhites, and those with less formal schooling, are more concerned about mtDNA reliability and contamination.

Chapter 6 – Jury Innovations: Use, Attitudes and Effects

In this chapter, we examine one of the major purposes of this study, to explore the use and impact of jury trial innovations. As outlined earlier, mock jurors were randomly assigned to eight-person juries and to one of the six conditions in the experiment.

Table 6.1: Jury Innovations Permitted Across the Experimental Conditions

Experimental Condition Number	Jury Innovations Permitted
Condition 1	Control (No Innovations)
Condition 2	Note Taking
Condition 3	Question Asking and Note Taking
Condition 4	DNA Checklist and Note Taking
Condition 5	Jury Notebook and Note Taking
Condition 6	All Innovations (Note Taking, Question Asking, DNA Checklist, Notebook)

We examined jurors' uses of the innovations in multiple ways. We asked mock jurors a variety of questions about their use of the jury reforms in the questionnaires. We reviewed their written notes, as well as copies of the checklist and the notebook materials for any notations. We also analyzed the questions jurors posed during the trial. Finally, all sixty deliberations were videotaped, reviewed, and coded to determine the use of jury innovations.

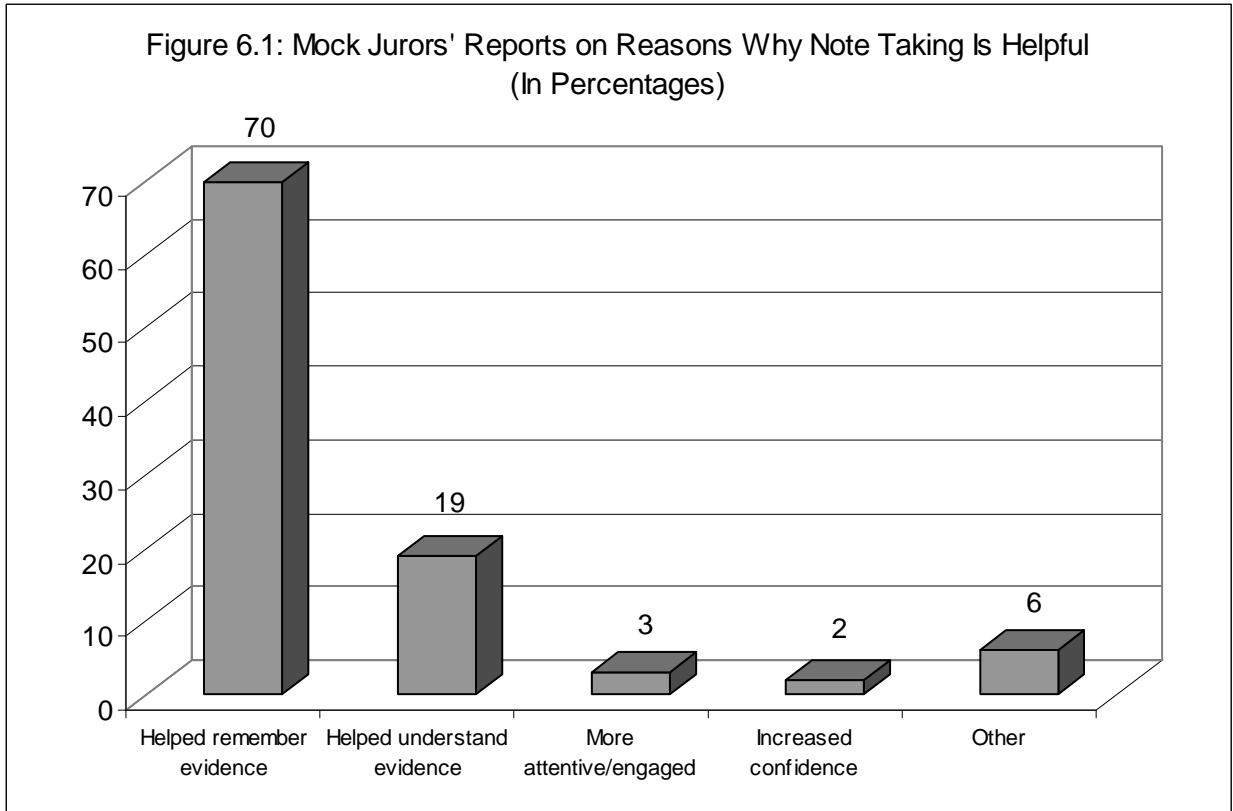
Note Taking

Frequency of Note Taking and Jurors' Impressions of Notetaking

As described earlier, jurors in five of the six conditions, or a total of 400 jurors, were instructed about their ability to take notes during the videotaped mock trial, and were furnished with pens and either a stenographer's notepad or blank sheets of paper, depending on the experimental condition.

Juror note taking is frequent. Of the 400 jurors who are told they could take notes, 351, or 88%, do so. Just the chance to take notes is identified as helpful by 85% of the jurors. For the 12% who elect not to take notes, the reasons most often cited are lack of need for notes (42%) and distraction (26%).

The note-takers were asked to state why they found the procedure helpful, and Figure 6.1 displays their responses. The most significant benefit seen to notetaking is as a memory aid. Two-thirds of note-takers report that taking and having their notes to refer to during deliberations helped them remember the evidence. Over 18% report that note taking contributed to their understanding of the evidence.



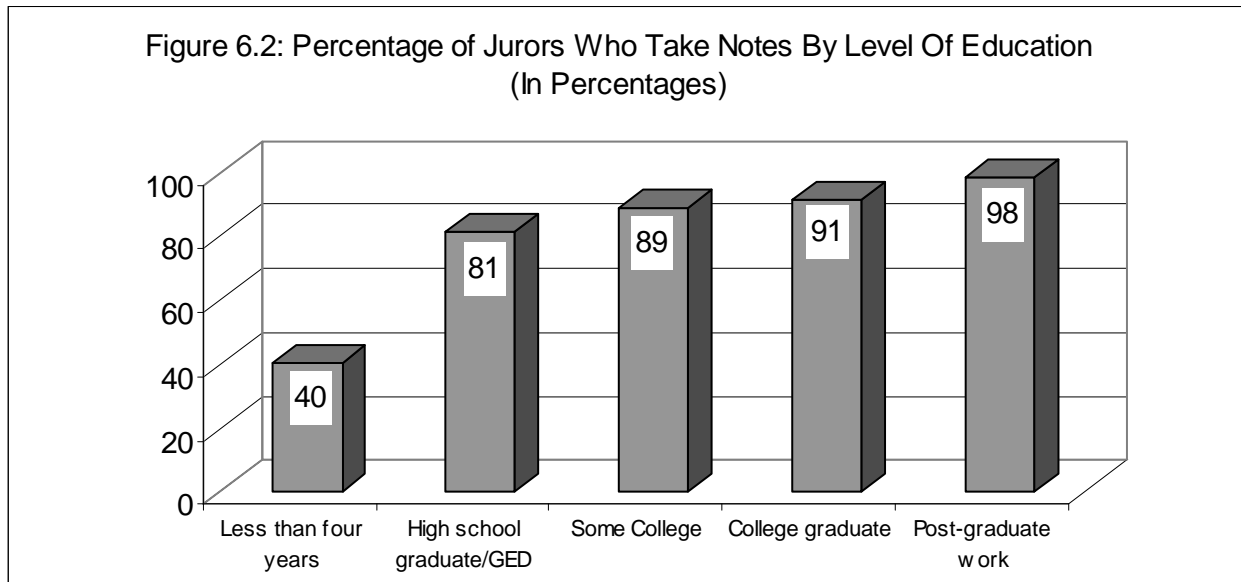
Juror support for note taking is very strong. Out of a total of 480 respondents, 426 (89%) say they favor allowing jurors to take notes during trial. Support for note taking as a recommended jury reform is highest among those 400 jurors allowed to take notes (91%, N=362) compared to the 80 mock jurors in the control condition not allowed to take notes (80%, N=64). Support increases still further if jurors do in fact take notes (91%, N=319) over those who choose not to take notes (88%, N=43) ($F(7, 399) = 15.49, p = .03$). Opposition to note taking also decreases depending on whether jurors take notes. Among those who refrain from taking notes after being told of the opportunity, 10% (N=5) say they oppose allowing jurors to take notes at trial; among note takers, the fraction opposed is just 6% (N=21).

Juror satisfaction with the verdict is significantly higher among jurors who are told they can take and use notes compared to those who are not allowed to do so ($F(1, 477) = 5.31, p = .02$). However, the actual experience of note taking does not produce greater confidence in jurors' individual verdict preferences or their satisfaction with their jury's final verdict. Note takers and non-note takers express about the same levels of confidence in their initial verdict preferences and satisfaction with the final verdict.

Thus, the vast majority of jurors take advantage of the opportunity to take notes, see it as an important memory aid, and endorse notetaking as a jury reform.

Who Takes Notes?

The juror's educational attainment is the most important factor associated with note taking. As illustrated by Figure 6.2, note takers with at least some college education are over twice as likely to take notes as those without a high school degree (89% vs. 40%). The most educated—those with post-graduate education—are the most likely to take notes (98%).



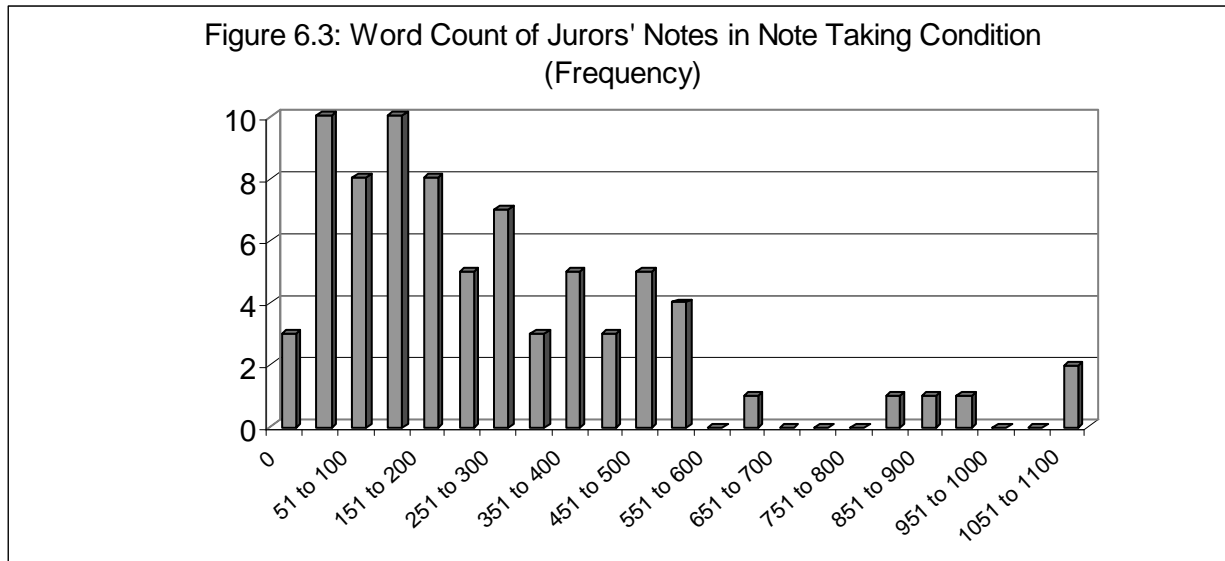
Those who have more math and science courses are also more likely to take notes when offered the chance ($F(1, 379) = 5.69, p = .018$). Women are more likely than men to take notes (92% versus 84%, $\text{Chi Square}(1, N = 398) = 5.41, p = .02$). The mock jurors' racial and ethnic identity and age do not affect their likelihood of note taking. Finally, note takers are no more likely to vote guilty than non-note takers.

Interestingly, jurors in the note taking-only condition are marginally more likely to take notes (96%) than those in the other innovation conditions where another reform is paired with note taking (85%) ($\text{Chi Square}(4, N = 9.16, p = .057)$). Indeed, Condition 6 juries, where all four reforms are available to those 80 jurors, include the lowest percentage of note takers (81%). It is likely that being able to rely on other materials reduces the need to rely exclusively on one's own notes.

Analysis of Notes in the Notetaking Condition

For a word count analysis of the notes taken by mock juries, we selected the 80 participants in the 10 mock juries in Condition 2, the Note Taking condition. Just three mock jurors failed to take notes in that condition.

All of the notes were transcribed and a word count analysis was undertaken. That analysis shows that, for all 80 participants in the Notetaking condition, including the non-note takers, there is an average number of 270 words per juror, with a standard deviation of 239 words. The range is tremendous, from a low of zero to a high of 1,089 words. The histogram in Figure 6.3 shows the wide range, and also the clustering of word counts in the 50-200 range.



The mock trial begins with judicial instructions, including the judge providing the legal definition of robbery. The majority of mock jurors in the Note Taking condition (65 of the 80 jurors, or 85% overall) include the judge’s instructions in their notes. Jurors who take more notes are also more likely to include these initial judicial instructions ($F(2, 79) = 4.88, p = .01$). The 65 jurors who include the judge’s instructions have an average word count of 306, while the 12 jurors who omit the judge’s instructions have a word count of just 140.

Use of Notes in Deliberations

Jurors who take notes have the notes with them during deliberations and can refer to them. Even in our shortened mock trial and deliberation, we find that jurors do refer to their notes. During the viewing of the recorded deliberations sessions, the number of jurors’ specific references to notes was coded. (Silent references to notes without a spoken confirmation of doing so were not coded.) Jurors in three-quarters of the notetaking juries make express references to their notes. The number of references per jury ranges from 1 to 12; the mean number per jury is 2.84 references. Most references involve factual or evidentiary matters (77%) as contrasted with notes of the court’s instructions of law (23%). Only one of the 142 coded references was found to be inaccurate—the juror had recorded the wrong last name of a witness.

Juror Questions of the Expert Witnesses

As described earlier, the instruction given to jurors regarding their opportunity to ask questions of the scientific experts, like the instruction on note taking, is almost identical to the one used by the grantee in civil and criminal trials in Arizona and similar to the one recommended by an influential publication on jury trial reforms.¹⁰⁷ Jurors were instructed that they should put any questions intended for the experts in writing and give them to a research assistant so that one of the on-call DNA experts could answer the question by telephone. Jurors were told that a written answer would be given to them as soon as possible after receipt of their question. They also heard that they might be told that for legal reasons some of their questions might not be answered and that they were not to guess what the answer might have been or wonder why the question could not be answered.

Frequency of Juror Questions and Jurors' General Impressions and Support for the Procedure

Fourteen of the twenty juries in the two question-asking conditions (conditions 3 and 6) submitted at least one question. A total of 67 separate questions, including subparts, were asked in writing during the mock trials. Although the mock jurors were instructed that questions were to be limited to the experts, the submitted questions included some for other witnesses or the judge. Of the total number of questions, 49 (73%) were asked of the experts. All of the questions for the DNA experts received a written answer. The remaining 18 questions for other witnesses were acknowledged, but the jurors were reminded that only questions for the experts were being taken.

Thirty-five jurors, or 22% of all jurors in the question-asking conditions, report that they personally asked a question. Three-quarters of those who ask personally ask questions say that the major benefit is that it helps them understand the evidence. Even if they did not personally ask a question, the majority of jurors in these conditions (83%, or 126 of 160 mock jurors) agree that it is at least somewhat helpful to have the opportunity to ask questions of the experts. Jurors who ask questions report having taken significantly more math and science courses than jurors who have the opportunity to ask questions but do not ($M = 12.85$ for jurors who ask a question, versus $M = 8.91$ for jurors who do not ask a question; $F(1, 153) = 7.27, p = .008$). Jurors with science or math job experience are marginally ($p = .09$) more likely to ask questions. Juror education is not a statistically significant factor though it is in the expected direction ($p = .13$).

What Do Jurors Ask?

All 49 juror questions for the DNA experts were reviewed, as were the written answers to each. A content analysis of the 49 questions reveals what the jurors want to learn from the experts. The number of questions asked for each subject are listed in Table 6.2.

¹⁰⁷ JURY TRIAL INNOVATIONS, *supra* note 1, at 144-45.

Table 6.2: Content Analysis of Jurors' Questions

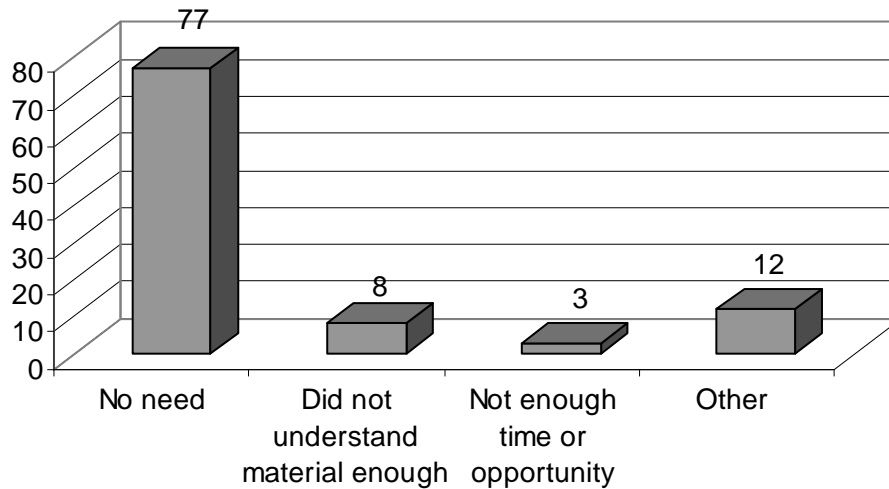
Number of Questions	Subject
10	FBI's mtDNA database
5	Differences between mtDNA and nDNA
5	Heteroplasmy (2 requests to "explain again") (3 questions about mutations)
4	Use of mtDNA generally
4	Reliability of mtDNA
4	Number of base pairs compared
3	Amount of hair analyzed
3	History of use of mtDNA in court
3	Lab procedures (e.g., microscopic analysis and contamination possibilities)
3	Whether other DNA found or analyzed
2	Maternal lineage
1	Define "frequency"
1	Number of mitochondria per cell
1	Whether outside testing done to confirm findings

One out of five juror questions (10 of the 49) reflect their interest in and, most likely, their concerns about the size, sources and content of the FBI's mtDNA database. These are chief among the reservations jurors express about the database during jury deliberations.

Why more jurors (and deliberating juries) do not take advantage of the opportunity to ask questions of the two expert witnesses is surprising, especially given the nature and complexity of the mtDNA presentations and the issues presented by the experts.

Jurors' responses to the questionnaires shed light on why most do not submit questions. Figure 6.4 below illustrates the percentages of jurors who feel that there is "no need" to ask a question (77%, N= 89), do not understand the material well enough to ask a question (8%, N=9) and the lack of time and opportunity to do so (3%, N=3). Taken together, these three proffered reasons shed further light on why most (88%, N=101) jurors do not ask questions.

Figure 6.4: Jurors' Reports for Not Asking a Question (In Percentages)



Despite the low number of questions received from jurors, mock jurors on the whole support the reform that allows jurors to ask questions during the trial. A total of 59% of all mock jurors endorse juror questions. Of the 160 jurors in the question conditions, 69% (N=110) support the trial innovation permitting jurors to submit questions to witnesses. The greater support among those who experience the opportunity to ask questions is statistically significant ($F(1, 478) = 15.23, p < .001$).

In actual jury trials in which jurors are able to ask questions, the typical number of questions per trial is fairly low.¹⁰⁸ Even though we actively encouraged study participants in our mock jury research to ask questions, the number was likewise fairly low considering the complexity of the expert testimony. However, the number of juror questions we found may be due to characteristics of our research project including the lack of time and opportunity for jurors to frame questions in their own minds, then write them down, discuss them with other deliberating jurors and ask the presiding jurors to send them out, given that the mock jurors' total time in trial and deliberations averaged about three hours. In reality, a case of this type and complexity would typically take from two to four days to try, with much more time and many more opportunities to submit questions. However, there might also be greater repetition of scientific material in an actual trial, and more procedural impediments to submitting questions. One of our findings, that persons with more background in math and science were more apt to ask questions, also suggests the possibility that some jurors without a science background do not understand the mtDNA evidence well enough to be able to frame a question for the experts or are otherwise reticent to do so.

¹⁰⁸ See Chapter 2, Literature Review, for a summary of the studies of juror questions.

Checklists (Decision Trees) Relating to DNA Evidence and Issues

Jurors in two conditions (Condition 3, Checklist and Jury Note Taking; and Condition 6, All Innovations) were provided with a checklist, and heard a judicial instruction that the one-and-one-half page checklist might be helpful in assisting them in understanding the expert evidence in the case. They were told to use them as they saw fit.

As described earlier, although use of such checklists (sometimes referred to as “decision trees” or “inference charts”) as jury decision aids is rare, we selected this innovation because of its potential to assist lay jurors in addressing and resolving the issues presented by complex and contested mtDNA evidence¹⁰⁹ and at the suggestion of the project’s Advisory Committee. The checklist presents the issues presented by the two DNA experts in a simple, step-by-step “yes” or “no” fashion, leading the jurors who accept the relevance and scientific soundness of the uncontested match in the mtDNA samples to choose between the two versions of random match probabilities presented by the parties’ experts, and ultimately to a choice of inferences concerning the likelihood that the hairs found in the discarded sweatshirt were those of the defendant’s. The checklist may be found in Appendix B. It was adapted from a published one tailored to older DNA technology.¹¹⁰

A large percentage of jurors in the two checklist conditions report that they “reviewed” the checklist (86%, N=136). Use of the checklist in a step-by-step collective manner appears to have been quite limited, however. The total number of references to the questions in the checklist observed in the recorded deliberations was 8. Those references occurred in 7 of the 20 (35%) of all the juries supplied with checklists. Only two of those juries were observed attempting to work through the seven numbered questions in the checklist. Both group efforts were abandoned about midway through when discussion of related evidence commenced.

Although collective use of the checklists is very low, it remains possible that individual jurors worked through them, in part or in whole, in a somewhat systematic way. When the small number of jurors who say they did not review the checklist (N = 23) were asked their reasons for not doing so, about a third (35%, N = 8) say they didn’t have the time to do so; while others (22%, N=5) report they saw no need. We hypothesize that some other reasons that jurors do not take a step-by-step approach to their review of the checklist, which would have been the most helpful for comprehension, include time limitations, a lack of clarity about how to employ the checklist, the possibility that jurors do not find it that helpful, and the chance that jurors find it somewhat intimidating.

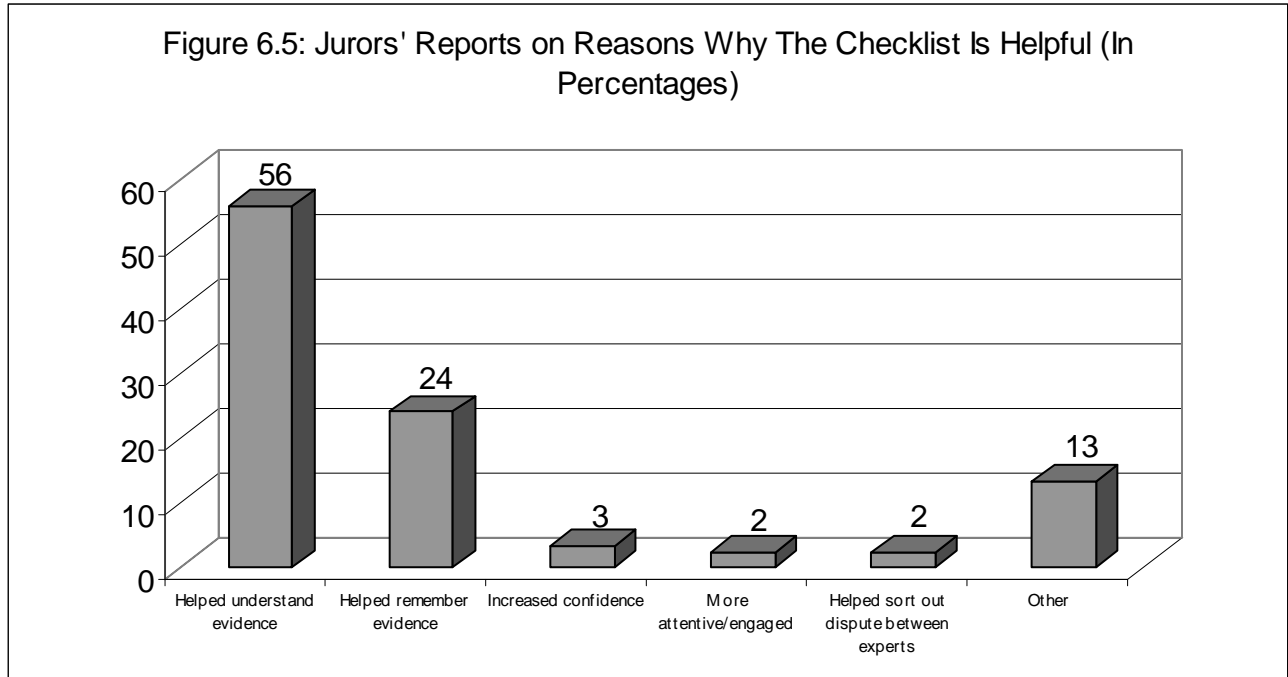
In any event, use of the checklist is not related to the juror’s science and math background, science and math job experience, or educational level.

¹⁰⁹ See Chapter 2, Literature Review, for a fuller discussion of the juror checklist innovation.

¹¹⁰ See Eric Magnusson & Ben Selinger, *Jury Comprehension of Complex Scientific Evidence: The Inference Chart Concept*, 14 Crim L.J. 389 (1990).

How Does the Checklist Benefit Jurors?

Sixty-nine percent (69%, N=109) of jurors in the checklist conditions say that the chance to review the checklists is “somewhat,” “very,” or “extremely” helpful. The reasons the jurors cite for believing that the checklist is helpful are summarized in Figure 6.5.



As illustrated, significant percentages of the jurors (out of a total N of 133) report that the checklists help them understand the evidence (56%, N=75) or remember the evidence (24%, N=32). These two responses, dealing with comprehension and recall of the mtDNA evidence, account for a substantial majority of jurors supplied with checklists (80%, N=107).

Support for Provision of Checklists in Jury Trials

The support for the checklist innovation among all jurors is 77%, with about half (46%) strongly in favor of their use in trials. Of the 160 jurors who are provided with the checklists, about half (49%, N=79) “strongly favor” their use in trials. Jurors in the checklist conditions favor their use by somewhat wider margins—81%, N=130—compared to jurors in the control groups (77%, N=62). Support for checklist use is highest among those jurors who choose to review them (85%, N=136/159). Only 17% (N=23/159) of those who review the checklists oppose the idea.

Whether or not jurors use the checklists does not materially affect the confidence they express in their personal individual pre-deliberation verdict preference or their satisfaction with their juries’ final verdicts. This is not surprising, given the low percentages of juries and jurors

who we observed working through their checklists to completion. Nevertheless, support for the innovation is high.

Multi-Purpose Juror Notebooks

Finally, juries in two conditions (Condition 5, Jury Notebooks and Note Taking; and Condition 6, All Innovations) were provided with jury notebooks. As described earlier, courts are making increasing use of jury notebooks and we deemed it worthwhile to examine their use and impact.¹¹¹ The multi-purpose juror notebooks used in the research study were divided into five tabbed sections: (a) blank paper for note taking; (b) copies of the two experts' slides; (c) the mtDNA checklist; (d) a glossary of the DNA terms used in the case; and (e) a witness list. The instructions to the 20 juries in the Notebooks conditions were straightforward and the same: they were told of the notebooks' contents and that they were free to make use of them as they saw fit.

Frequency of Notebook Use

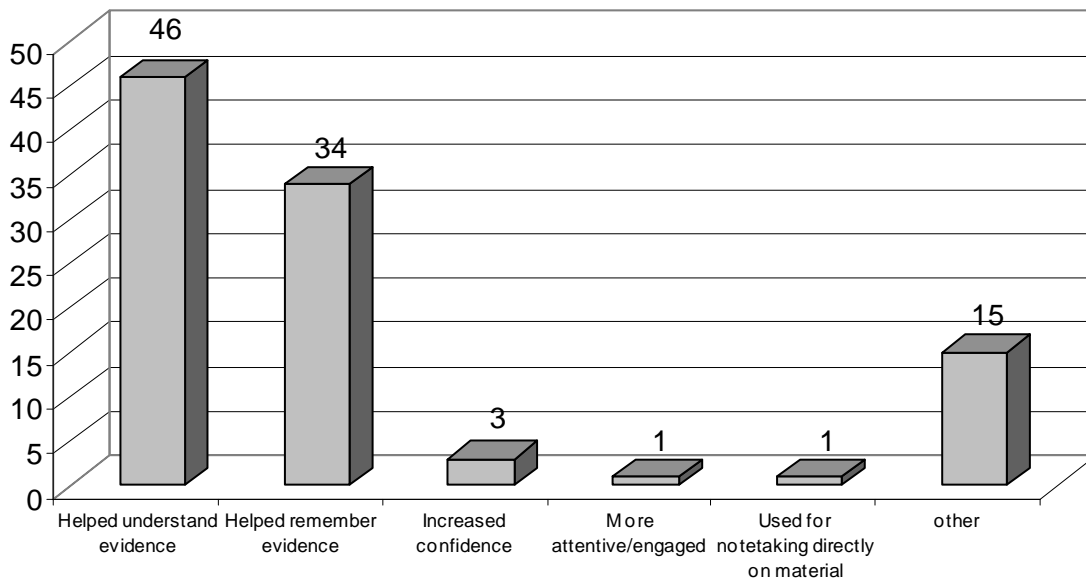
Over ninety percent (92%, N=147) of the 160 jurors in the two conditions say they took advantage of the opportunity to review the contents of their notebooks. For the small minority who do not do so, the reasons most often cited are that jurors find it unnecessary (35%, N=6); they are not aware of the contents (18%, N=3), or that they are confused or distracted (12%, N=2). During deliberations, articulated references to notebook contents other than juror notes are infrequent. Only 17 such references, involving 11 of the 20 juries, were observed. It was apparent from a review of the taped deliberations that the great majority of the references are to the copies of the DNA experts' slides.

Jurors' Reactions to Notebooks

Jurors attach considerable value to the notebook materials. Ninety percent (90%, n = 142) rate the chance to use them as "somewhat" to "extremely helpful." When asked how the notebooks help, many jurors report that the notebooks help in the understanding (46%, n = 66) and recall (35%, n = 50) of the evidence. Figure 6.6 displays a more complete picture of how the notebooks assist the jurors.

¹¹¹ See Chapter 2, Literature Review, for a fuller discussion of the growing use of jury notebooks.

Figure 6.6: Mock Jurors' Reports on Reasons Why the Notebooks Are Helpful (In Percentages)



Support for permitting jurors to use notebooks ran high (85%, N=480) particularly among the jurors who reviewed the contents of the notebooks. (Perhaps these findings represent the opposite of a familiar maxim, “Familiarity breeds support.”) The notebook users support the practice at a rate of 82% (N= 119) compared to 61% of the 13 who said they did not review the notebook contents. Likewise, support for notebook use is lower for the remaining jurors who did not receive notebooks (76%, N=242/319).

Recapitulation of Major Findings Regarding Juror Use of and Support for the Four Innovations

Figures 6.7 and 6.8 summarize and compare the major conclusions drawn regarding the jurors’ use, assessment and support for the specific innovations we explored in this study.

Figure 6.7: Mock Jurors' Reports of Use and Support for Innovations
(In Percentages)

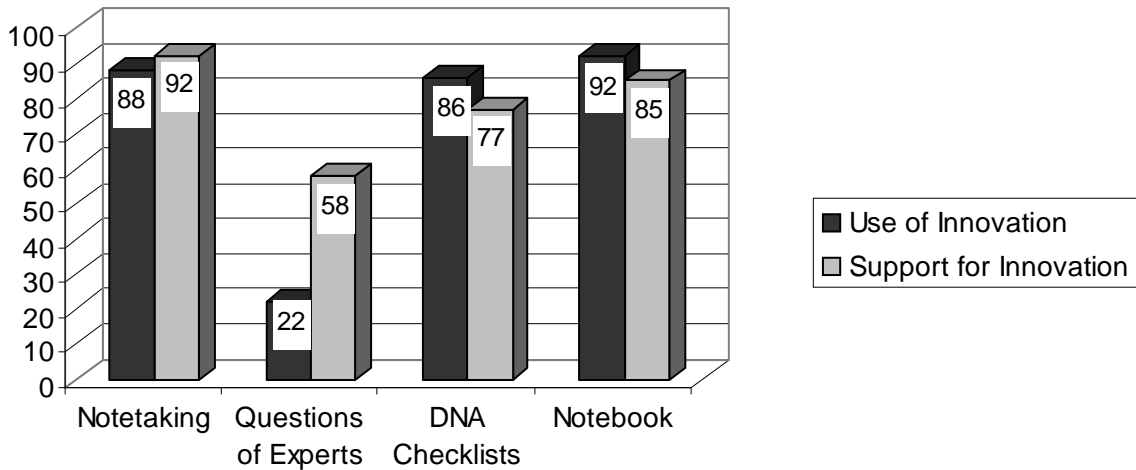


Figure 6.7 compares the jurors' use of innovations in the different experimental conditions that offered different jury innovations. It also compares support for the four tested innovations among the entire sample. When given the opportunity to do so, jurors employ notebooks, notetaking, and the mtDNA checklist at a high rate. A smaller proportion of jurors ask questions of the experts. However, support for all four of the tested innovations among the study participants is substantial, even among those jurors who do not have the opportunity to use the innovation.

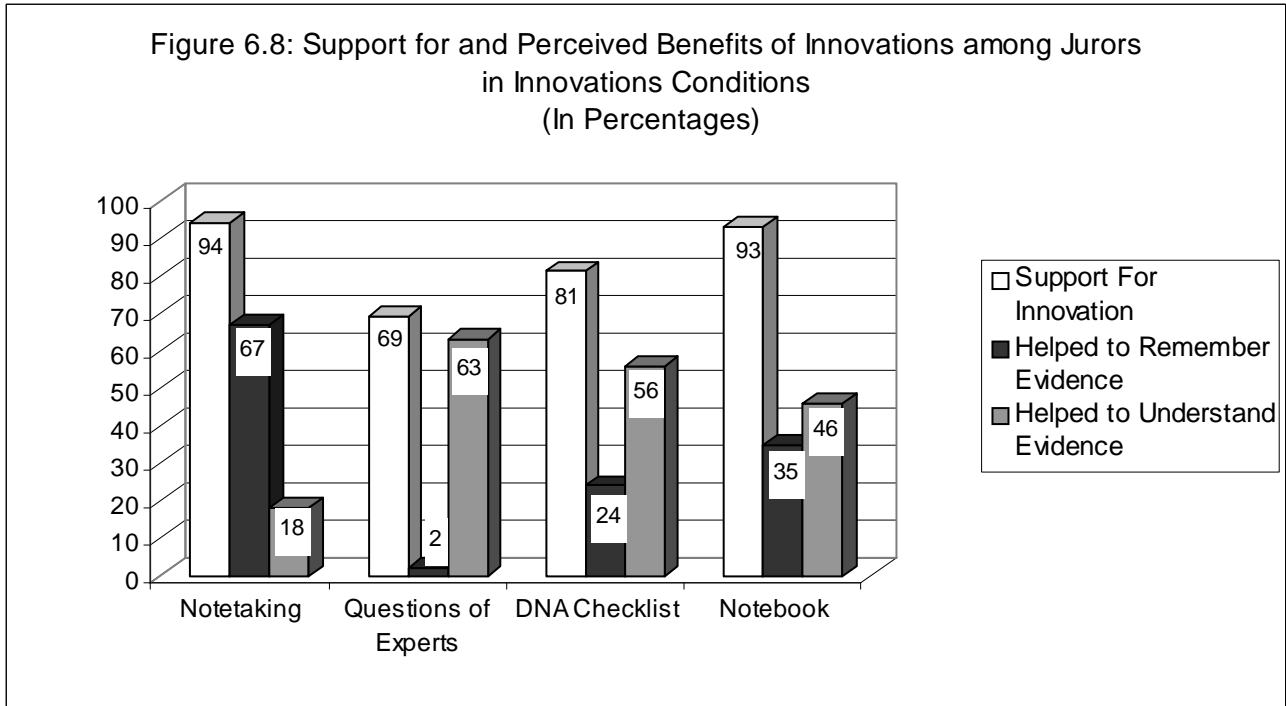


Figure 6.8 focuses on the jurors in the innovations conditions, comparing their support of the specific innovations they had the opportunity to use. These study participants who have the opportunity to employ particular innovation are even more enthusiastic about the reforms.

Figure 6.8 also examines and contrasts whether different innovations are most helpful to understanding or remembering the evidence. Note taking is rated as contributing the most to juror recall of the evidence, compared to the other innovations. However, more jurors rate the question-asking procedure higher in terms of aiding understanding of evidence. Interestingly, juror questions are valued most highly for their contribution to understanding, even though the use is the lowest of any innovation.

The Impact of Trial Innovations on Jury Comprehension of Scientific Evidence

A final and most important issue is to examine how providing the study participants with various jury reforms influences their ability to understand and employ the scientific evidence in the trial.

We examined this issue in several ways. We have already detailed the jurors’ own reports about the value of various innovations and how they are most helpful. That is very significant in that jurors have the most direct access to their own decision making processes and can inform us about their perceptions of the usefulness of different reforms.

Because we also attempted to gauge the accuracy of jurors’ knowledge of mitochondrial DNA, we have a ready method for assessing whether providing different jury innovations

increases jury comprehension of mtDNA. In a number of analyses, we explored how jurors in the different experimental conditions performed on the Jury Comprehension Scales both before and after their deliberations.

In undertaking these analyses, we employed nested analyses. Jury research is well suited for nested analyses, as jurors are “nested” within each jury. Since the mock jurors in this study were assigned to a jury and jurors deliberate with one another, the members of the assigned jury influence (subtly or not) each juror and thereby his or her responses on the questionnaires. Jurors’ responses following deliberations are no longer strictly independent observations, as assumed by many traditional statistical techniques. Several techniques are able to accommodate such nested designs. Survey regression analysis allows researchers to analyze individual (e.g., juror-level) variables yet account for group membership (e.g., jury-level), thus overcoming any problem of juror dependence by adjusting the standard errors in individual juror responses.¹¹² Nested ANOVA designs are also available. Because we regularly find the juror’s educational background is a significant factor in jury comprehension of mtDNA, we control for education in assessing the impact of innovations.

One set of analyses compared jurors who were allowed to use each particular innovation with jurors not allowed to use that innovation. So, for example, the notebooks analysis compared the juries where notebooks were allowed (Conditions 5, Jury Notebook and Note Taking, and Condition 6, All Innovations) with juries in the other four conditions. Before deliberations, there are no significant differences on jurors’ responses on the basic 8-item Juror Comprehension Scale between the various innovation conditions. However, after deliberation, jurors allowed to use notebooks perform significantly better on both the basic and expanded factual true-false tests than those not provided with notebooks (basic scale: $t = 2.11, p = .04$; expanded scale: $t = 2.12, p = .04$).¹¹³ Using the expanded 10-item Jury Comprehension Scale, jurors in conditions with the checklists perform significantly better than those without access to the checklists ($t = 2.27, p = .027$).¹¹⁴ These results controlled for jurors’ education levels, which show a strong positive effect on comprehension in all analyses.¹¹⁵

Another way to assess the effectiveness of the innovations is to compare the control group, where mock jurors decided the case without any innovative procedures, with each of the other conditions. These analyses were done on the Juror Comprehension Scales for juries following deliberation. No significant differences are found when comparing each condition separately to the control group (controlling for educational differences). However, there is some evidence that multiple innovations do improve the jurors’ comprehension of the scientific evidence. For example, jurors allowed to take notes and use a jury notebook do better on the Jury Comprehension Scales as compared to those only allowed to take notes ($t = 2.77, p = .01$

¹¹² The analysis was run using Stata (statistical package) with the command “svyreg” and specifying “psu’s” (clusters such as juries) for regression analysis.

¹¹³ The nested regression used jury notebooks and jurors’ educational attainment as predictor variables. The overall result, which measures the combined impact of both variables, is: basic scale: $F(2, 58) = 41.05, p < .001, R^2 = .15$, expanded scale: $F(2, 58) = 30.28, p < .001$.

¹¹⁴ The nested regression used jury checklists and jurors’ educational attainment as predictor variables. The overall result is: basic scale: $F(2, 58) = 42.14, p < .001, R^2 = .15$; expanded scale = $F(2, 58) = 30.77, p < .001, R^2 = .14$. The impact of checklists on the basic scale is only marginally significant ($t = 1.91, p = .06$).

¹¹⁵ The t -values range from 7.61 to 9.23, all statistically significant beyond the .0001 probability level.

and $t = 2.07$, $p = .05$, respectively on the 8-item and the expanded 10-item scales). This is also true for jurors exposed to all innovations. They outperform those only allowed to take notes ($t = 2.82$, $p = .01$, and $t = 3.07$, $p = .006$, respectively on the two scales).

Thus, two innovations in particular, jury notebooks and jury checklists, produce significant improvement in jury comprehension of complex scientific evidence.

Chapter 7 – Jury Deliberations

The principal reasons for videotaping the deliberations of all 60 mock juries were to assess jurors' uses and the impact of the innovations on the discussion and evaluation of the mtDNA evidence. The grantee watched all of the videotaped deliberations and recorded a range of aspects of the mock jury discussions.

Almost all of the deliberating jurors appear to take deliberations and verdict decisions seriously despite the fact they knew they were not deciding a real case. This observation is consistent with other high fidelity mock jury research. Several patterns emerged that deserve comment, including the selection of the presiding juror, the tendency to take immediate votes, the satisfaction jurors report with their deliberations, and the frequency of hung juries. The desirability of deliberation instructions is discussed. Finally, jurors' statements about combining scientific and nonscientific evidence and their association with distinctive verdicts warrant mention.

General Observations about the Deliberations

Jury deliberations range from as few as five minutes to as many as 105 minutes. The average deliberation length is 38.85 minutes. Of the 46 juries that reach unanimous verdicts, 26 acquit and 20 convict the defendant. Not surprisingly, hung juries deliberate the longest (68 minutes, on average), juries that acquit the shortest (13 minutes, on average), and juries who convict are in between (35 minutes).

The researchers expected that jurors would be divided over the case since the non-scientific evidence was designed to be ambiguous. That ambiguity caused some juries difficulty in reaching a verdict. Thirty-five percent (35%, $n = 21$) of all juries announced that they had reached an apparent impasse in their deliberations and did not think they would be able to reach a unanimous verdict. The grantee, a retired trial judge, appeared before all juries that announced an impasse, and delivered a "modified-Allen charge" or instruction encouraging the jurors to keep trying to reach a unanimous verdict and giving them some suggestions for doing so.¹¹⁶ Verdicts were ultimately returned by one-third (33%, $n = 7$) of the juries that received and heard the supplemental charge. The remaining 14 juries (67%) "hung" since they were unable to obtain a unanimous vote on a verdict.

¹¹⁶ All of the impasse instructions were recorded along with the juries' deliberations. The typical instruction reminded the jurors that their verdict had to be unanimous, that a verdict was both preferable and desired, that nothing in the remarks should be taken as an attempt to coerce any jurors to abandon strongly-held verdict views, that none of the jurors should be unduly invested in any earlier vote or poll and should be open to the views of other jurors, that they should allow each juror to repeat their reasons for preferring one verdict over another or for remaining undecided, and that jurors should change their positions and votes only if they were convinced on the merits to do so.

That so many of the 60 juries hang (23%, $n = 14$) is likely due to the simulated nature of the jury decision rather than a reflection of the real world, since the hung jury rate in actual trials is much smaller. A recent major study of hung jury rates funded by the National Institute of Justice found average rates as low as 2.5% in federal court and 6.2% in large urban state courts.¹¹⁷ In contrast, mock jury studies often have high hung jury rates.¹¹⁸

Jurors are on the whole satisfied with their deliberation experiences and their jury's ultimate decision in the case. A high percentage—84% (403)—say they are either somewhat or very satisfied with their jury's deliberation. Only 7% (32) report that they are dissatisfied with the deliberations. Likewise, most jurors are satisfied (77% (369) and agree (76% (362) with the jury's verdict. Satisfaction with the deliberation and verdict and agreement with the verdict are all highly correlated, as expected (r 's range from .32 to .78, all p 's < .01).

In Chapter 6 we reported that jury comprehension of mitochondrial DNA evidence improves after jury deliberation. Table 7.1 shows that jurors recognize the beneficial role of deliberation, with 77% seeing deliberation as helpful in increasing their understanding of the expert evidence in the case.

Table 7.1: How Helpful Was the Deliberation in Terms of Increasing Your Understanding of the Expert Evidence in this Case?

5-Point Scale	Percent
Very Helpful	41
Somewhat Helpful	36
Neutral	19
Somewhat Unhelpful	3
Very Unhelpful	2

Deliberating jurors on 20 of the 60 juries asked 28 questions, both written and oral, of the judge. Virtually all of the questions (25 of 28) sought answers to questions of law or pertaining to the judge's instructions. Most of the questions about law sought a further explanation of the reasonable doubt standard (84%, $n = 21$); three of the remaining four wanted confirmation that a verdict required a unanimous vote of all jurors. All of the legal questions were answered in full. The three questions seeking additional evidence were not answered; the jurors were told that additional evidence could not be provided and that they should base their decision on the evidence they had.

Selection of the Presiding Juror and the Jury Deliberation Process

Most juries choose one of their members to preside over the deliberations rather quickly. More often than not, the presiding juror (foreman or forewoman) is decided on the apparent basis of who is seated at the head of the table, the first juror to speak at all, or the only male on the

¹¹⁷ See, e.g., Paula L. Hannaford-Agor, Valerie P. Hans, Nicole L. Mott & G. Thomas Munsterman, Are Hung Juries a Problem? (2002) (National Institute of Justice No. 201096 http://abstractsdb.ncjrs.org/content/AbstractsDB_Download.asp?page=1). See also BEHIND CLOSED DOORS: A RESOURCE MANUAL TO IMPROVE JURY DELIBERATIONS (American Judicature Society 1999).

¹¹⁸ Dennis J. Devine et al., Jury Decision Making: 45 Years of Empirical Research on Deliberating Groups, 7 PSYCHOLOGY, PUB. POL'Y & L. 622 (2001).

jury. But, as other studies of the jury show, the presiding juror selection is not random. In our study, men are significantly more likely to be selected as presiding juror than women (X^2 (1 d.f. (N =477) = 6.28, $p = .01$). Fully 38 of the 60 juries (63%) have a male leader even though men constitute 48% of the study participants. In addition, those mock jurors who report higher household incomes are more likely to be jury leaders (M for presiding jurors = 5.52, M for other jurors = 5.27; F (1, 470) = 4.40, $p = .037$). Half the jury leaders in the study report household incomes of over \$75,000, compared to 38% of other jurors who report the highest level of income. Finally, science expertise seems to be a factor. Presiding jurors have higher total numbers of math and science courses (9.97 for presiding jurors; 8.64 for other jurors; F (1, 452) = 7.85, $p = .005$). The accuracy of their open-ended definitions of mitochondrial DNA is higher as well (1.47 for presiding juror; 1.25 for other jurors; F (1, 479) = 5.57, $p = .019$).¹¹⁹

The choice of presiding juror appears to matter too. The grantee's observations from reviewing all 60 deliberations are that the presiding juror often sets the tone and determines the nature and quality of the discussion that follows. A majority of presiding jurors do not seem to make much of an effort to keep order, encourage just one speaker at a time, or assure that all jurors have an opportunity to speak their minds. Frequently, two or more jurors talk at the same time for minutes at a time, while some of the silent jurors appear distracted or bored. Some presiding jurors personally dominate the discussion.

Several jury studies have found a significant relationship between juries taking an immediate vote before discussing the evidence and the likelihood of jury deadlock.¹²⁰ Studies also find that the quality of deliberations is lower for such "verdict driven" juries compared to "evidence driven" juries that focus on the amount and quality of the evidence before taking a vote or poll.

Almost two-thirds of the 60 juries in this study (65%, N = 39) take an immediate vote on jurors' verdict preferences. A vote or poll is deemed "immediate" if it occurs within the first two minutes of the deliberations. Of these 39 juries, 15 later announced an impasse. They received a "modified-Allen" instruction and were asked to keep deliberating in a further attempt to reach a unanimous verdict. However, 11 of these 39 immediate vote juries (28%) ultimately hang.

The remaining 21 juries that choose to discuss the evidence first rather than take an immediate vote are a bit less likely to say they've reached an impasse (6 of the 21; or 29%) and to declare themselves hung (3 of the 21; or 14%). However, the relationships between first vote timing and these consequences are not statistically significant. Nonetheless the overall pattern is similar to that found in other jury studies.¹²¹

¹¹⁹ The juror's racial and ethnic background does not affect whether he or she is selected as presiding juror. Other factors that make no difference are the juror's age, math or science job experience, occupation, and previous jury service. Educational attainment is only marginally related ($p = .09$).

¹²⁰ Hannaford-Agor et al., *Are Hung Juries a Problem?*, supra note 110. In addition, see Norbert L. Kerr & Robert MacCown, *The Effects of Jury Size and Polling Method on the Process and Product of Jury Deliberations*, in Lawrence S. Wrightsman, Saul M. Kassin & Cynthia E. Willis eds., *IN THE JURY BOX*, at 209 (1987).

¹²¹ Hannaford-Agor et al., *Are Hung Juries a Problem?*, supra note ___.

Previous reports on jury decision-making and other jury scholars have concluded that jurors often need and could benefit from some suggestions or guidance from the trial judge regarding the process of choosing a presiding juror and conducting jury deliberations.¹²² In his review of the mock jury deliberations, the grantee observed a number of instances of disorganization and dysfunction. A leading national court reform organization, the American Judicature Society, offers free guides for use by jurors or judges that contain extremely helpful suggestions for choosing a presiding juror and conducting fair, effective and efficient jury deliberations.¹²³ The authors of this report concur that jurors would likely welcome and benefit from such suggestions, especially if they are couched in terms of suggestions instead of directives.

The Frequency and Effects of Jurors' Evidence Combination Statements

Bayes' rule, or theorem, is a mathematical formula that expresses the impact of evidence on a prior subjective probability or belief.¹²⁴ Use of Bayes' rule has been suggested to assist jurors in combining non-scientific evidence with scientific evidence presented in terms of probabilities.¹²⁵ The most common proposal for using Bayesian reasoning in the jury trial context calls for informing lay jurors of the extent to which the probability changes via an instruction or an explanation by an expert witness.¹²⁶ Other research on juror decision making likewise focuses on the ways in which jurors combine and integrate evidence to generate a plausible story of the case.¹²⁷

The jurors in the instant study do not hear about Bayes' theorem, prior or posterior probabilities or how to combine probabilities. The prosecutor argues in closing that the jurors could infer guilt from the nonscientific evidence alone, pointing out that there is strong scientific evidence as well and concluding by asserting that "guilt had been proven when the non-scientific and scientific evidence are considered together." Defense counsel denigrates both categories of evidence by name, but deals with them separately. There is no instruction on how to assess any evidence, nonscientific or scientific.

¹²² E.g., ARE HUNG JURIES A PROBLEM?, *supra* note 110; BEHIND CLOSED DOORS: A RESOURCE MANUAL TO IMPROVE JURY DELIBERATIONS (American Judicature Society (1999)(collecting authorities and making suggestions for jury instructions); G. Thomas Munsterman, Paula L. Hannaford & G. Marc Whitehead eds. JURY TRIAL INNOVATIONS 171-73 (1997)(same); Valerie Hans & Neil Vidmar, JUDGING THE JURY (1986); and Nancy S. Marder, *Juries, Justice and Multiculturalism*, 75 So. Cal. L. Rev. 659, 704-05 (2002).

¹²³ "Behind Closed Doors: A Guide for Jury Deliberations" (American Judicature Society 1999). To order free copies, go to <http://www.ajs.org/cart/storefront.asp>.

¹²⁴ David H. Kaye & David A. Freedman, *Reference Guide on Statistics*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE, 2d ed. 83, 160 (Federal Judicial Center 2000).

¹²⁵ See, e.g., Michael O. Finkelstein & William B. Fairley, *A Bayesian Approach to Identification Evidence*, 83 Harv. L. Rev. 489 (1970); David L. Faigman & A.J. Baglioni, Jr., *Bayes' Theorem in the Trial Process*, 12 L. & Hum. Beh. 1 (1988).

¹²⁶ E.g., 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* 1 (2002) (expert witness using an illustrative chart); Norman Fenton & Martin Neil, *The 'Jury Observation Fallacy' and the Use of Bayesian Networks to Present Probabilistic Legal Arguments*, *Mathematics Today* 180 (Dec. 2000) (use of a visual model and calculator); Brenda Inman Rowe, *A Possible Solution for the Problem of Juries Slighting Nonscientific Evidence*, 24 *Am. J. Crim. L.* 541 (1997) (judicial instruction).

¹²⁷ For an excellent overview of theories of juror decision-making, see Reid Hastie (Ed.) *Inside the Juror*.

Because jury scholars have theorized about jurors' different combinatorial strategies, it is of great interest to observe how jurors spontaneously offer statements and arguments about the combination and integration of the scientific and nonscientific evidence in their jury deliberations. We coded a juror's statement or argument as an Evidence Combination Statement if it sought to combine the two categories of evidence—the nonscientific evidence which was circumstantial in nature and the random match probabilities (RMP) stated by the two mtDNA experts (as applied to the size of the local relevant population)—to arrive at a judgment about the likelihood that the defendant was the source of the hair found on the discarded sweatshirt worn by the bank robber.

We observed a number of instances in which jurors made evidence combination statements, seeking to combine the inferential or probative value of the scientific DNA evidence and the nonscientific evidence. They typically begin with the likelihood of a match based on the DNA evidence, frequently using the lower RMP number suggested by the defense expert, *then* turn to and assess the non-scientific evidence connecting the defendant with the sweatshirt and robbery. They conclude their analysis of the two by stating the high probability that the defendant is likely the source of the hair and, therefore, the robber.

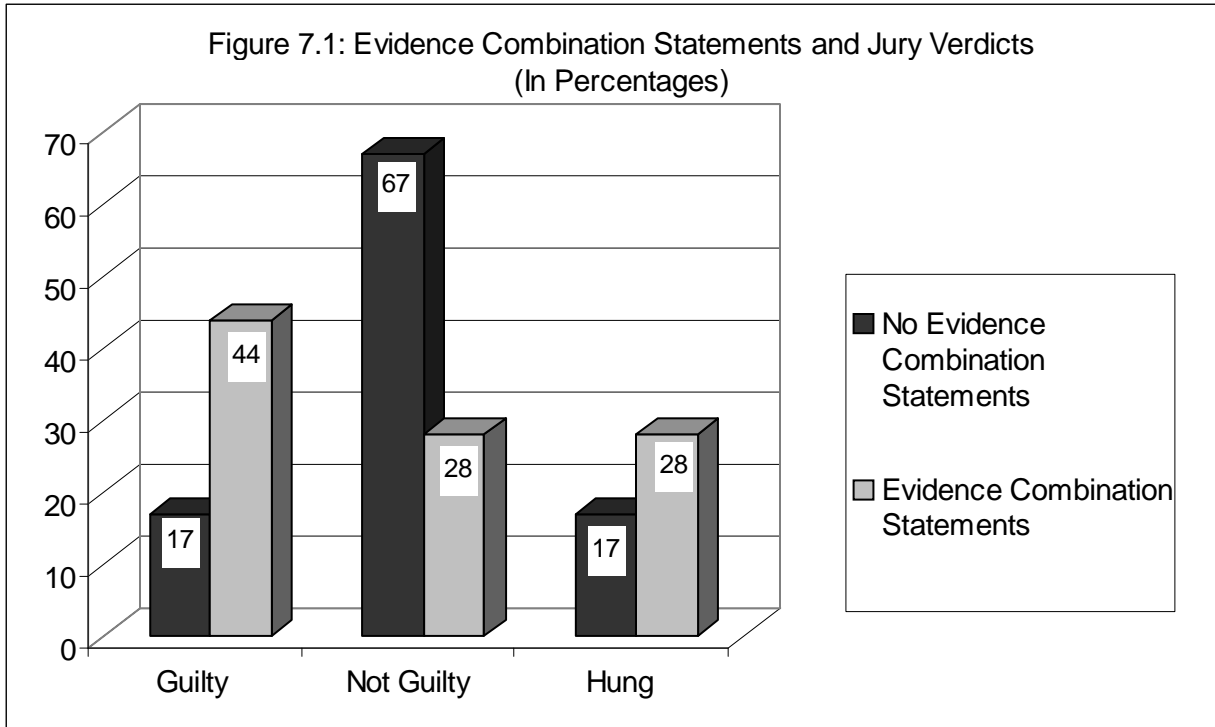
Two examples of such juror statements or arguments follow:

“Out of 57 possibles [defense number for possible number of potential contributors in local area given defense version of RMP], you can narrow it down to a very high probability by age, build, facial scar, flashing money, hooded blue sweatshirt, no alibi, etc. You can't string that many coincidences together without coming to a conclusion of guilt.” (Jury 12).

“The mtDNA match puts him in a very select pool [from 6 to 57 in local population]. Not conclusive standing alone, but when you put it together with all the other evidence—scar, money, sweatshirt, 5'11” and 175 in weight—it all adds up.” (Jury 16)

The 60 deliberations include a total of 48 evidence combination statements or arguments by an equal number of jurors. The statements are distributed across 36 of the 60 juries, or 60% of all juries.

The presence of such statements during jury deliberation is significantly related to the jury's eventual verdict (Chi Square (2 d.f., $N = 60$) = 9.12, $p = .01$). The relationship is shown in Figure 7.1. Juries in which no such statements are voiced tend to acquit the defendant. When one or more jurors explicitly advance evidence combination arguments, the jury is more apt to convict. Hung juries are a bit more likely in juries in which evidence combination statements are advanced. Longer deliberations are more likely to include such statements ($F(1, 59) = 6.62$, $p = .01$). The average length of the deliberation that includes evidence combination arguments is 45 minutes, compared to a 30-minute average deliberation for juries that do not.



The cause of the relationships we discovered is not clear, and more analysis is warranted. It could be that more evenly divided juries generate a range of arguments, including statements about how to combine the probability of various pieces of evidence. Jurors who favor a guilty verdict may be prone to make these types of statements.

The fact that juries that hear evidence combination statements and arguments appear to reach somewhat different verdicts is an intriguing and unexpected finding. Further experimentation should be undertaken examining the relationship between such statements and verdict preferences.

Chapter 8 – Summary of Findings and Conclusions and Some Practical Suggestions for DNA Practitioners

In this experimental research, we explore the use and impact of jury trial innovations upon mock jurors' understanding of a criminal trial presentation of contested mitochondrial DNA (mtDNA) evidence. Four hundred and eighty mock jurors were randomly assigned to eight-person juries and to one of the six conditions in the experiment. Ten mock juries were run in each of the following six conditions:

Experimental Condition Number	Jury Innovations Permitted
Condition 1	Control (No Innovations)
Condition 2	Note Taking
Condition 3	Question Asking and Note Taking
Condition 4	DNA Checklist and Note Taking
Condition 5	Jury Notebook and Note Taking
Condition 6	All Innovations (Note Taking, Question Asking, DNA Checklist, Notebook)

At the outset, we collected demographic and background information from the mock jurors (all jury-eligible adults called to jury duty in Wilmington, Delaware), and we inquired into participants' attitudes toward science in general and DNA evidence in particular. Then, all 60 juries watched the same videotaped armed robbery trial. Trial lasted about 70 minutes, including one ten-minute break.

The trial for armed robbery of a bank featured both non-scientific evidence and the scientific mtDNA testimony. Bank employees could not positively identify the robber since he wore a blue hooded sweatshirt and a partial mask. The teller who testified at trial that she saw an unmistakable inch-long horizontal red scar on his cheek.

A police search of the area turned up blue sweatshirt, one glove and a small amount currency, including some of the bait money. Two human hairs were found in the sweatshirt hood. No other physical evidence was found. The defendant denied committing the robbery and the rest of the circumstantial evidence was purposefully ambiguous so the jurors would feel compelled to address the mtDNA identification evidence and resolve the issues raised by the two sides' experts.

The prosecution's mtDNA expert, an FBI analyst, testified that the mtDNA profiles of the sweatshirt hairs and the hairs combed from defendant's head at the time of his police interview were an exact match, that the profile was rare and had not been observed in the FBI's mt database of over 5,000 samples. He added that 99.98% of all Caucasian males would be excluded as potential contributors of the two mtDNA samples. That meant, he said on cross-examination, that assuming a male Caucasian population in the relevant area of 29,000, he would expect to see only 6 males with the same mtDNA profiles in addition to other men in the same maternal line as the defendant.

The geneticist called by the defense agreed that the mtDNA samples matched, but said that the FBI's percentage of the population excluded by the mtDNA evidence was too large because the FBI failed to properly account for the possibility of heteroplasmy in human hair, a condition where some males could have some cells with mtDNA that matches the crime-scene samples and others with mtDNA sequences that differ at just one base pair. To account for the fact that these individuals could not be excluded as possible sources of the hairs, she reduced the FBI's percentage to 99.8% and said that 57 males in the locality, not just 6, could have supplied the mtDNA found in the sweatshirt hairs. She said her reasoning was correct even though she agreed that the defendant did not exhibit signs of heteroplasmy.

Following trial, but before jury deliberations, we examined jurors' uses of the innovations in multiple ways. We asked mock jurors a variety of questions about the mtDNA and their use of and attitudes toward the jury reforms in the questionnaires. The juries were then told to deliberate to reach a unanimous verdict. Following the return of the verdicts, or upon a mistrial being declared on account of a hung jury, all participants filled out a third and final questionnaire. Participants' responses in the 1,440 juror questionnaires were coded and analyzed. We reviewed their written notes, as well as copies of the checklist and the notebook materials for any notations. We also analyzed the questions jurors posed during the trial. Finally, all 60 jury deliberations were videotaped, reviewed, and coded to determine the use of jury innovations in group deliberations.

The most salient findings and conclusions resulting from the data generated by this experiment follow, presented by general category:

Juror Understanding of Contested mtDNA

Jurors demonstrated basic understanding of the mtDNA evidence. Almost 90% of mock jurors said they followed and understood the expert testimony. A number of true-false knowledge questions were also asked concerning the mtDNA in the case. Solid majorities of jurors (ranging from 66% to 90%) exhibited correct understandings of most of the basic knowledge items about mtDNA—e.g., where the mitochondria are found in the cell, how samples are compared and matches declared and how mtDNA compares to nuclear DNA in terms of its ability to identify a specific individual as the contributor of the DNA.

Fully 90% of jurors correctly understood that mtDNA is inherited solely from one's mother, unlike nuclear DNA. They rejected the "red herring" interjected by the defense when the defendant testified that his wayward half-brother (on his father's side) lived in town at the time of the robbery. Many jurors also showed some comprehension of the term "heteroplasmy" (variations in at least one base pair of an individual's mtDNA due to mutations of the cells) and its implications of heteroplasmy for calculating the number of potential contributors of the mtDNA.

On the other hand, as in previous studies, some of our participants showed some susceptibility to adversarial exaggerations and misstatements about the scientific evidence. A number of jurors were persuaded by the “prosecutor’s fallacy,” equating the likelihood of innocence with the random match probability (here .02%); and some jurors also agreed with the defense attorney’s questionable claim that the mtDNA evidence was entirely worthless because people other than the defendant could have contributed the hairs.

In addition, fully one quarter of the mock jurors thought that sample contamination was “likely” despite the absence of evidence or argument from either side suggesting contamination of the hair samples or the mtDNA.

As anticipated, the amount of formal education, number of courses in science and mathematics, and science and mathematics job experience positively correlated with correct juror understanding of mtDNA.

Jury Innovations: Uses, Attitudes and Effects

Three of the four jury trial innovations received heavy use: 88% of jurors took notes; 85% reviewed the mtDNA checklist; and 92% examined the contents of the juror notebooks. However, fewer than one quarter of the jurors told they could ask questions of the experts did so. The total number of questions asked and answered was 49. One-fifth of the jurors’ questions pertained to the FBI’s mtDNA database, a matter frequently discussed in deliberations.

Jurors were asked for their assessments of the value, or impact, of the innovations. Two-thirds of note takers said that note taking helped them to remember the evidence. Eighty percent of jurors who reviewed the mtDNA checklists felt that the checklists contributed to their understanding or recall of the evidence. Nine out of ten jurors who reviewed the notebook materials found them helpful to understanding and recall.

Support for the adoption and use of the innovations in jury trials was high, especially among the jurors who used the procedures:

- Note taking 91%
- mtDNA checklists 85%
- Juror notebooks 82%
- Juror questions for witnesses 97%

The effects of the innovations on juror understanding of mtDNA were measured by assessing whether providing different jury innovations increases jury comprehension of mtDNA. In a number of analyses, we explored how jurors in the different experimental conditions performed on the Jury Comprehension Scale both before and after their deliberations, controlling for jurors’ educational levels. Before deliberations, there were no significant differences on jurors’ responses on the Juror Comprehension Scale between the various innovation conditions. However, after deliberation, jurors allowed to use notebooks performed significantly better on the factual true-false tests than those not provided with notebooks. Improvement was also observed in some analyses with the DNA checklist innovation; using the expanded Juror

Comprehension Scale that included statements about mtDNA and probabilities of guilt, jurors who were provided with a checklist did somewhat better than those who were not given a checklist.

The use of multiple innovations also improved the jurors' comprehension of the mtDNA evidence. For example, jurors allowed to take notes and use a jury notebook performed better on the Juror Comprehension Scale as compared to those only allowed to take notes. This was also true for jurors exposed to all innovations. They outperformed those only allowed to take notes.

Jury Deliberations

With very few exceptions, jurors took the mock trial and their obligation to reach a verdict very seriously; deliberations were often intense. Deliberations also improved juror comprehension of complex scientific evidence. We did notice, consistent with other studies of jury deliberations, that jurors and jury deliberations could benefit from some specific suggestions from the trial judge regarding the process, as choices of presiding jurors was frequently random and deliberations often very disorderly.

Of particular note to DNA practitioners, jurors in 60% of all deliberating juries made arguments about combining scientific and nonscientific evidence in assessing the probability of guilt. In their own words, they attempted to combine the separate probabilities arising from the scientific mtDNA evidence and the non-scientific evidence to reach posterior probabilities of guilt based on all of the evidence. The presence of such statements was associated with greater tendencies to convict or hang as opposed to acquit the defendant.

Juror Demographics, Education, Job Backgrounds and Attitudes About DNA

The demographic profile (gender, race, age) of the 480 mock jurors bore striking similarities to those of the entire pools of jury eligible adults from which they came. Mock jurors were somewhat better educated than the jury pools at large, but those difference can be explained by the differences in the forms of questions used to solicit the information.

Most mock jurors had some science or mathematics courses. Our participants had taken an average of over nine such courses in high school or college. About half had some job experience involving science or math.

Consistent with a national study of attitudes about science and technology, the overwhelming number of mock jurors (as high as 89%) held very positive attitudes about science in general. However, a significant minority (but somewhat lower than the national figures) expressed reservations about science. Negative attitudes about the role of science in their lives were strongly correlated with the level of formal education; jurors with less education tended to express more negative views.

Views about DNA were also solicited before jurors saw the mock trial. Two-thirds of mock jurors agreed that DNA evidence was “extremely reliable.” Only about half of the participants had heard anything about mtDNA before this trial. Of those, most said they had heard only a “small amount” about mtDNA.

Some Practical Suggestions for DNA Practitioners

The results of our study and our experiences with 480 mock jurors from the 60 trials show that most juries are capable of comprehending and using different forms of DNA evidence at trial. Nonetheless, some jurors are likely to have trouble with complex evidence. In this final section, we draw on the collected research on jury trial procedures and jury reforms to offer some practical suggestions for expert DNA witnesses and attorneys presenting or contesting DNA in jury trials:

1. Provide jurors a brief, simple, and plain-English explanation of forensic DNA without burdening them with the details about the technical procedures or steps utilized in the laboratory. Many of the deliberating jurors in our experiment and many following actual trials conducted by the grantee complained of “technical overload” regarding essentially uncontested matters.
2. Notwithstanding the first suggestion, take the initiative in every case to eliminate the chances of sample contamination at every stage of the process, from the discovery of samples at the crime scene through collection and analysis to trial. A significant number of jurors in our experiment believed sample contamination was a problem in the case despite the total lack of evidence or argument by counsel suggesting contamination.¹²⁸
3. Use simple, clear slides or posters to illustrate testimony. Come to trial with sufficient copies to give each juror and the judge individual copies. Using visuals and enabling jurors to follow along from their copies recognizes the desires of today’s jurors for sensory stimulation.
4. To the extent possible, avoid double negatives when describing the significance of a match (e.g., “the defendant cannot be excluded” and “the possible non-exclusions in this case total...”). The study of the jury deliberations in our project revealed such expressions as a source of confusion for the lay jurors.
5. The party introducing the results of DNA analysis should request that the trial judge permit jurors to ask questions of witness, at least of the experts; witnesses should encourage the attorneys to seek permission for juror questions.
6. The explanations should avoid first principles and formulas. Attorneys presenting DNA evidence should encourage jurors to consider the probative value of the match evidence together with the value of the non-scientific evidence and offer jurors an approach to combining the probabilities suggested by both types of evidence. See the discussion in this report of jurors attempting to combine the probabilities presented by the evidence to

¹²⁸ See Chapter 4, Concerns about Reliability and Contamination of mtDNA.

arrive at an opinion regarding guilt.¹²⁹ Experts may have to encourage attorneys to do so and help them frame simple, understandable approaches for the jury.

7. Don't assume that jurors, the judge or attorneys understand statistical presentations—even basic terms, principles or operations! I believe this is suggested by our data. It is probably self-evident to folks like the present grantee, who don't have such training or experience!!

¹²⁹ See Chapter 7, Jury Deliberations.