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

FINAL TECHNICAL REPORT

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The second taping, made necessary by changes in the mtDNA presentation in the case, occurred in August 2003 in Williamsburg, Virginia , at the College of William & Mary Law School's Courtroom 21. This version, the one used in the research project, included cast members James Metcalf, Assistant U.S. Attorney, Norfolk, Virginia; Robert Moody, private criminal defense attorney, Newport News, Virginia; Katherine Dann, George Washington University 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 note taking 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, Department 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) evidence. 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 juries were run. Ten mock juries decided the case without the benefit of any innovations. Ten mock juries in each of five other conditions were permitted to use one or more jury innovations in deciding the case.

Jurors expressed enthusiasm for the innovations and reported that all four of the innovations enhanced comprehension and recall of the mtDNA evidence. Data analyses of juror comprehension of mtDNA provided a mixed picture. In some analyses, the use of jury notebooks and the employment of a checklist improved juror comprehension after jury deliberation. In other analyses no effects on juror comprehension were detected.

The research project offers a unique window into how laypersons understand and assess mitochondrial DNA evidence in jury trials. It reveals some concerns about reliability of mtDNA evidence and worries about laboratory and other contamination.

The report concludes with suggestions for the presentation of complex evidence in jury trials.

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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.[1]

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.[2] 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 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.[3] 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

[1] See text accompanying footnotes 13-15, infra, and Table 2.1.
[2] *Id.*
[3] See text accompanying footnotes 20-30, infra.

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. 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,[4] led to forty years of jury studies by social scientists who explored jury competence and decision-making.[5]

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.[6] Many argue that jurors often fail to understand and properly evaluate statistical presentations in particular.[7] Some, but not all, question whether jurors are capable of rationally deciding such cases.[8]

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.[9] 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.[10] An alternative view, discomforting in another way, held that information processors are more comfortable with qualitative information than with statistics and that "[t]he

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[4] Harry Kalven, Jr. & Hans Zeisel, THE AMERICAN JURY (1966).
[5] Valerie P. Hans & Neil Vidmar, The American Jury at Twenty-Five Years, 16 Law & Soc. Inquiry 323 (1991).
[6] 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).
[7] E.g., Brian C. Smith, Steven D. Penrod, Amy L Otto & Roger C. Park, Jurors' Use of Probabilistic Evidence, 20 Law. & Hum. Behav. 49 (1996); William C. Thompson, Are Juries Competent to Evaluate Statistical Evidence?, 52 Law & Contemp. Probs. 9 (1989).
[8] E.g., John P. Cronan, Is Any of This Making Any Sense? Reflecting on Guilty Pleas to Aid Criminal Juror Comprehension, 39 Am. 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 (Robert E. Litan ed., 1993).
[9] David L. Faigman & A.J. Baglioni, Jr., Bayes' Theorem In the Trial Process: Instructing Jurors on the Value of Statistical Evidence, 12 Law & Hum. Behav. 1, 2-3 (1988).
[10] E.g., Lawrence H. Tribe, Trial by Mathematics: Precision and Ritual in the Legal Process, 84 Harv. L. Rev. 1328 (1971).

more realistic problem is presenting statistical evidence so that people will incorporate it into their decisions *at all*."[11] 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."[12]

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 (1993)	RMP of 1:1 billion	None	Over weighted
Schklar & 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 study participants tended to improperly evaluate the significance of DNA match statistics due to confusion regarding the statistics used by the expert witnesses.[13] However, the methodology employed in most of these studies was quite different from the situation that confronts actual juries in real trials.

[11] Michael J. Saks, & Robert F. Kidd, Human Information Processing and Adjudication: Trial by Heuristics, 15 Law & Soc'y Rev. 123, 149 (1981)(emphasis added).
[12] David H. Kaye & Jonathan J. Koehler, Can Jurors Understand Probabilistic Evidence?, 154 J. Royal Stat. Soc'y Ann. (1991).
[13] Jane Goodman, Jurors' Comprehension and Assessment of Probabilistic Evidence, 16 Am. J. Tr. Advoc. 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 Law & Hum. Behav. 159 (1999); Jonathan J. Koehler, When Are People Persuaded By DNA Match Statistics?, 25 Law & Hum. Behav. 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 J.

For example, 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.[14] 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, and the researchers varied the manner of the statistical expression. 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."[15] Among the law students, less 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%

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

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1 (2002); Samuel Lindsey, Ralph Hertwig & Gerd Gigerenzer, Communicating Statistical DNA Evidence, 43 Jurimetrics J. 147 (2003).

[14] Schklar & Diamond, supra note 13, at 178.

[15] Lindsey et al., supra note 13, at 159.

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. However convenient, the use of a relatively homogeneous group of college students makes it difficult to estimate how the broader range of people represented in a typical jury pool might respond to scientific evidence.

2. All of the mock jurors in the six previous studies read the facts and applicable law of their "cases" from brief 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.

3. 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. In earlier studies, the scientific presentations were typically quite limited.

4. 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. Actual jurors' understanding of and regard for technical and scientific evidence is often shaped and changed by the give-and-take of jury deliberations.

5. 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. 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.)[16]

6. None of the jury trial innovations commonly being adopted or considered was utilized in any of the studies. One of the four innovations subjected to study here—note taking—is so common that it can be considered "mainstream." Two of the reforms selected for the current experiment—juror questions and juror notebooks—are being used or seriously considered in many jurisdictions, but cannot yet be considered mainstream. 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.

[16] A discussion of the actual case upon which this project's mock trial was based upon is found in Marlan D. Walker, Note, Mitochondrial DNA Evidence in State v. Pappas, 43 Jurimetrics J. 427 (2003).

Courts and commentators have identified 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.[17] Consider 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."[18] 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.[19] 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.

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.

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[17] 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.)

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

[19] Kaye & Sensabaugh, supra note 17, at 538-39; National Research Council Report, supra note 18, at 198; 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).

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.[20]

These and many other reform ideas, both from the pretrial and jury trial stages, are collected and discussed at length elsewhere.[21] 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

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.[22] 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.

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[20] 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).

[21] 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).

[22] Vicki L. Smith, How Jurors Make Decisions: The Value of Trial Innovations, in JURY TRIAL INNOVATIONS, supra note 21, 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"].

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.[23] 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

Assumptions	Reinforcing Rules & Practices
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.[24] 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.

The traditional assumptions that jurors must and do remain cognitively passive 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."[25]

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

[23] The two "models" are fully discussed in Dann, supra note 22, at 1238-47.
[24] 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 6, 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).
[25] Edward W. Cleary, Evidence as a Problem in Communicating, 5 Vand. L. Rev. 277, 278 (1952).

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.[26] 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.[27]

For educators, the positive correlation between classroom interaction and effective learning has been an accepted truth for some time.[28] 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.[29]

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.

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

[26] 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); Valerie P. Hans, U.S. Jury Reform: The Active Jury and the Adversarial Ideal, 21 St. Louis U. Pub. L. Rev. 85 (2002).

[27] E.g., Hans & Vidmar, supra note 26; ABA REPORT ON JURY COMPREHENSION, supra note 6; and Arthur D. Austin, COMPLEX LITIGATION CONFRONTS THE JURY SYSTEM 102 (1984).

[28] 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).

[29] Hugh Mehan LEARNING LESSONS: SOCIAL ORGANIZATION IN THE CLASSROOM 79-80 (1979).

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."[30]

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.[31])

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.[32] Trial judges in most other state and federal courtrooms may permit juror note taking in the judge's discretion. Most do, but many still do not. A recent collection of state and federal laws regarding the practice of juror note taking reveals that nearly all jurisdictions either permit or require the trial judge to allow jurors to take notes during trial and to use their notes during deliberations.[33] One state, Nebraska, permits the practice only if both parties agree; and two states, Louisiana and Pennsylvania, have statutes or rules flatly forbidding note taking by jurors.[34]

The typical procedure for note taking is described in the encyclopedic Jury Trial Innovations, published by the National Center for State Courts in 1997:[35]

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

[31] 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 Law. & Hum. Behav. 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. Reform 302 (1999).

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

[33] Annot., Taking and Using of Trial Notes by Jury, 36 A.L.R. 5th 255 (2004).

[34] Nebraska: State v. Kipf, 234 Neb. 227, 450 N.W.2d 397 (1990); Louisiana: La. Code of Crim. Proc., Art. 793; Pennsylvania: Penn. Rules of Crim. Proc., Rule 644.

[35] JURY TRIAL INNOVATIONS, supra note 21, at 141-43.

"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 unaided 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.[36] 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 as follows:

- 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,[37] and some studies bear them out. For example, Flango[38] 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.[39]

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

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[36] Id., at 142.
[37] ABA STUDY OF JURY COMPREHENSION, supra note 6, at 34-37; Kassin & Wrightsman, supra note 24, at 436-39.
[38] Victor E. Flango, Would Jurors Do a Better Job if They Could Take Notes?, 63 Judicature 436 (1980).
[39] 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).

from a single state, half of which permitted jurors to take notes, the other half not.[40] 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.[41] 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.[42]

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.[43] 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.[44] 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.[45] 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.[46]

These two major studies by Heuer and Penrod are often cited by legal professionals (many of whom oppose the innovation) for the proposition that juror note taking doesn't materially contribute to comprehension. As noted immediately above, Heuer and Penrod themselves qualified their findings by mentioning limitations inherent in field studies. For one, each jury studied heard different cases, witnesses and evidence, and it was impossible to control for case complexity and test hypotheses through repetition of identical trials. In addition, much of the data studied by the researchers amounted to after-the-fact self-reports by jurors about the effects that note taking had on them.

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 mock jury trials involving 128 college students, in which each jury saw and heard the same

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[40] Larry Heuer & Steven Penrod, Increasing Jurors' Participation in Trials: A Field Experiment with Jury Note taking and Question Asking, 12 Law & Hum. Behav. 231 (1988).
[41] Id., at 245-47.
[42] Id., at 247-51.
[43] Larry Heuer & Steven Penrod, Juror Note taking and Question Asking During Trials: A National Field Experiment, 18 Law & Hum. Behav. 121 (1994).
[44] Id., at 136-37.
[45] Id., at 137-40.
[46] Id., at 149.

case.[47] 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.[48] Note takers also scored higher in attentiveness, involvement in the trial and ability to keep up with the proceedings.[49] Even though Rosenhan et al. took advantage of the mock jury format, their effort suffered from the limitation that only college students were recruited as subjects for the experiment. In addition, mock jurors understand that they are not deciding a real person's fate.

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.[50] ForsterLee and Horowitz improved on Rosenhan's methodology by using jury-eligible adults instead of students in their mock jury trials. 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.[51]

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.[52] Ninety-eight percent (98%) of the pilot program judges who were surveyed about their experiences supported note taking. The 289 attorneys polled agreed, adding there was no significant evidence that any of the purported negatives in fact materialized. A solid majority of the jurors found note taking helpful.

A field study in Tennessee, undertaken as part of that state's jury reform effort, surveyed judges and jurors from 45 trials.[53] 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

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[47] David L. Rosenhan, Sara L. Eisner & Robert J. Robinson, Note taking Can Aid Juror Recall, 18 Law & Hum. Behav. 53 (1994).
[48] Id., at 58.
[49] Id., at 59.
[50] Lynne ForsterLee & Irwin Horowitz, The Effects of Jury-Aid Innovations on Juror Performance in Complex Civil Trials, 86 Judicature 184 (2003).
[51] Id., at 188-89.
[52] 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).
[53] Neil P. Cohen & Daniel R. Cohen, Jury Reform in Tennessee, 34 Memphis L. Rev. 1 (2003).

were tested in civil and criminal trials involving 1,590 participants,[54] reported a "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.[55] 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."

[54] 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).
[55] State v. Doleszny, 844 A.2d 773 (Vt. 2004).

> "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 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."[56]

The purported advantages and disadvantages of allowing juror questions are listed in Jury Trial Innovations:[57]

> The advantages 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. A number of expert commentators 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.[58]

Among the leading studies of allowing jurors to question witnesses are those of Heuer and Penrod.[59] In their 1988 field study of 77 trials in Wisconsin, they found that juror questions enhanced juror satisfaction with the trial process and juror confidence that they had enough information to decide the case, and that the process created some useful feedback for the

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[56] 844 A2d. at 777.
[57] JURY TRIAL INNOVATIONS, supra note 21, at 144-46.
[58] E.g., TOWARD MORE ACTIVE JURIES: TAKING NOTES AND ASKING QUESTIONS (American Judicature Society 1991); Kassin & Wrightsman, supra note 24, at 129-31; Sand & Reiss, supra note 39, at 443-44.
[59] Heuer & Penrod, supra notes 40 and 43.

attorneys.[60] However, there was insufficient evidence to support the claims that the process will uncover important evidence or lead to greater overall juror satisfaction with the trial.[61] 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."[62] The authors concluded that the innovation deserved "serious consideration" by policy-makers.[63]

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.[64] 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.[65] 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.[66] As with 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.[67] The authors reviewed their earlier research and restated these same conclusions in a more recent article.[68]

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.[69] 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.[70] Over 88% of the Ohio judges who participated in its pilot program testing the procedure approved of allowing jurors to ask questions.[71] 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.

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[60] Heuer & Penrod, supra note 40, at 252.
[61] Id., at 252-53.
[62] Id., at 254-56.
[63] Id., at 256.
[64] Heuer & Penrod, supra note 43.
[65] Id., at 142.
[66] Id., at 143-44.
[67] Id., at 144-48.
[68] Steven Penrod & Larry Heuer, Tweaking Commonsense: Assessing Aids to Jury Decision Making, 3 Psychol. Pub. Pol'y & L. 259 (1997).
[69] Jacqueline A. Connor, Los Angeles Trial Courts Test Jury Innovations, 67 Defense Couns. J. 186 (2000).
[70] See text accompanying note 54, supra.
[71] See text accompanying note 52, 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."[72] 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 program[73] 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.[74] 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 to enhance the quality of decision-making. Lastly, she concluded that the process was not detrimental to the adversarial trial.[75] These latter conclusions coincide with the earlier findings from a national study by the American Judicature Society.[76]

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

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[72] Mary Dodge, Should Jurors Ask Questions in Criminal Cases? A Report to the Colorado Supreme Court's Jury System Committee (2002).
[73] See text accompanying note 53, supra.
[74] 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).
[75] Id., at 1113-21.
[76] TOWARD MORE ACTIVE JURIES, supra note 58.

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.[77] The devices are viewed as "jargon-free flow charts of the logical pathway followed by a forensic scientist in drawing conclusions from laboratory tests."[78] 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.

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.[79] 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."[80] 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.[81] 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.)

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[77] 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, 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).

[78] Magnusson & Selinger, supra note 77, at 390.

[79] 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).

[80] Magnusson & Selinger, supra note 77, at 390.

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

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.[82]

The preparation and use of notebooks for jurors is addressed in Jury Trial Innovations[83] and by some court rules.[84] 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.[85] 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.

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[82] E.g., Neil P. Cohen, Better, Happier Juries: Jury Reform in Tennessee, 39 Tenn. B.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. B.J. 14 (2001); and Nancy S. Marder, Juries and Technology: Equipping Jurors for the 21st Century, 66 Brook. L. Rev. 1257 (2001).

[83] JURY TRIAL INNOVATIONS, supra note 21, at 109-11.

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

[85] JURY TRIAL INNOVATIONS, supra note 21, at 110; ABA REPORT ON JURY COMPREHENSION, supra note 6, at 34-37.

Research regarding the use and value of juror notebooks is extremely limited. In her study of trial complexity,[86] 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 overwhelming or impractical to use.[87]

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

> 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.[88]
>
> Ohio: Surveyed judges and jurors who participated in pilot study[89] 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.[90]
>
> Massachusetts: All of the judges that oversaw preparation of and furnished notebooks to jurors reported that they were helpful and worthwhile.[91]

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.

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[86] Mott, supra note 74.
[87] Nicole L. Mott, How Civil Jurors Cope with Complexity: Defining the Issues 167, 188-89 (2000) (doctoral dissertation; copy on file with grantee).
[88] See text accompanying note 69 supra.
[89] See test accompanying note 52 supra.
[90] See text accompanying note 53 supra.
[91] See text accompanying note 54 supra.

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.

Chapter 3 – Research Design and Methodology

Research Design

The mock jury study included one condition (Condition 1, No Innovations), in which no juror trial reform techniques were used, and five experimental conditions with different combinations of jury trial reform techniques. Four specific techniques – note taking, 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 note taking, was permitted in all but the No Innovations condition, because more advanced techniques such as juror question asking, checklists, and jury notebooks are unlikely to be employed in the absence of juror note taking, making it important to determine whether these additional techniques would improve the performance of note taking juries. Therefore, jury note taking 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 (since appointed to 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 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. Often, 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. 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 an average of 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, 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. No Innovations condition – no additional materials.
2. Note taking – steno pads for note taking.
3. Note taking and Question asking – steno pads for note taking and sheets of paper for questions.
4. Note taking and Checklist – steno pads for note taking, and a copy of checklist for each juror.
5. Note taking and Jury notebooks – Jury notebooks, with paper for note taking, 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 note taking 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., No Innovations 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 asking questions of the expert witnesses. 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 turned 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*[92] 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,

[92] 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).

and that jurors should change their positions and votes only if they were convinced on the merits to do so.

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*,[93] 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.[94]

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*.)

[93] 256 Conn. 854, 776 A.2d 1091 (2001). The case is fully discussed in Walker, supra note 16.

[94] 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.

The videotaped mock trial pertained to 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, the teller Blessing noticed a distinctive red scar on the robber's fact when he wiped his face with his gloved hand. Immediately after the robbery, 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 the defendant 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 nonscientific 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.[95] 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.

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

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, supplemented by the current list of drivers' licenses and identification cards maintained by the Division of Motor Vehicles.[96]

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. For gender, race, and age, they are remarkably similar. For example, women 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.

[96] 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 reported educational background of the participants. A Chi Square analysis finds that the jury pool and the mock jury participants are significantly different.[97] 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 graduate. 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.

[97] X^2 (4 *d.f.*) = 14.46, p = .002. 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.

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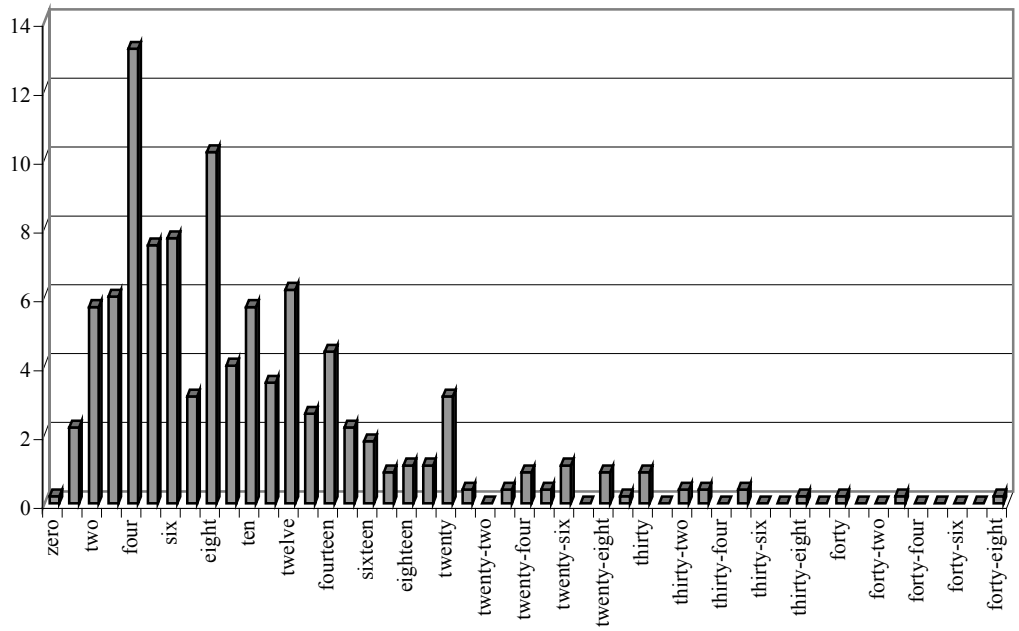
Chapter 4 – Study Participants' Science Backgrounds and Attitudes

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. A systematic analysis of the scientific background and attitudes of members of a jury pool provides new and unique data that may help legal practitioners and scholars better understand the typical knowledge base of criminal and civil juries.

Mock Jurors' Science and Mathematics Background

Study participants' backgrounds in science and mathematics were explored through questions about high school and college courses in these areas, 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 mathematics. Combining mathematics 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.

Figure 4.1: Mock Jurors' Math and Science Courses in High School and College
(In Percentages)



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 mathematics and science courses.

A substantial proportion (43%) of the mock jurors report some job experience that is related to mathematics or science. A total of 196 jurors say they have some mathematics 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 mathematics- 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 mathematics 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 mathematics 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 mathematics and science courses are more likely to have science and mathematics 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.[98] Four of these items deal with the promise of science, while the other three focus on examining reservations about science.

[98] 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

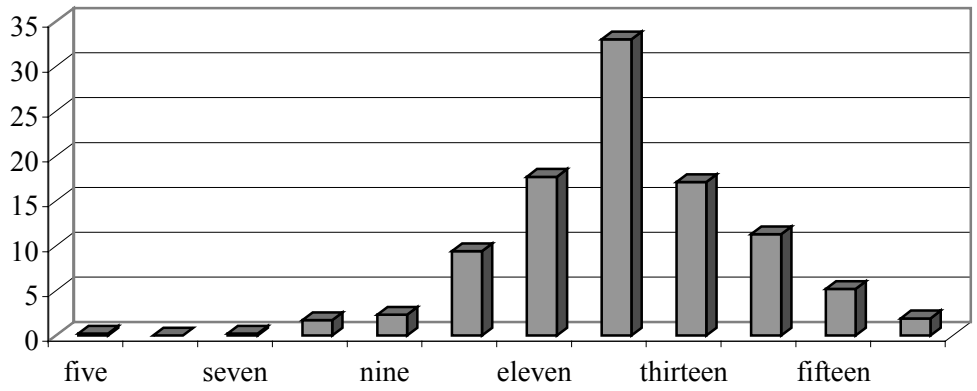
Item	Strongly Agree %	Agree %	Disagree %	Strongly Disagree %
PROMISE OF SCIENCE				
Science and technology are making our lives healthier, easier, and more comfortable.	26	69	4	1
Most scientists want to work on things that will make life better for the average person.	12	77	10	1
With the application 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.

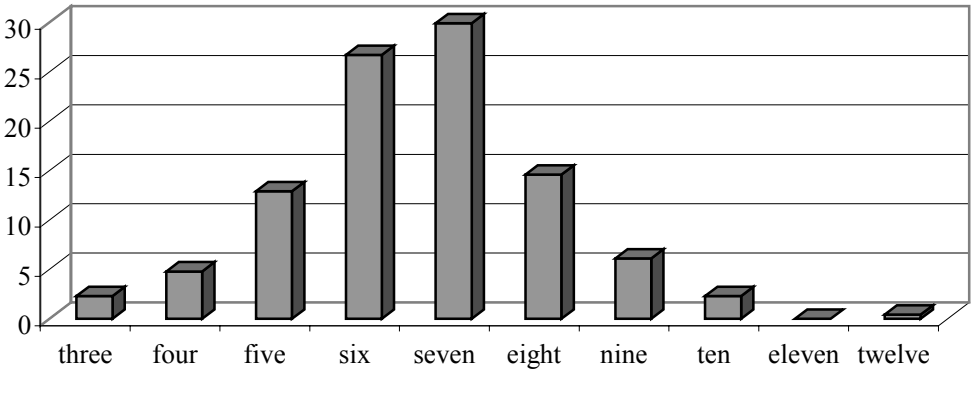
The four items dealing with the promise of science were recoded so that higher numbers indicated more positive views about science, and scaled together to form an Index of Scientific Promise, with a mean of 12.1 and a Cronbach's Alpha (a measure of the internal consistency among items in a scale) of .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.

Figure 4.2: Index of Scientific Promise Scores
(In Percentages)



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.[99] The index has a potential low of 3 and a high of 12. The mean and overall shape of the response distribution indicate that a minority of our participants possess reservations about science.

Figure 4.3: Index of Scientific Reservation Scores
(In Percentages)



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).

[99] 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.

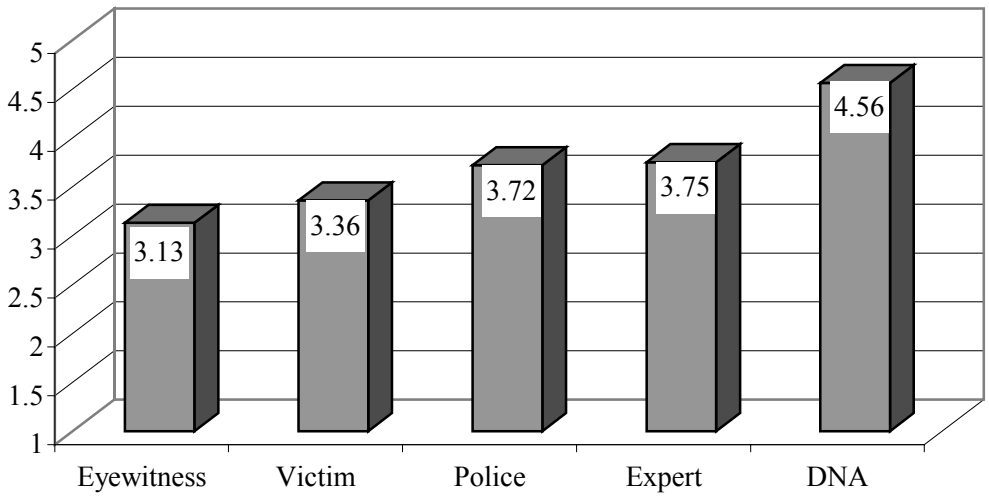
The Index of Scientific Promise is unrelated to educational attainment (F (4, 477) = .16, *ns*) but educational attainment is significantly and negatively related to the Index of Scientific Reservation (F (4, 477) = 6.15, p = .001). Those with more education have fewer reservations about science. Similarly, 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 mathematics and science courses in high school or college and about a fifth of the sample has substantial mathematics 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.

Figure 4.4: Jurors' Mean Prejudgments of the Reliability of Different Types of Evidence



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.[100] 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.

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	**N**	**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

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

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.[101]

To summarize, our study participants reflect a wide range of scientific backgrounds, from those who have taken only a modest number of mathematics and science courses in high school to those who have had a substantial amount of mathematics 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.

[101] 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.

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Chapter 5 – Juror Comprehension of mtDNA

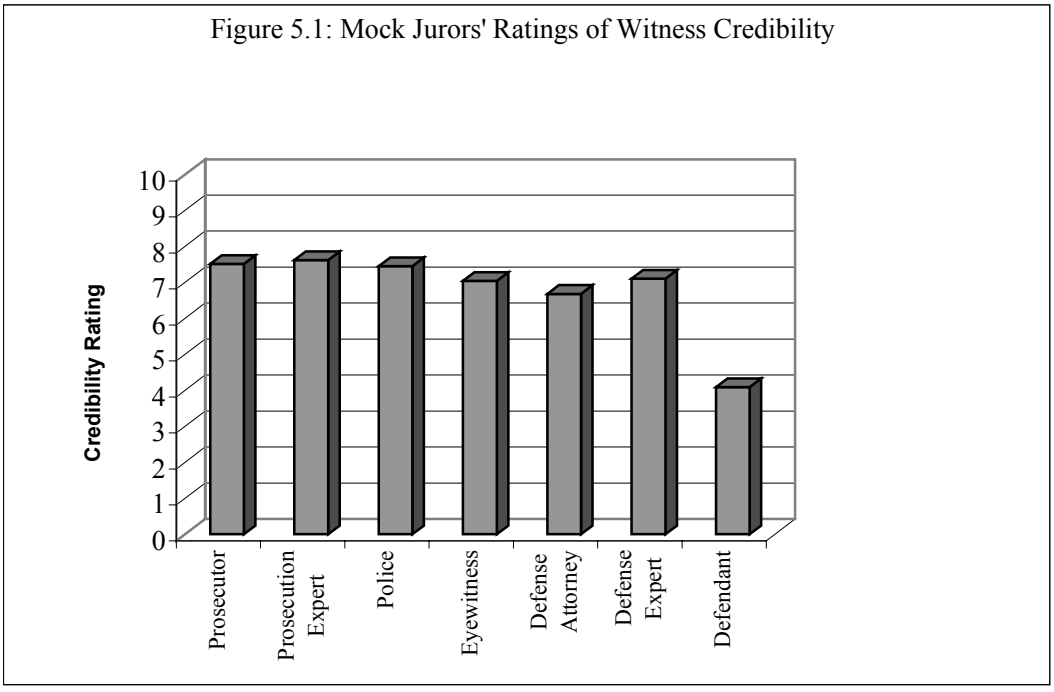
Our study examined the comprehension and use of mitochondrial DNA evidence within the context of a mock trial of robbery charges. In this chapter, we first examine how the study participants evaluate the evidence, paying particular attention to how jurors evaluate the expert witnesses for the prosecution 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.[102]

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

Figure 5.1: Mock Jurors' Ratings of Witness Credibility



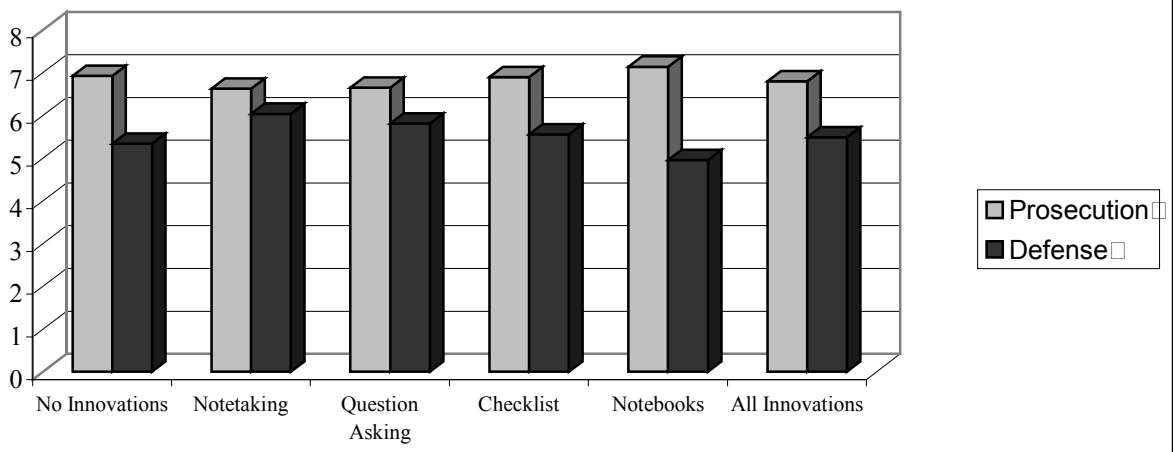
[102] Dennis Devine et al., Jury Decision Making: 45 Years of Empirical Research on Deliberating Groups, 7 Psychology, Pub. Pol'y & L. 622, 673 (2001); Paula L. Hannaford-Agor et al., Are Hung Juries a Problem? (National Center for State Courts Sept. 30, 2002); Valerie P. Hans et al., The Hung Jury: 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.[103]

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.[104]

Figure 5.2: Mock Jurors' Judgments of Strength of Evidence of Prosecution and Defense Cases



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.

[103] Unexpectedly, the credibility of the bank teller, who is an eyewitness, is rated more highly in the No Innovations 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.

[104] 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 Note taking and Question Asking conditions, and the No Innovations condition is statistically different from the Note taking 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.

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	Percentage
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	Percentage
Not at all	2
Slightly	9
Somewhat	43
Well	38
Very Well	9

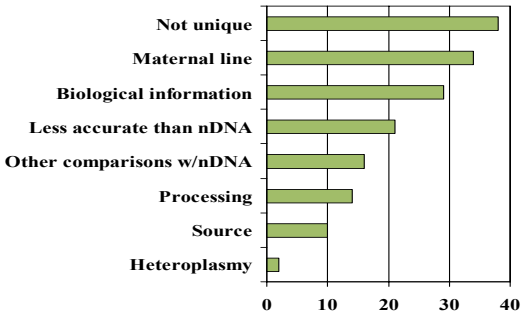
Not surprisingly, those with more formal education are more likely to say they understand the mtDNA evidence (r (N = 476) = .21, p < .001); the same goes for jurors with more mathematics and science courses (r (N = 450) = .33, p < .001). Most mock jurors state, then, that they can follow the expert testimony. Those who say that they are having trouble following some evidence are apt to identify mtDNA or DNA evidence; about half of those who report that they are having trouble specifically mention the 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. Professor David Kaye, an expert in the forensic use of DNA evidence and one of the study authors, also coded each of the participants' definitions for the presence of accurate statements about mtDNA. His expert ratings were highly correlated with the other accuracy measures (r's = .79 with the number of correct statements and .68 with overall accuracy measure; both are statistically significant correlations at $p < .0001$). 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.

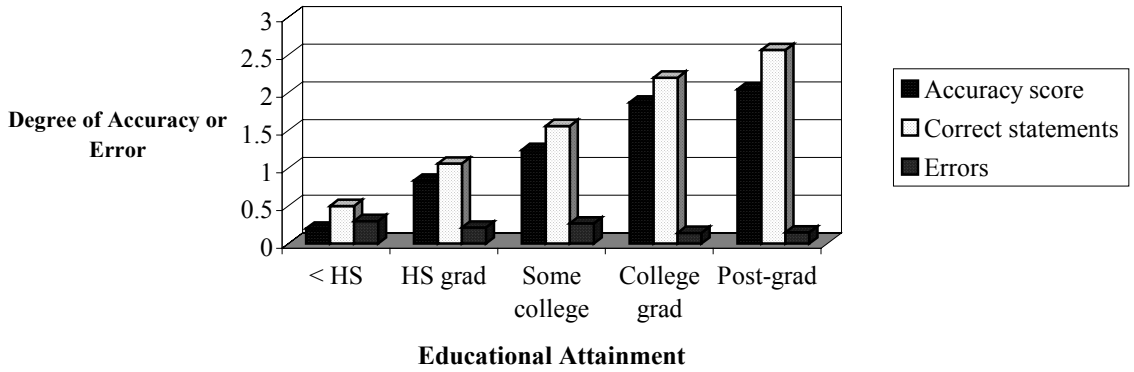
Figure 5.3. How Do People Define mtDNA?
Proportion of Jurors Including Statement about Topic



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.[105]

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 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.[106]

[105] 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 Kaye & Sensabaugh, supra note 17, at 539, 574; Thompson, supra note 7, at 25-35.

[106] 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 5.3: 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 sequence of base pairs is important, that about 600 base pairs are analyzed, and that a match is the same mtDNA sequence in two samples.

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
Do mtDNA and nDNA have the same ability to prove identity, or is one better than the other? [nDNA better]*+	89	4	89	3
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. 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,[107] 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.

If the suspect is innocent, then the probability that his DNA will match is P(match | innocence) = 1%. The inverse probability, P(innocence | match), could be quite different. If the suspect matches, then all that can be said (from the fact of the match alone) is that he is included in the class of people who might have left DNA at the crime scene. This group might be large, or it might be small. If its size is denoted by N, and if every individual in the group is equally likely to have left the DNA, then P(innocence | match) = 1/N. For example, if five individuals have matching DNA and if there is no other evidence pointing to any one of them, then the chance that any named individual–including the suspect – is innocent is 4/5 = 80%. This is a far cry from the 1% figure that comes from transposing the conditional probability.[108]

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.[109] However, the jury deliberations included some discussions about combining probabilities, which we discuss in Chapter 7.

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[107] See Kaye & Sensabaugh, supra note 17.

[108] For further discussion and examples of the transposition fallacy in judicial opinions, see David H. Kaye, David E. Bernstein & Jennifer L. Mnookin, THE NEW WIGMORE, A TREATISE on EVIDENCE: Expert Evidence sec. 12.4.1(b), at 463-74 (2004).

[109] 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 Kaye & Sensabaugh, supra note 17, at 539 and 574. 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.

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.[110]

Table 5.5: Probability Judgments and Initial Verdict Choices

	Guilty	Not Guilty	Unsure
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.[111]

Juror Comprehension Scale

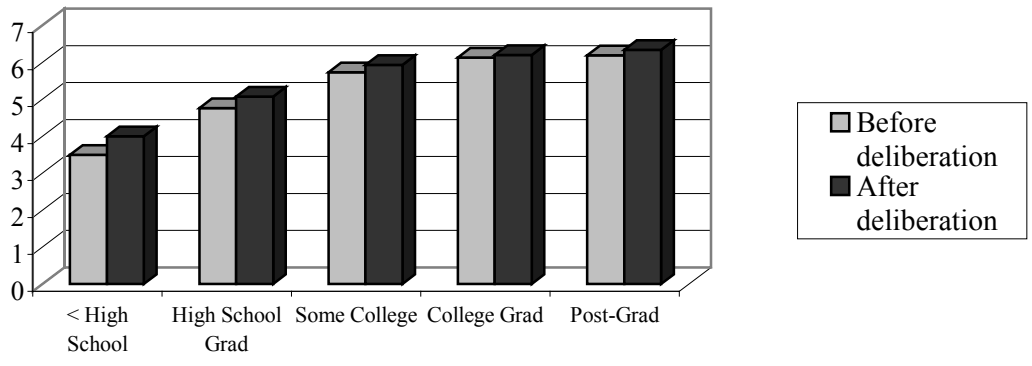
We combined eight factual knowledge items about mtDNA (see starred items in Table 5.4) to develop an overall measure of juror comprehension of mitochondrial DNA. Each correct answer on an individual item contributed 1 point; incorrect and don't know responses and failures to respond were given no points. The Juror Comprehension Scale could range from 0, no correct answers, to 8, all correct answers. Before deliberation, the average Juror Comprehension Scale score was 5.6, with a standard deviation of 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 eight answers correct. After deliberation, the Juror Comprehension scale scores increased slightly but significantly (scale M = 5.8, SD = 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.

[110] 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.

[111] 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.

Figure 5.5: Juror Comprehension of mtDNA
(In Percentages)



In a repeated-measures analysis of variance, using the before-and-after eight-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 Mathematics 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 mathematics 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 mathematics 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. Non-whites have lower scores than whites, controlling for juror's age, education, gender, and the number of mathematics 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 eight basic knowledge questions, we added two probability items to the eight existing items to form an Expanded Juror Comprehension Scale.[112] Data analysis of this expanded scale once again reveals the strong and continuing impact of the juror's

[112] The two items are: "The mtDNA evidence is 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."

educational level, the number of mathematics and science courses, and science-relevant job experience. Non-whites again have lower scores than whites, controlling for the juror's age, educational level, gender, and the number of mathematics and science courses. However, jury deliberation, which produces a significant improvement in scores on the eight-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.[113]

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 trial videotape included testimony from the prosecution expert detailing the steps taken to avoid and detect any possible contamination in the laboratory.

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	Percentage
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

[113] 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.

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.

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 mathematics and science courses they have had (F (4, 451) = 4.06, p = .003). Those with more formal schooling and more mathematics 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 eight-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	Percentage
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 mathematics and science courses (F (4, 452) = 4.32, p = .002), are more likely 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 (β = .14, t = 3.13, p = .002) and white versus non-white race (β = -.15, t = -3.40, p = .001). Similar results are found with judgments that the mtDNA evidence is likely to be contaminated (education β = -.16, t = -3.57, $p < .001$; nonwhite versus white race β = .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 certain easily quantifiable 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. Non-whites, 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	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

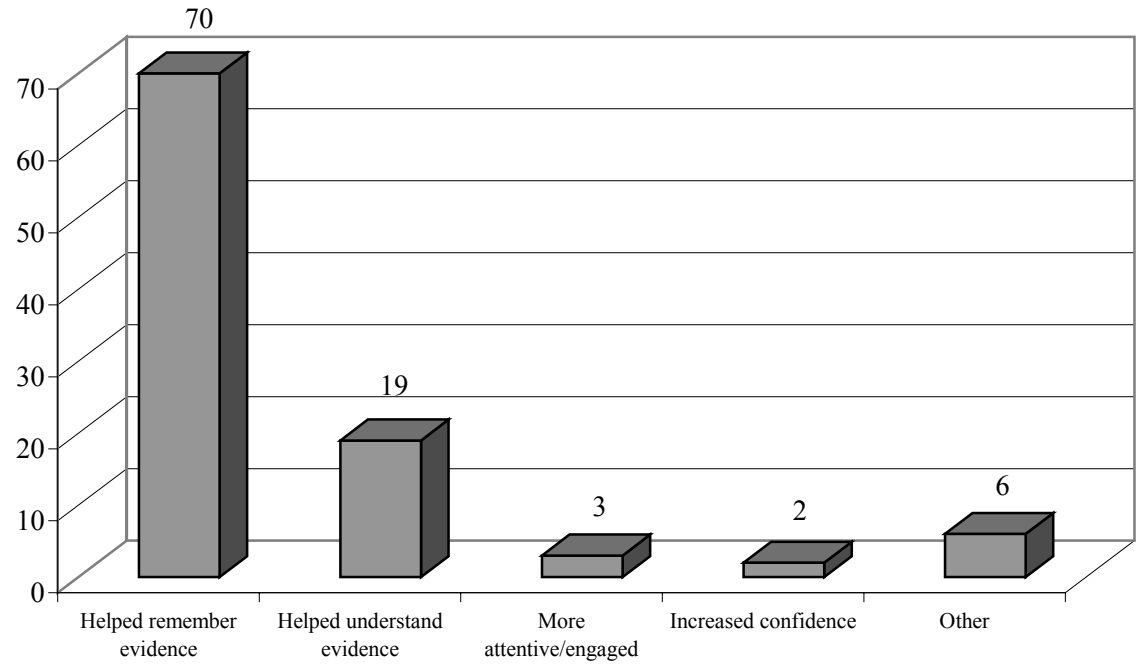
Frequency of Note Taking and Jurors' Impressions of Note Taking

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. Because jurors in most U.S. jurisdictions are permitted to take notes, this condition serves a dual function, as a useful contrast to the No Innovations condition where juror note taking is not permitted, and as a baseline or control for the other innovations conditions.

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 note taking 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.

Figure 6.1: Mock Jurors' Reported Reasons Why Note Taking Is Helpful
(In Percentages)



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% support the reform) compared to the 80 mock jurors in the No Innovations condition not allowed to take notes (80% support). 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% ($n = 21$).

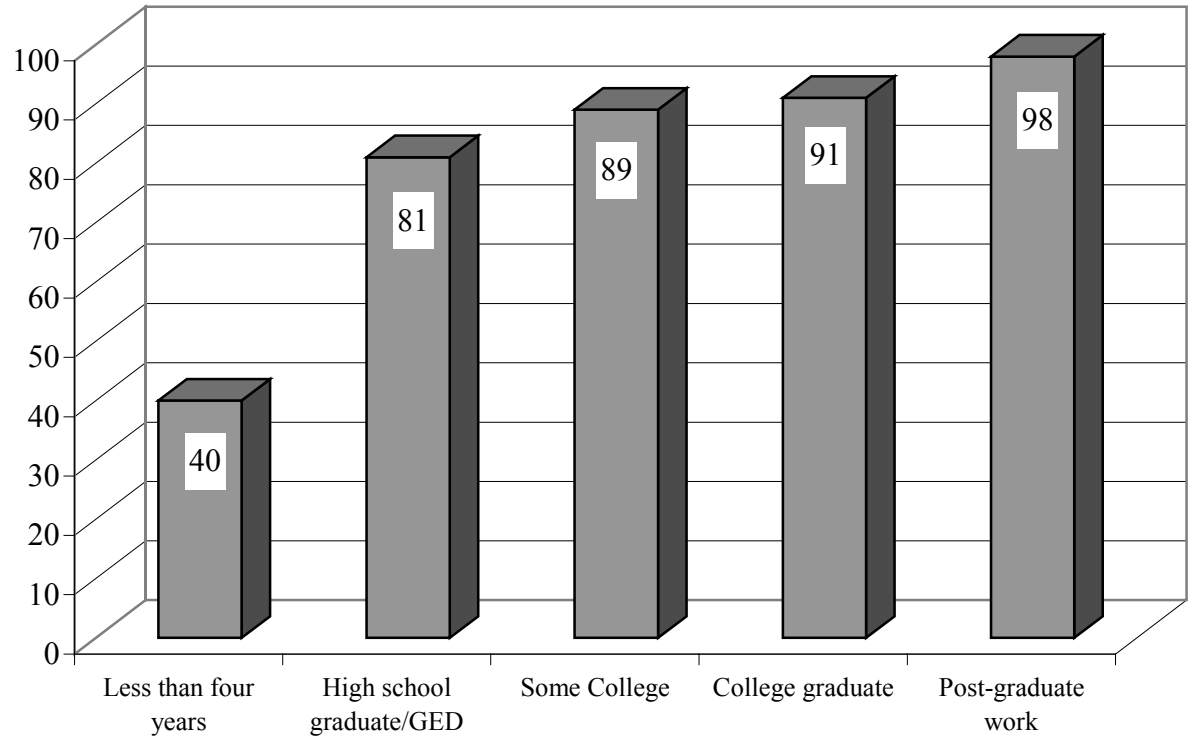
Juror satisfaction with the verdict is significantly higher among jurors who are told they can take and use notes compared to those who are not allowed to do so (F (1, 477) = 5.31, $p = .02$). However, the actual experience of note taking does not produce greater confidence in jurors' individual verdict 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 note taking 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%).

Figure 6.2: Percentage of Jurors Who Take Notes By Level Of Education (In Percentages)



Those who have more mathematics 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%, X^2 (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.

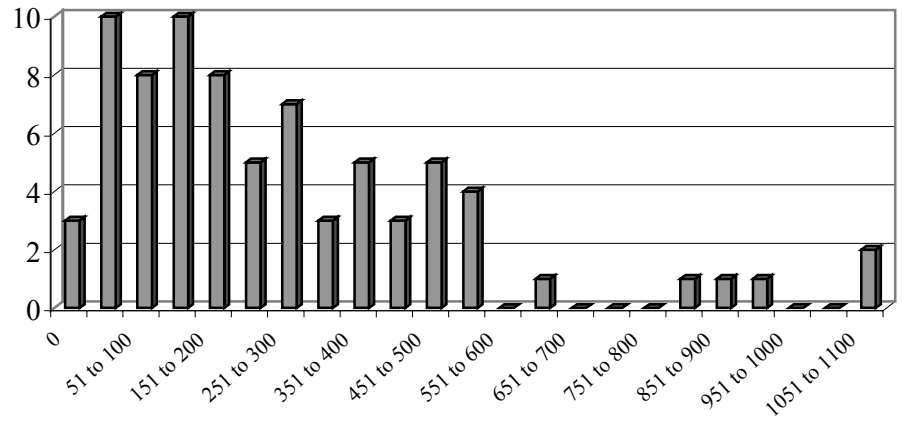
Interestingly, jurors in the note taking-only condition are marginally more likely to take notes (96%) than those in the other innovation conditions where another reform is paired with note taking (85%) (X^2 (4, N = 400) = 9.16, p = .057). Indeed, the All Innovations juries, where all four reforms are 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 Note Taking 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 Note Taking 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.

Figure 6.3: Word Count of Jurors' Notes in Note Taking Condition (Frequency)



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 note taking 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.[114] 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 (Condition 3, Question Asking and Note Taking, and Condition 6, All Innovations) 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 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 mathematics 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 mathematics 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. Table 6.2 lists the number of questions asked about each subject.

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[114] JURY TRIAL INNOVATIONS, supra note 21, at 144-45.

Table 6.2: Content Analysis of Jurors' Questions

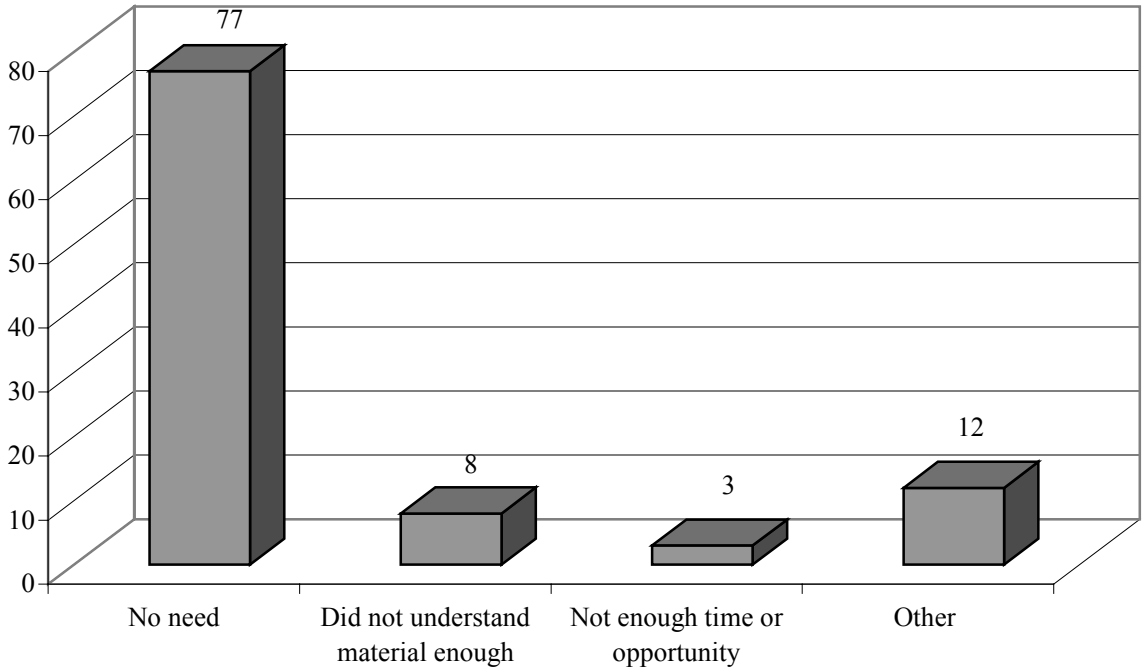
Number of Questions	Subject
10	FBI's mtDNA database
5	Differences between mtDNA and nDNA
	Heteroplasmy (2 requests to "explain again")
5	(3 questions about mutations)
4	Use of mtDNA generally
4	Reliability of mtDNA
4	Number of base pairs compared
3	Amount of hair analyzed
3	History of use of mtDNA in 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 jurors do not ask questions.

Figure 6.4: Jurors' Reported Reasons 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.[115] Even though we actively encouraged study participants to ask questions, the number was likewise fairly low considering the complexity of the expert testimony. However, given that the mock jurors' total time in trial and deliberations averaged about three hours, 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. 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 mathematics and science were more likely 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.

[115] 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 the checklist as they saw fit.

As described earlier, although the employment 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 evidence[116] 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 from the defendant. The checklist may be found in Appendix B. It was adapted from a published one tailored to older DNA technology.[117]

A large percentage of jurors in the two checklist conditions report that they "reviewed" the checklist (86%, n =136). Actually following through 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 juries (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 work on 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, reported use of the checklist is not related to the juror's science and mathematics background, science and mathematics job experience, or educational level.

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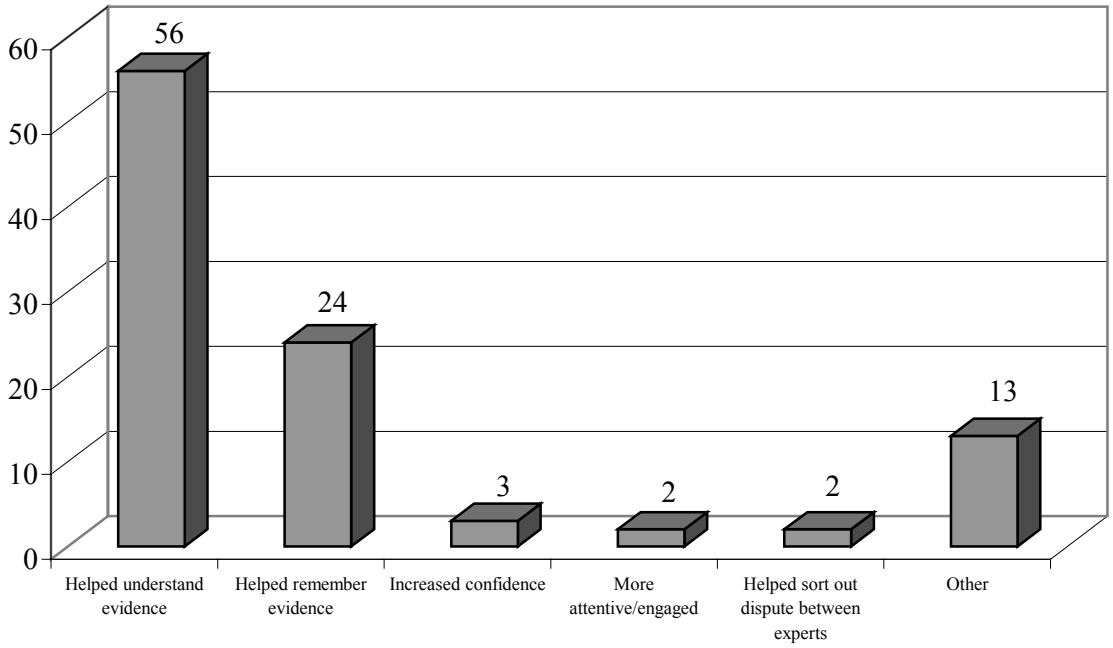
[116] See Chapter 2, Literature Review, for a fuller discussion of the juror checklist innovation.
[117] See Magnusson & Selinger, supra note 77.

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.

Figure 6.5: Jurors' Reported Reasons Why The Checklist Is Helpful (In Percentages)



As illustrated, significant percentages of the jurors (out of a total group 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%—compared to jurors in other groups (77%). Support for checklist use is highest among those jurors who choose to review them (85%, or 136 of the 159). Only 17% (or 23 of 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.[118] 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

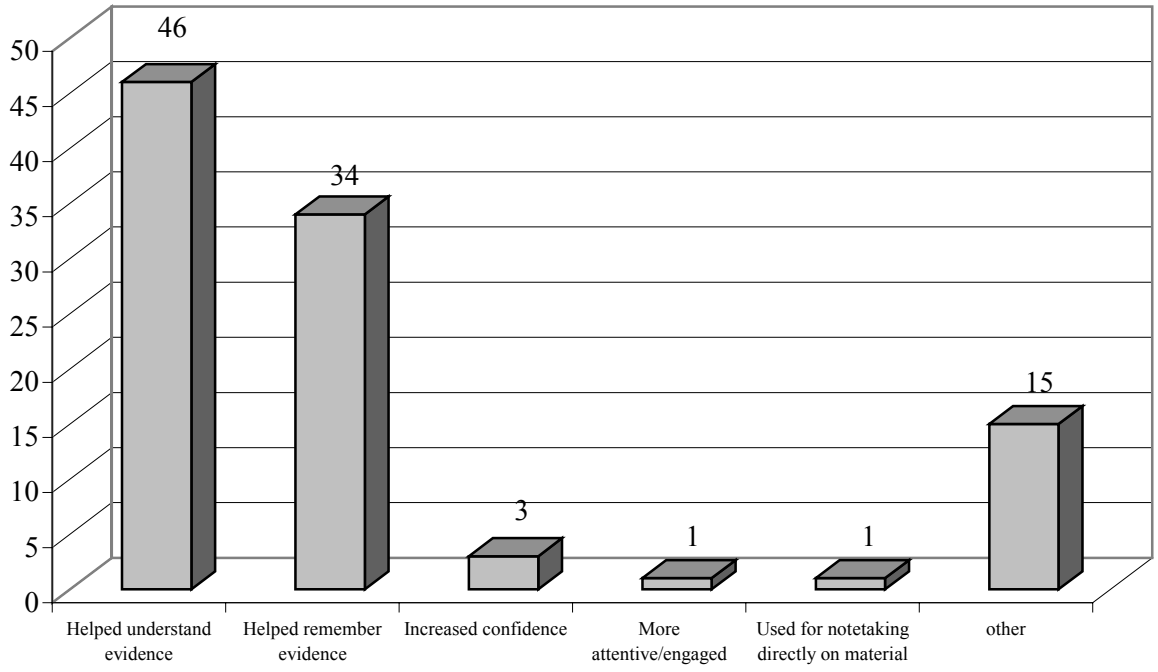
Over ninety percent (92%) of the 160 jurors in the two conditions say they took advantage of the opportunity to review the contents of their notebooks. For the small minority who do not do so, the reasons most often cited are that jurors find it unnecessary ($n = 6$); they are not aware of the contents ($n = 3$), or that they are confused or distracted by the notebook ($n = 2$). 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 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 their 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.

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

Figure 6.6: Mock Jurors' Reported 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 a familiar maxim's opposite, "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%, or 242 of 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)

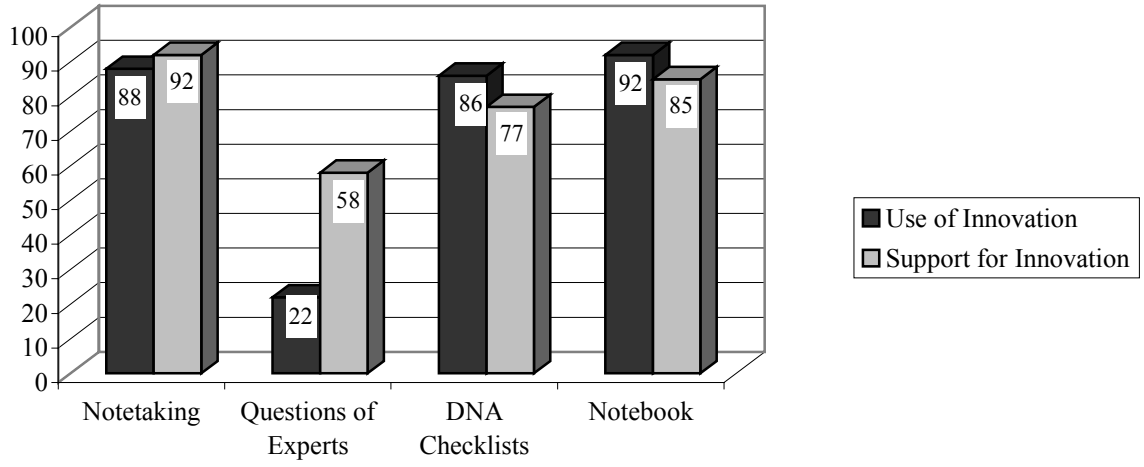


Figure 6.7 compares the jurors' use of innovations in the different experimental conditions that offered different jury innovations. It also compares support for the four tested innovations among the entire sample. When given the opportunity to do so, jurors take notes and refer to the jury notebooks at a high rate. A substantial number report reviewing the checklist, although not many are observed working through the steps of the checklist. 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: Support for and Perceived Benefits of Innovations among Jurors in Innovations Conditions
(In Percentages)

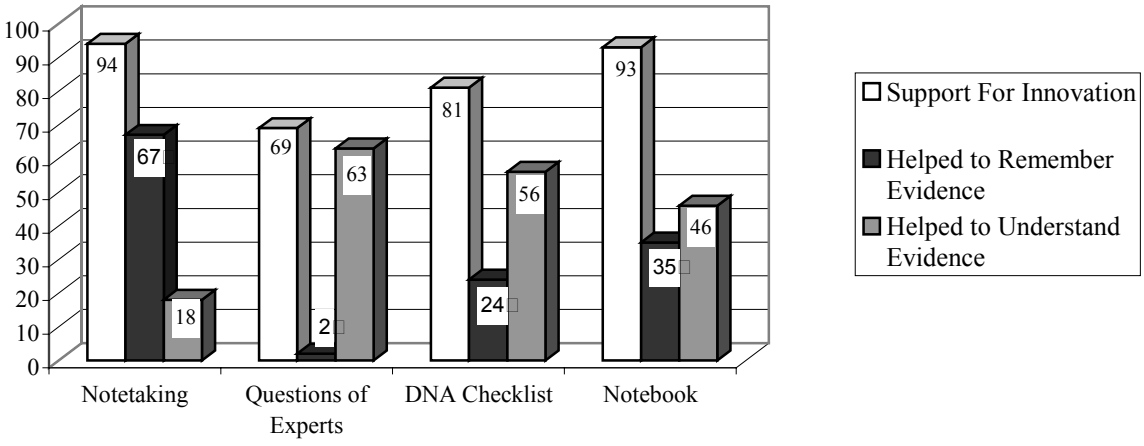


Figure 6.8 focuses on the jurors in the innovations conditions, comparing their support of the specific innovations they had the opportunity to use. These study participants who have the opportunity to employ particular innovation are even more enthusiastic about the reforms.

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 explore how jurors in the different experimental conditions perform on the Jury Comprehension Scales both before and after their deliberations. Table 6.3 and Figure 6.9 show the overall scores on the basic eight-item Juror Comprehension Scale for jurors in each of the conditions.

Table 6.3 Juror Comprehension Scores Before and After Deliberations by Condition

	Basic 8-Item Scale	
Condition	**Before**	**After**
No Innovations	5.60	5.77
Note Taking	5.60	5.44
Question Asking and Note Taking	5.51	5.73
DNA Checklist and Note Taking	5.58	5.90
Jury Notebook and Note Taking	5.88	6.00
All Innovations	5.60	6.14
Total	**5.63**	**5.83**

Note: Range of comprehension scores is (0-8) for the 8-item scale.

Figure 6.9 Juror Comprehension of mtDNA with Different Innovations Before and After Deliberation

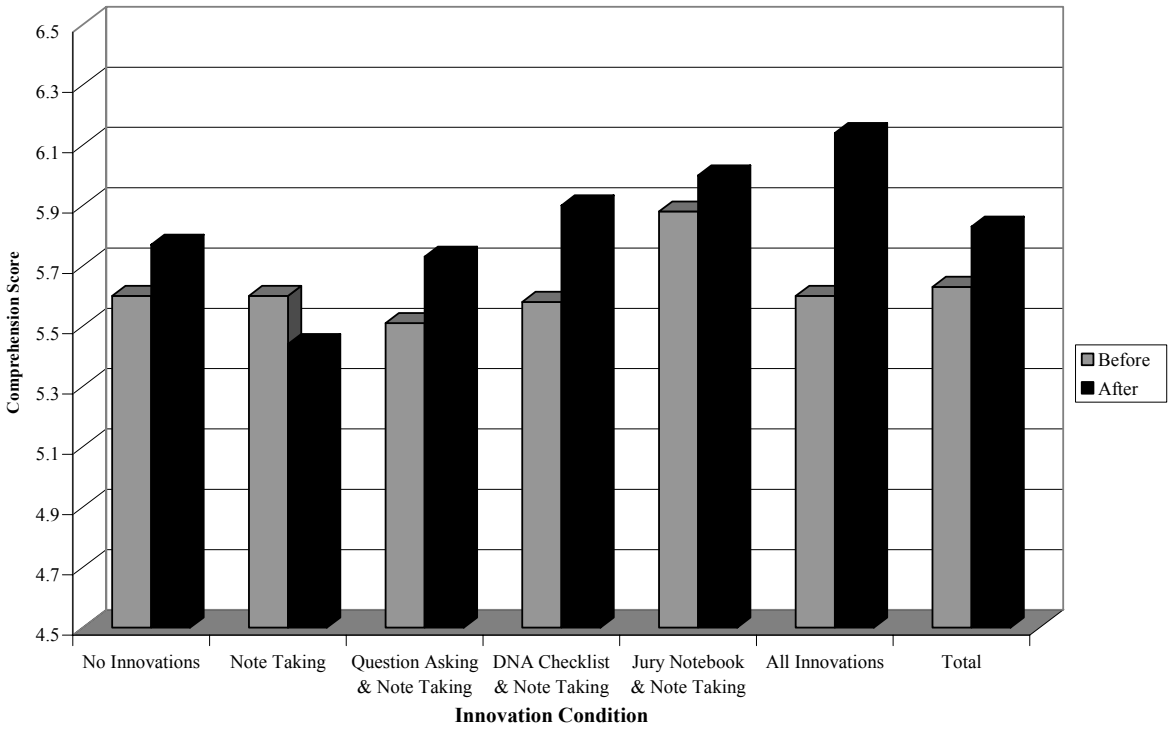


Figure 6.9 provides a simple visual comparison of the average juror comprehension scores for each of the six conditions. The figure shows graphically that most of the scores improve slightly after deliberations, except for the note taking only condition, in which the scores after deliberations move slightly downward. The greatest improvement in scores seems to come for jurors able to employ all innovations. What is more, jurors in the All Innovation condition perform best, on average, after deliberations.

To analyze whether the differences between and among these conditions are statistically significant and meaningful, we employed nested analyses, taking into account the juror's membership on a particular jury. Jury research is well suited for nested analyses, as jurors are "nested" within each jury. Due to membership in a group, in this case their jury, individuals are not completely independent of one another. Since the mock jurors in this study deliberated with one another, jurors potentially influenced one another. Jurors' responses following deliberations are no longer strictly independent observations, as assumed by many traditional statistical techniques, so it is appropriate to take their jury membership into account.[119]

[119] Several techniques are able to accommodate such nested designs. For example, 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. Another nested design option suitable for these data is a nested, repeated-measures MANOVA design. For our analyses, we ran regression analyses using Stata (statistical package) with the command "svyreg" and specifying "psu's" (clusters such as juries) to accommodate the nested design. We also obtained effect sizes and power

We also controlled for the juror's educational background in comparing the conditions to assess the impact of the jury innovations on juror comprehension. As reported earlier, many of our analyses showed that juror education is a substantial factor in comprehension of mtDNA evidence. More highly educated jurors have better command of mtDNA evidence than their less educated peers. No other variable comes close in terms of its regular, strong impact on juror comprehension. To make sure our comparisons are unaffected by chance fluctuations in juror education across the different groups and conditions, we therefore control for juror education.[120]

To fully understand the possible impact of the jury innovations, we undertook four types of comparative analyses of jury comprehension. These analyses produced somewhat different results. Therefore, we present each set of results in turn, and then comment on the overall patterns.

- First, we used the No Innovations condition as a "control" condition. We compared the No Innovations condition to each of the other conditions to determine how juries able to use these particular combinations of innovations compared to juries who had no access to any innovations.

- Second, we used the Note taking condition as a second "control" condition. We compared the Note Taking condition with each of the four other innovation conditions. Since note taking is frequently employed across the United States, these comparisons provide an opportunity to determine how juries might benefit from additional innovations over and above their current use of note taking.

- A third set of analyses compared the set of conditions in which jurors were allowed to use each particular innovation with the set of conditions in which jurors were not allowed to use that innovation. So, for example, the Notebooks analysis compared all the juries where notebooks were allowed (Conditions 5, Jury Notebook and Note Taking, and Condition 6, All Innovations) with all the juries in the other four conditions who did not have the chance to review jury notebooks. Similarly, in the Note Taking analysis, we contrasted how the No Innovations juries (who could not take notes) compared to the juries in all the other five conditions who were allowed to take notes.

- Fourth, we considered actual usage of an innovation. In each of the experimental conditions jurors had the *opportunity* (or not) to employ a particular set of jury innovations. The previous analyses compare all of the individuals in each of the conditions, whether or not they actually employed a particular innovation. Not all jurors took advantage of this opportunity. So, in a final set of analyses, we compared those *who were allowed to and did employ* a particular innovation, against those who

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analyses through a MANOVA in SPSS (statistical package). All analyses controlled for education levels, as explained below.

[120] There are no statistically significant differences between conditions in the overall educational background of our participants, but there are fluctuations. For example, 6 of the 10 participants with less than a high school degree are, by chance, in the All Innovations condition; no other condition has more than 1.

did not employ that innovation. For instance, we compared those who *could take notes and did* against those who *did not take notes at all*.

No Innovations versus each of the five innovations conditions: Our first and most basic comparison is to contrast the juror comprehension scores of the No Innovations juries, where mock jurors decided the case without any innovative procedures, with each of the other individual conditions. These analyses assessed the Juror Comprehension Scales for juries both before and after their deliberation. Furthermore, the juror's level of education was used as a control variable. Contrary to our predictions, both before and after deliberation, no significant differences are found when comparing each condition separately to the No Innovations group.[121] That is, compared to jurors who had no access to the innovations, the Juror Comprehension scores are not significantly higher for jurors in the various innovations conditions.

Note taking versus each of the four other innovations conditions: We did find some differences, however, with juries in our other control group, the Note Taking juries. Comparing the Note Taking juries before deliberation, and controlling for juror education levels, there were no differences between the Note taking juries and the juries in the other innovation conditions. However, once juries had the opportunity to deliberate, some significant differences emerged. After deliberation, jurors in the Jury Notebooks condition, the Checklist condition, and the All Innovations conditions score significantly higher on the juror comprehension scale, compared to the jurors in the Jury Note taking condition. Thus, additional innovations on top of jury note taking appear to improve the jurors' comprehension of the scientific evidence.[122] It's important to note that the Note Taking condition and the No Innovations condition are not significantly different, so these results are not explained by a significant drop in the Note taking condition.

Conditions with and without specific innovations: We also find some statistically significant differences between conditions with and without particular innovations. Before deliberations, as with the other analyses, 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 the

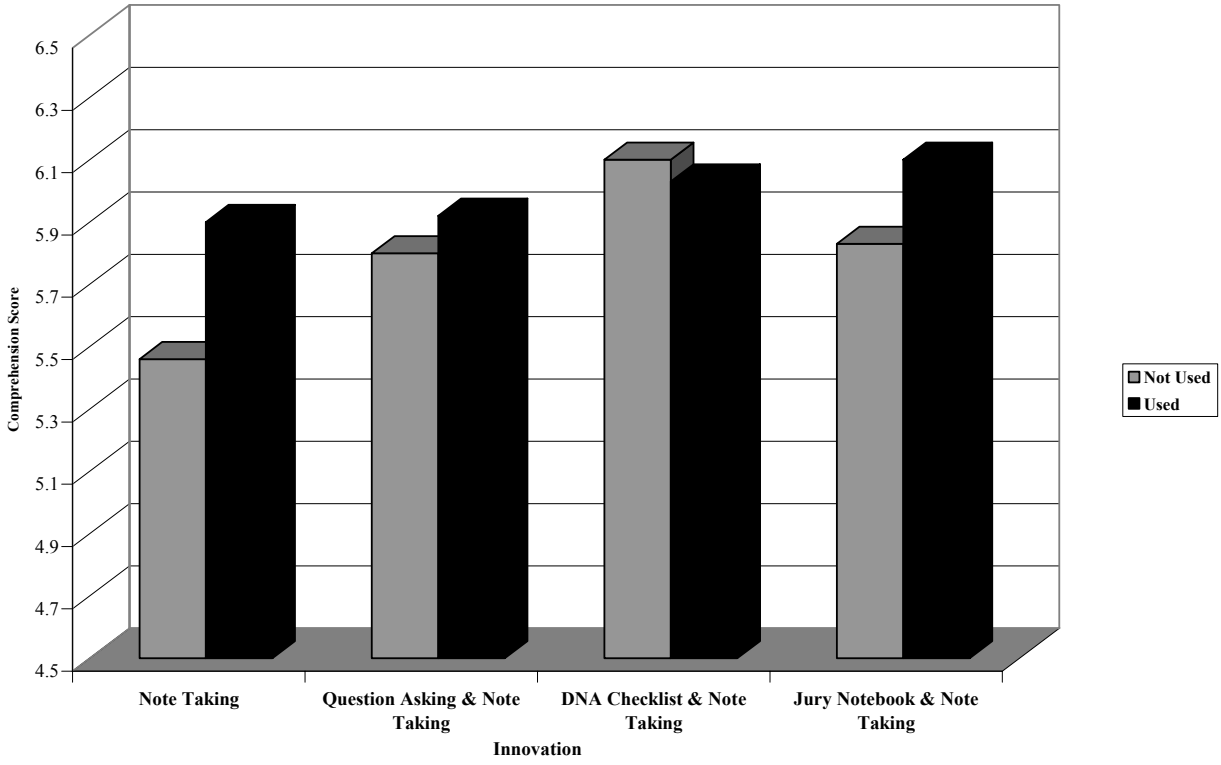
[121] Before deliberation, the overall model is not significant. After deliberation, the overall model becomes significant, $F(6, 466) = 10.63$, $p < .05$ with an $R^2 = .11$. However, post-hoc analyses reveal that none of the five innovations conditions significantly differs from the No Innovations group. The effect size of the innovation condition is very small (.024), indicating that the substantive difference between the innovation conditions is quite small. However, the observed power is .93, suggesting the probability of differences going undetected is statistically quite small.

[122] After deliberation, the overall model is significant, $F(5, 388) = 10.31$, $p = .006$ with an $R^2 = .12$. Post-hoc analyses comparing jury checklist vs. note taking reveal a significant difference ($p = .022$) and for notebooks vs. note taking ($p = .005$). The effect size of the innovation condition remains very small at .027, and the observed power is .94. These results are supported by the nested regression analyses. Checklists: $F(2,18) = 21.66$, $p < .001$, $R^2 = .16$, $\beta = .60$ for the innovation and $\beta = .08$ for education, $t = 2.41$, $p = .027$. Notebooks: $F(2,18) = 24.52$, $p < .001$, $R^2 = .17$, $\beta = .65$ for the innovation and $\beta = .08$ for education, $t = 2.77$, $p = .012$. The statistically significant post-hoc analyses for all innovations vs. note taking ($p < .001$) are also supported by nested regression analysis. All innovations: $F(2,18) = 31.36$, $p < .001$, $R^2 = .21$, $\beta = .79$ for the innovation and $\beta = .09$ for education, $t = 2.82$, $p = .011$.

basic factual test than those not provided with notebooks.[123] There is a marginal difference for those who could versus could not use a checklist; jurors in the Checklist conditions tend to do somewhat better than jurors in the other four conditions who had no opportunity to employ the checklist.[124]

Innovation Users versus Non-users: Thus far we have compared the jurors across conditions. However, because jurors make differential use of various innovations, it is of strong interest to see whether the actual use of particular innovations is associated with higher juror comprehension. As a final approach to understanding the impact of the innovations, we compare jurors who take advantage of each innovation to those who either choose not to employ the technique or are not permitted to do so because they are in an experimental condition that does not allow it. We use the juror's own reports of usage in this final set of analyses.

Figure 6.10 Juror Comprehension of MtDNA After Deliberations by Innovation Usage



[123] For the comparison of the Notebooks conditions with the No Notebooks conditions after deliberation, the overall model is statistically significant: $F(2, 58) = 41.05$, $p < .05$, $\beta = .40$ for notebook and $\beta = .08$ for education, $t = 2.11$, $p = .039$.

[124] Checklist: overall model, $F(2, 58) = 42.14$, $p < .05$, $\beta = .37$ for checklist and $\beta = .08$ for education, $t = 1.91$, $p = .061$. The Note Taking conditions comparison is not significant: The overall model, $F(2,58) = 40.40$, $p < .05$, $\beta = .09$ for note taking and $\beta = .08$ for education, $t = .30$, $p = .775$; neither is the Questions conditions versus No Questions conditions comparison: overall model, $F(2,58) = 41.20$, $p < .05$, $\beta = .13$ for questions and $\beta = .08$ for education, $t = .67$, $p = .504$.

Figure 6.10 visually displays the variation of jury comprehension scores for jurors who use each innovation compared to those who do not. The most salient feature of the figure is that those who do not take notes perform lowest on the comprehension scale. However, it is important to recall that there is a relationship between those who take notes and education levels. That is not surprising; jurors with more formal education have more experience sitting in a classroom setting and likely have more experience taking notes. Thus, it is crucial to add statistical controls to account for education as a component of the explanatory variance.

Once we control for a juror's education level, jurors who take notes do not differ significantly from those who chose not to take notes.[125] Similarly, jurors who take advantage of the opportunity to ask questions do not outperform those who do not ask questions.[126] However, those who say they make use of the checklist and employ the notebook both significantly outperform jurors who do not use these innovations, even when we control for the juror's educational background.[127]

Summary of Impact of Innovation Analyses

The analyses present a nuanced picture. For greater clarity we present a summary of the multiple approaches we have taken, and their key conclusions in Table 6.4.

Table 6.4: Innovation Impact Analyses: A Summary

Type of Comparison	Note Taking	Question Asking	Checklist	Notebooks
Juror self-reports	√	√	√	√
No Innovations condition versus other innovations conditions				
Notetaking versus other innovations conditions			√	√
Conditions with and without specific innovations				√
Users and non-users of innovations			√	√

Note: Checks for juror self-reports indicate innovations that jurors identified as helpful. Checks for other analyses indicate a statistically significant difference in juror comprehension.

The mock jurors themselves tell us that they benefited tremendously from the ability to employ the various jury innovations. However, when we narrow the focus to the issue that most concerns our project, whether the innovations can improve the comprehension of mtDNA evidence, the results are mixed. If we examine comprehension before deliberation, there is no discernible impact of any of the innovations in any of the statistical analyses. After deliberation, comparing the No Innovations with each of the other conditions, we again can detect no statistically significant effect. However, comparing the Note Taking condition to the other innovation conditions suggests that multiple innovations can have some positive impact in combination. The addition of jury notebooks, the provision of a DNA checklist, and allowing a

[125] $F(1, 470) = .28$, $p = .60$.
[126] $F(1, 470) = .48$, $p = .49$.
[127] Checklist: $F(1, 470) = 4.78$, $p = .029$; Notebook: $F(1, 470) = 10.03$, $p = .002$. All analyses controlled for the effect of educational differences.

broad pallet of jury innovations all appear to have the potential to produce significant improvement in jury comprehension of complex scientific evidence beyond that of jurors permitted to take notes. Comparing actual use of the techniques, we again find that those jurors who report employing the checklist and the jury notebooks comprehend significantly better, even when we control for education.

If we look closely at the overall improvement in juror comprehension, as measured by our basic 8-item comprehension scale, even the statistically significant changes, when they occur, are relatively modest. It's possible that our comprehension measure – a scale of predominantly true/false questions about mitochondrial DNA evidence – is not well-suited to detect improvement in juror understanding of mtDNA, especially given the good performance of our mock jurors. However, the comprehension scale scores do vary with the jurors' educational background, mathematics and science training, and job experience as expected, and they are correlated with the accuracy of jurors' definitions of mtDNA. These relationships provide us with some assurance that the scale is measuring juror comprehension to some degree.

From a methodological perspective, we believe that the internal validity of the study is high. The only difference between conditions is the opportunity to employ jury innovations, and our scale appears to measure comprehension reasonably well. However, the study conditions, although approximating those of actual juries, do differ from those experienced by real juries. Mock jury studies do not imitate all aspects of a juror's experience. So the external validity of our study deserves some mention, specifically as it might affect the operation of jury innovations. In particular, in an actual trial, the time period for the trial and for jury deliberations would be longer than was typical of the mock juries in this study. This is relevant given that the innovations we tested might be most useful for jurors in longer and complex trials. If some innovations such as note taking are helpful primarily for memory recall, as our mock jurors say they are, then the advantages that might accrue over a longer trial from note taking would be less obvious or even absent in a short mock jury trial such as ours. Such considerations may explain the small effect sizes and the lack of a substantive difference between certain innovations and the control conditions.

We conclude from these divergent results that the impact of jury reforms studied here on overall juror comprehension may be modest. If the effects were strong, we would have expected to see a pronounced difference between the No Innovations condition and the other experimental conditions, and we did not observe that. It was especially interesting that the most common of all jury techniques, that of note taking, did not appear to aid comprehension at all in our study. Likewise, question asking is not associated with improved understanding of the scientific evidence. The checklist and jury notebooks both seem to be more helpful. Perhaps these latter two reforms provide more expert guidance and assistance to the jurors, whereas the former rely more on the juror's own initiative.[128]

[128] Objections are often made that these kinds of devices may unfairly emphasize some evidence relative to other evidence and that, with regard to the checklist, that it may be too suggestive and tend to steer the jury toward a particular conclusion regarding the scientific evidence. These concerns can be ameliorated to the point where their value to the jurors outweighs considerations of unfair prejudice. See, generally, JURY TRIAL INNOVATIONS, supra note 21, at 109-111 (notebooks) and 187-190 (checklists).

It is quite intriguing that whatever effects occur emerge only after jury deliberation. That discussion period appears to be crucial in assisting jurors with how to understand and employ scientific evidence. We are currently in the process of transcribing the mock jury deliberations, with an eye to analyzing how the scientific evidence is discussed in different groups. That may provide us with more insight about the role of deliberation in jury comprehension of complex testimony about mtDNA. Although a full picture awaits the completion of the transcribing effort, some insights can be gained from a systematic analysis of some aspects of the jury deliberation. We now turn to that topic.

Chapter 7 – Jury Deliberations

The principal reason for videotaping the deliberations of all 60 mock juries was 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 5 to 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 nonscientific 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.[129] 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.

[129] 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 probably due to the simulated nature of the jury decision, 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.[130] In contrast, mock jury studies often have high hung jury rates.[131]

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%) and agree (76%) 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	Percentage
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) pertained to the law or 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.

[130] See, Hannaford-Agor et al., supra note 76; BEHIND CLOSED DOORS: A RESOURCE MANUAL TO IMPROVE JURY DELIBERATIONS (American Judicature Society 1999).
[131] Devine et al., supra note 102.

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 either the individual seated at the head of the table, the first juror to speak at all, or the only male on the jury. Men are significantly more likely to be selected as presiding juror than women (X^2 (1, 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 could be a factor. Presiding jurors have higher total numbers of mathematics 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).[132]

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.[133] 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 (one within the first two minutes of the deliberation). 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.

[132] 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, mathematics or science job experience, occupation, and previous jury service. Educational attainment is only marginally related (p = .09).

[133] Hannaford-Agor et al., supra note 102. In addition, see Norbert L. Kerr & Robert MacCoun, 48 J. Personality & Soc. Psychol. 349 (1985).

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.[134]

Previous reports on jury decision-making 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.[135] 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.[136] 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' theorem is a mathematical formula that expresses the impact of evidence on a prior subjective probability or belief.[137] Use of Bayes' rule has been suggested to assist jurors in combining nonscientific evidence with scientific evidence presented in terms of probabilities.[138] 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.[139] 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.[140]

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 nonscientific and scientific evidence are considered together." Defense counsel denigrates both categories of

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[134] Hannaford-Agor et al., supra note 102.
[135] E.g., Id.; BEHIND CLOSED DOORS, supra note 130 (collecting authorities and making suggestions for jury instructions); JURY TRIAL INNOVATIONS, supra note 21, at 171-73 (same); Valerie Hans & Neil Vidmar, supra note 26; Nancy S. Marder, Juries, Justice and Multiculturalism, 75 So. Cal. L. Rev. 659, 704-05 (2002).
[136] BEHIND CLOSED DOORS, supra note 130.
[137] David H. Kaye & David A. Freedman, Reference Guide on Statistics, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE, 2d ed. 83, 160 (Federal Judicial Center 2000).
[138] See, e.g., Michael O. Finkelstein & William B. Fairley, A Bayesian Approach to Identification Evidence, 83 Harv. L. Rev. 489 (1970); Faigman & Baglioni, supra note 9.
[139] E.g., Nance & Morris, supra note 13 (expert witness using an illustrative chart); Fenton & Neil, supra note 19 (use of a visual model and calculator); Brenda Inman Rowe, A Possible Solution for the Problem of Juries Slighting Non-scientific Evidence, 24 Am. J. Crim. L. 541 (1997) (judicial instruction).
[140] For an excellent overview of theories of juror decision-making, see INSIDE THE JUROR: THE PSYCHOLOGY OF JUROR DECISION MAKING (Reid Hastie ed., 1993).

evidence by name, but deals with them separately. There is no instruction on how to assess any evidence, nonscientific or scientific.

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 nonscientific 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:

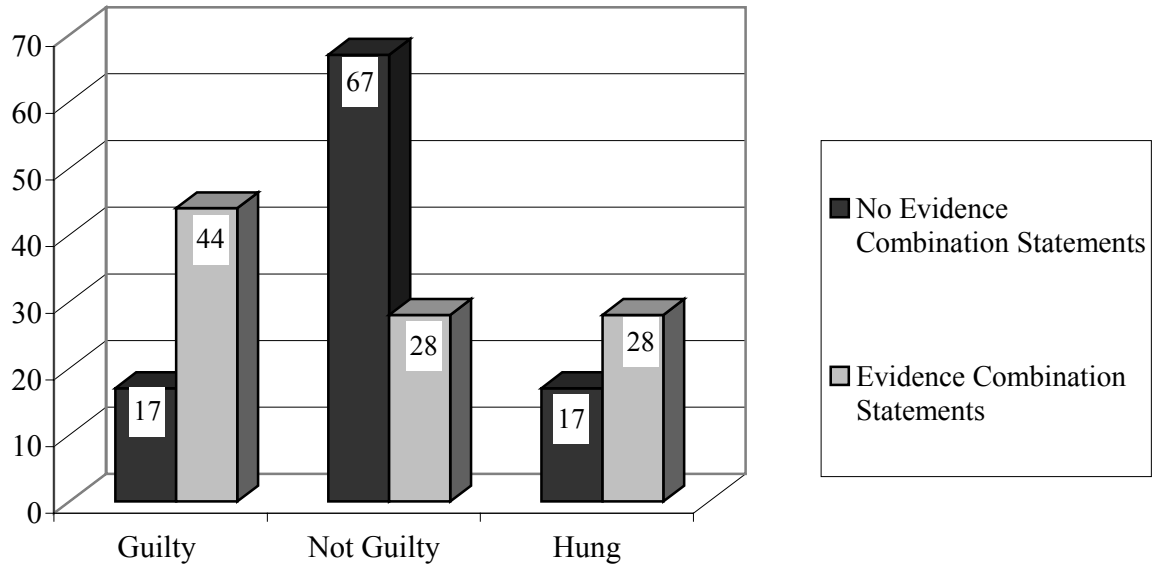
> "Out of 57 possibles [defense number for possible number of potential contributors in local area given defense version of RMP], you can narrow it down to a very high probability by age, build, facial scar, flashing money, hooded blue sweatshirt, no alibi, etc. You can't string that many coincidences 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 (X^2 (2, 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 likely to convict. Hung juries are a bit more likely when 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.

Figure 7.1: Evidence Combination Statements and Jury Verdicts
(In Percentages)



The cause of these relationships is not clear. 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 in Table 8.1.

Table 8.1: Experimental Conditions used in Mock Juries

Experimental Condition Number	Jury Innovations Permitted
Condition 1	No Innovations (Control)
Condition 2	Note Taking (Control)
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 nonscientific evidence and mtDNA testimony. Bank employees could not positively identify the robber since he wore a blue hooded sweatshirt and a partial mask. The teller testified at trial that she saw an unmistakable inch-long horizontal red scar on his cheek. A police search of the area turned up a blue sweatshirt, one glove and a small amount of 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. He commented that the profile was rare and had not been observed in the FBI's mtDNA 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 six 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 account properly 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 a few base pairs. 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 differs from 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 expected number of potential contributors of the mtDNA in the region.

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 apparently 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

Two of the four jury trial innovations received heavy use: 88% of jurors took notes, and 92% examined the contents of the juror notebooks. Although 85% of the jurors reported that they reviewed the mtDNA checklist, only a minority appeared to work through it in a step-by-step fashion. Furthermore, less 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 statistically significant differences on jurors' responses on the Juror Comprehension Scale between the various

innovation conditions in any of the statistical analyses. After deliberation, comparisons of the No Innovations mock juries with the juries offered various innovations again showed no significant differences. Using the Note Taking condition as a control, the addition of jury notebooks, the provision of a checklist, and offering all of the innovations, significantly enhanced comprehension. Comparing those juries in conditions with specific innovations and those without, some small but significant differences also emerged. For instance, after deliberation, jurors allowed to use notebooks performed slightly 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. Finally, those mock jurors who reported that they employed the checklist and reviewed the jury notebook performed better, even after controlling for the jurors' educational attainment. We conclude that the use of certain jury innovations have the potential to improve jurors' comprehension of scientific evidence. Methods that provide direct guidance or additional expert information seem to have the most potential. This suggests that other jury innovations that provide significant expert impact, such as juror tutorials in complex subjects and court-appointed experts to discuss the parties' often conflicting scientific evidence, are ripe for evaluation.

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 nonscientific 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.

Participating in jury deliberations appeared to improve juror comprehension of the complex scientific evidence. Jurors responded to true-false items about mitochondrial DNA both immediately before and right after jury deliberation. The post-deliberation comprehension scores were significantly higher. This reinforces the point made by a number of jury scholars that jury deliberation is a key element in ensuring jury competence.

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 differences 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. Given the findings that resulted from this experiment with selected jury trial innovations, we can offer five suggestions for judges, expert witnesses or attorneys presenting or contesting DNA evidence in jury trials:

1. Distribute juror notebooks that contain, among other things, copies of the expert's slides, overheads, charts, and the like, a glossary of technical terms, a list of the issues presented by the DNA evidence (see paragraph 2 below), and blank paper for juror note taking.[141]
2. Distribute a checklist or inference chart listing the issues presented by the DNA evidence, and provide a step-by-step pathway for the jurors' resolution of those issues.[142]
3. Provide a brief, simple, and plain-English explanation of forensic DNA without burdening jurors with nonessential details about the technical procedures used in the

[141] See discussion in Chapter 6, Multi-purpose Juror Notebooks, supra.
[142] See discussion in Chapter 6, Checklists (Decision Trees) Relating to DNA Evidence and Issues, supra and Appendix B (mtDNA Checklist).

laboratory. Some of the deliberating jurors in our experiment complained of "technical overload" regarding essentially uncontested matters.

4. A significant number of jurors in our experiment believed sample contamination was a problem despite the total lack of evidence or argument by defense counsel to suggest actual contamination. The party introducing DNA evidence should consider what information, if any, would best allay fears of contamination.[143]
5. Encourage jurors to consider the probative value of the match evidence together with the value of the nonscientific evidence. Jurors do attempt to combine both types of information to arrive at an opinion regarding guilt,[144] but how they should best go about this task is far from clear. If attorneys or experts could present simple, understandable approaches for the jury, they would perform a valuable function.

[143] See Chapter 4, Concerns about Reliability and Contamination of mtDNA, supra.
[144] See Chapter 7, Jury Deliberations, The Frequency and Effects of Jurors' Evidence Combination Statements, supra.

Appendix A. Juror Consent Form and Questionnaires

Participant Consent Form
Initial Juror Questionnaire
Questionnaire Following the Presentation of the Trial Evidence
Post-Jury Deliberation Questionnaire
Jury Verdict Form

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Consent Form: Mock Jury Research Project
Dr. Valerie P. Hans, Ph.D., Professor, University of Delaware

Purpose and Description of the Research. The current research project is designed to test whether different approaches to trial procedures have positive benefits for juries. Participants must be at least 18, and either registered to vote or have a driver's license. The reason for this is that the jury pool in Delaware is drawn from these lists. Participants will watch a videotape of trial evidence. They will answer a questionnaire about their individual opinions of the case, then deliberate with other people to arrive at a group decision. The group deliberation will be videotaped. They will fill out additional questionnaires that ask questions about their understanding of the evidence, their perceptions of the case, attitudes, and demographic information. The study will take between 3 and 4 hours. Approximately 480 people will participate in the study. The study is sponsored by the National Institute of Justice.

Confidentiality of Participants' Information. Participants will be asked to fill out questionnaires or answer questions about their views. The deliberation will be videotaped. No names or other identifying information will appear on the written material or videotapes. At the conclusion of the research study, the questionnaires will be shredded. The videotapes of mock jury deliberations will be used in research, to analyze how different approaches to trial procedures affect the discussions of mock juries. The videotapes may also be used for education and training; excerpts of the videotapes may be shown to individuals or groups to demonstrate the impact of different approaches to trial procedures on the jury's understanding of evidence.

Risks and Benefits. There are no known risks to participants. Participants will receive $50.00 for participating in the study. Participation is completely voluntary. Participants may refuse to participate in the study, and may withdraw from the study at any point. Participants may also refuse to answer one or more specific questions on the questionnaires without penalty. Participants who complete the study will receive $50.00.

Contact Information. Questions and further information about the research project may be obtained by contacting: Valerie P. Hans, Ph.D., Professor of Sociology and Criminal Justice, University of Delaware, Newark, DE 19716; 302-831-8231. Questions about participants' rights may be directed to: Dr. T. W. Fraser Russell, Vice Provost for Research, University of Delaware, Newark, DE 19716; 302-831-4007.

Consent Form Signature (Required for Participation):

I have read the above description and voluntarily agree to participate in the mock jury research project.

_____	_____	_____
Name	Signature	Date

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Initial Juror Questionnaire

Juror Number _____

Greetings! Below are some background information questions. The purpose of gathering this information is to learn more about the views of the participants in the study. As with all of the information you provide in this study, your answers will be confidential, and used only for research or educational purposes.

Please answer the questions below. Please fill them out independently. Do not consult with other jurors. To ensure anonymity, do not put your name on the questionnaire, only your Juror Number. If you need help, or have any questions, please ask one of the research assistants.

Background Information

Shortly you will be viewing a videotaped trial in which different types of evidence will be presented. Before you see this tape, we would like to know your general views of the reliability of different types of evidence. So, please CIRCLE the option below that best corresponds to your views.

1. Police evidence
Not at all reliable Slightly reliable Somewhat reliable Very reliable Extremely reliable

2. Victims' evidence
Not at all reliable Slightly reliable Somewhat reliable Very reliable Extremely reliable

3. Expert evidence
Not at all reliable Slightly reliable Somewhat reliable Very reliable Extremely reliable

4. DNA evidence
Not at all reliable Slightly reliable Somewhat reliable Very reliable Extremely reliable

5. Eyewitness evidence
Not at all reliable Slightly reliable Somewhat reliable Very reliable Extremely reliable

Below are some statements like those you might find in a newspaper or magazine article. For each statement, please indicate if you generally agree or disagree by circling the option that best corresponds to your views. If you feel especially strongly about a statement, please circle "strongly agree" or "strongly disagree."

6. Science and technology are making our lives healthier, easier, and more comfortable.
Strongly agree Agree Disagree Strongly disagree

7. Most scientists want to work on things that will make life better for the average person.
Strongly agree Agree Disagree Strongly disagree

8. With the application of science and new technology, work will become more interesting.
Strongly agree Agree Disagree Strongly disagree

9. Because of science and technology, there will be more opportunities for the next generation.
Strongly agree Agree Disagree Strongly disagree

10. We depend too much on science and not enough on faith.
Strongly agree Agree Disagree Strongly disagree

11. It is not important for me to know about science in my daily life.
Strongly agree Agree Disagree Strongly disagree

12. Science makes our way of life change too fast.
Strongly agree Agree Disagree Strongly disagree

Finally, we are interested in your general opinions about your community.

13. How much trust and confidence do you have in the police in your community?
None 1 2 3 4 5 6 7 A great deal

14. How much trust and confidence do you have in the courts in your community?
None 1 2 3 4 5 6 7 A great deal

15. To what extent do you believe that crime is a serious problem in your community?
None 1 2 3 4 5 6 7 A great deal

Thank you! When you have completed this set of questions, please turn your sheet in to the research assistant. We will start the videotape shortly.

Questionnaire Following the Presentation of the Trial Evidence

Juror Number _____

Now you have heard both the prosecution's and the defendant's evidence and arguments and the judge's instructions on the law. Soon, you will be discussing the case with the other jurors. But first, we would like to know how <u>you as an individual</u> see the case at this point. Please answer the following questions based on your own current views. Because we are interested in your personal views right now, please don't discuss any of the questions or your answers with the other jurors while you are filling out the questionnaire. You will have a chance to talk to them soon. Again, to preserve confidentiality, please don't put your name on this questionnaire, only your Juror Number. If you need help, or have any questions, please ask one of the research assistants.

1. At this point in time, before discussing the case with your fellow jurors, what verdict do you favor? [please circle one] Guilty Not Guilty Unsure

2. If 1 is not at all confident and 10 is very confident, how confident are you in your preliminary verdict? _____

3. In your view, what is the likelihood that the defendant Kevin Jones is actually the person who committed the robbery? ____%

4. On a scale of 1 to 10, where 1 is low credibility and 10 is high credibility, how credible and believable are each of these people to you?

   The prosecutor, Mr. James Metcalfe ____
   The bank teller and eyewitness, Katherine Blessing ____
   Detective Jack Webb of Middletown Police Department ____
   The prosecution's expert on DNA evidence, FBI Special Agent David Jaye ____

   The defense attorney, Robert Moody ____
   The defendant, Kevin Jones ____
   The defense's expert on DNA evidence, Professor Elizabeth Allison ____

5. Overall, on a 1 to 10 scale, where 1 is very weak and 10 is very strong, how strong is the prosecution's case? _____

6. What statements or evidence presented by the prosecution did you find most persuasive?

7. Overall, on a 1 to 10 scale, where 1 is very weak and 10 is very strong, how strong is the defense's case? _____

8. What statements or evidence presented by the defense did you find most persuasive?

9. Is there any evidence that you do not understand at this point? Yes No [circle one]

   9a. If you answered yes, what evidence do you not understand?

10. How easy or difficult was it for you to follow the expert testimony about mtDNA evidence? [please circle one]
    Very easy Easy Neutral Difficult Very difficult

11. How well do you feel that you understand the mtDNA testimony at this point? [please circle one]
    Not at all Slightly Somewhat Well Very well

12. In your own words, what is mitochondrial DNA (mtDNA) evidence?

13. Do mtDNA and nuclear DNA (nDNA) have the same ability to prove identity, or is one better than the other? [Please circle one option]
MtDNA better nDNA better Both are the same Don't know

14. Are the following statements about mtDNA true or false? [please circle the option that shows your view]

a. Mitochondria are found inside the nucleus of every cell.
True False Don't Know

b. A match is the same mtDNA sequence in two samples.
True False Don't Know

c. When mtDNA evidence is analyzed, about 600 base pairs are compared.
True False Don't Know

d. Heteroplasmy means that the same individual has mtDNA with different base pairs at certain points.
True False Don't Know

e. The sequence of base pairs in mtDNA is important.
True False Don't Know

f. A person's mtDNA comes from both the mother and the father.
True False Don't Know

g. The mtDNA evidence in this case excludes at least 99% of the population as the source of the hairs.
True False Don't Know

h. The mtDNA evidence in this case is completely irrelevant because a substantial number of other people could also be the source of the hairs.
True False Don't Know

i. The mtDNA evidence in this case shows there is about a 1% chance that someone else besides the defendant committed the crime.
True False Don't Know

j. The mtDNA evidence in this case shows that there is only a 1-in-57 chance that the defendant committed the crime.
True False Don't Know

15. What questions remain in your mind that have still not been answered?

The Control Condition Questionnaire ended at this point. In the other conditions, the following questions tapped the use of the jury reforms used in specific experimental conditions. The All Innovations conditions I included questions about all jury reforms. Open-ended questions provided additional space for written answers.

For note-taking conditions (conditions 2, 3, 4, 5, & 6)

Did you take any notes? [circle one]
Yes, I took notes. No, I did not take notes.

If you did NOT take notes, why didn't you take any notes? [SKIP if you took notes]

Whether or not you took notes, how helpful was it for you to have the chance to take notes? [circle one]
Not at all helpful Slightly helpful Somewhat helpful Very helpful Extremely helpful

In what specific ways did you find it helpful? [SKIP if it was not at all helpful]

For question-asking conditions (conditions 3 & 6)

Did you personally ask any questions of the expert witnesses? [circle one]
Yes, I asked a question. No, I did not ask a question.

If you did not ask any questions of the expert witnesses, why not? [SKIP if you asked a question]

Whether or not you asked questions of the expert witnesses, how helpful was it to have the chance to ask questions of the experts? [circle one]
Not at all helpful Slightly helpful Somewhat helpful Very helpful Extremely helpful

In what specific ways did you find it helpful? [SKIP if it was not at all helpful]

For checklist conditions (conditions 4 & 6)

Did you review the checklist for the mtDNA evidence that was provided?
Yes, I reviewed the checklist. No, I did not review the checklist.

If you did not review the checklist, why not? [SKIP if you reviewed the checklist]

Whether or not you reviewed the checklist, how helpful was it to have the chance to review the checklist? [circle one]
Not at all helpful Slightly helpful Somewhat helpful Very helpful Extremely helpful

In what specific ways did you find it helpful? [SKIP if it was not at all helpful]

For notebook conditions (conditions 5 & 6)

Did you review the jury notebook with witness list, glossary, and other background material about mtDNA? [circle one]
Yes, I reviewed the notebook material. No, I did not review the notebook material.

If you did not review the notebook material, why not? [SKIP if you reviewed the material]

Whether or not you reviewed the material, how helpful was it to have the chance to review the material? [circle one]
Not at all helpful Slightly helpful Somewhat helpful Very helpful Extremely helpful

In what specific ways did you find it helpful? [SKIP if it was not at all helpful]

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Post-Jury Deliberation Questionnaire

Juror Number _____

We now have some final questions that ask about your reactions to the jury study, your current perceptions of the case, and your attitudes in general. We have asked some of these questions before; however, you have now had a chance to benefit from discussing the case with your fellow jurors, and your views of the evidence and the case may have changed. Therefore, please answer the questions below in terms of your current views. As before, answer the questions independently, without talking to or discussing the questions or answers with other jurors. To ensure confidentiality, do not put your name on the questionnaire, only your Juror Number. If you need help, or have any questions, please ask one of the research assistants.

Questions about the Trial and Jury Deliberation

Now that you've had a chance to talk about the case with the other jurors, we would like to find out how you now think about the case and the evidence.

1. What was the most important evidence presented by the prosecution?

2. What was the most important evidence presented by the defense?

3. Now that you have discussed the case with your fellow jurors, what verdict do you personally favor? [please circle one] Guilty Not Guilty Unsure

4. If 1 is not at all confident and 10 is very confident, how confident are you in your individual personal verdict? _____

5. In your view, what is the likelihood that the defendant Kevin Jones is actually the person who committed the robbery? _____%

6. How satisfied are you with your jury deliberation? [please circle one]
Very satisfied
Somewhat satisfied
Neutral
Somewhat dissatisfied
Very dissatisfied

7. How helpful was the deliberation in terms of increasing your understanding the expert evidence in this case? [please circle one]
Very helpful
Somewhat helpful
Neutral
Somewhat unhelpful
Very unhelpful

8. How satisfied are you with the verdict that your jury reached? [please circle one]
Very satisfied
Somewhat satisfied
Neutral
Somewhat dissatisfied
Very dissatisfied

9. How much do you agree with the verdict that your jury reached? [please circle one]
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

We would like to ask you some questions about the trial testimony concerning DNA, specifically, mitochondrial DNA or mtDNA. Again, we've asked some of these questions before, but if you discussed mtDNA during deliberation, your ideas may have changed.

10. On a 1-to-10 scale, where 1 is not at all important and 10 is very important, how important overall was the mtDNA evidence to your final decision in this case? ____

11. Do mtDNA and nuclear DNA (nDNA) have the same ability to prove identity, or is one better than the other? [please circle one option]
mtDNA better nDNA better Both the same Don't know

12. How well do you feel that you understand the mtDNA testimony at this point?
Not at all Slightly Somewhat Well Very well

13. How reliable was the mtDNA evidence presented by the prosecution in this case?
Not at all reliable Slightly reliable Somewhat reliable Very reliable Extremely reliable

14. How likely is it that the mtDNA evidence was contaminated in this case?
Not at all likely Slightly likely Somewhat likely Very likely Extremely likely

15. Are the following statements about mtDNA true or false? [please circle the option that shows your view]

a. Mitochondria are found inside the nucleus of every cell.
True False Don't Know

b. A match is the same mtDNA sequence in two samples.
True False Don't Know

c. When mtDNA evidence is analyzed, about 600 base pairs are compared.
True False Don't Know

d. Heteroplasmy means that the same individual has mtDNA with different base pairs at certain points.
True False Don't Know

e. The sequence of base pairs in mtDNA is important.
True False Don't Know

f. A person's mtDNA comes from both the mother and the father.
True False Don't Know

g. The mtDNA evidence in this case excludes at least 99% of the population as the source of the hairs.
True False Don't Know

h. The mtDNA evidence in this case is completely irrelevant because a substantial number of other people could also be the source of the hairs.
True False Don't Know

i. The mtDNA evidence in this case shows there is about a 1% chance that someone else besides the defendant committed the crime.
True False Don't Know

j. The mtDNA evidence in this case shows that there is only a 1-in-57 chance that the defendant committed the crime.
True False Don't Know

k. The mtDNA evidence in this case could have come from the defendant's brother, if the two had the same father but different mothers.
True False Don't Know

l. 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 False Don't Know

m. 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 False Don't Know

The next set of questions asks about changes people have been talking about making to the legal system. After each, please tell me if you favor or oppose the change, and if so how strongly. Please use a 1 to 10 scale, where 1 means that you strongly oppose the change, and 10 means that you strongly favor the change.

16. Allowing jurors to take notes ____

17. Letting jurors ask questions of witnesses ____

18 Allowing jurors to talk about the case during the trial, before the final group deliberation ____

19. Giving jurors a checklist to help them use expert testimony ____

20. Giving jurors jury notebooks with a witness list, glossary and background material to help them understand expert testimony ____

***We'd also like your views and opinions about the uses of DNA analysis in other cases.**

*21. How much would you say you have heard about mtDNA analysis before participating in this study, either in court cases or in your general reading or coursework? [circle one]
Nothing Small amount Moderate amount Substantial amount

*22. What kind of DNA analysis was used in the O.J. Simpson trial? [circle one]
mtDNA nDNA Don't know

*22. How many news media stories have you read or watched on TV about the Laci Peterson case, involving the California man who is accused of killing his wife and unborn child? [circle one]
No new stories
A few news stories
A moderate number of news stories
A large number of news stories

***Asked only of mock jurors who served after mtDNA evidentiary hearing in Scott Peterson California murder trial (hearing on Oct. 29, 2003).**

*23. Do you recall if there is any DNA evidence in the Laci Peterson case? [circle one]
Yes No Don't Know

23a. If you answered yes, please explain what you recall.

_____
_____
_____
_____

*24. If DNA evidence is used in the Laci Peterson trial, do you think it will be mtDNA or nDNA that is used? [circle one]
mtDNA nDNA Don't Know

Background Information Questions

Below are some background information questions. The purpose of gathering this information is to learn more about the participants in the study, and how their characteristics and experiences affect how they consider a criminal trial. As with all of the information you provide in this study, your answers will be used only for research and educational purposes.

25. Age: _____

26. Gender: Male Female (circle one)

27. Racial/ethnic background: (circle one)
Black/African American
White/Caucasian
White/Hispanic
Nonwhite/Hispanic
Native American
Asian/Pacific Islander
Other: please specify: _____

28. How many years of school have you completed? [circle one]
Less than four years of high school
High school graduate/GED
Some college
College graduate
Post-graduate work

29. How many science and math courses did you have in high school and/or college?

Number of courses in high school: _____
Number of courses in college: _____

***Asked only of mock jurors who served after mtDNA evidentiary hearing in Scott Peterson California murder trial (hearing on Oct. 29, 2003).**

30. Have you had any job experience in math or science?
Yes No [please circle one]

30a. If you answered yes, you have had job experience in math or science, please describe.

_____
_____
_____

31. Current job status: [please circle]
employed full time
employed part-time
self-employed
homemaker
retired
unemployed, seeking employment
unemployed, not seeking employment

32. If you are presently employed, please select the occupational category below that best fits your occupation:
Managerial specialties (financial, personnel, public relations, advertising)
Professional (teacher, doctor, lawyer, writer, engineer, architect)
Technical and sales (sales, clerical, secretary, computer operator, technician)
Service (police, firefighter, waitress, beautician, household worker)
Agricultural (farmer, operator and manager, forestry)
Mechanic/craftsman
Operator, laborer, transportation worker
Other–please specify: _____

33. In politics today, do you consider yourself a liberal, a moderate, or a conservative? [please check relevant box]
[ ] very liberal [ ] somewhat liberal [ ] moderate, leaning toward liberal [ ] moderate
[ ] moderate, leaning toward conservative [ ] somewhat conservative [ ] very conservative

34. Have you ever served on a jury in a criminal case?
[ ] Yes [ ] No

35. Have you ever served on a jury in a civil case?
[ ] Yes [ ] No

36. What was your total household income last year?
[ ] under $10,000 [ ] between $10,000 and $19,999 [ ] between $20,000 and $29,999
[ ] between $30,000 and $39,999 [ ] between $40,000 and $49,999
[ ] between $50,000 and $75,000 [ ] over $75,000

37. Do you have any comments about the trial and study you would like to share?

Thank you very much for participating in our mock jury study. If you are interested in receiving a copy of the study results, please leave your name and address with one of the research assistants.

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Superior Court of Middletown County

State vs. Kevin Jones

JURY VERDICT FORM

We, the jury, do find the defendant, Kevin Jones (check one):

____ Not guilty of armed robbery

_____ Guilty of armed robbery.

Signed, Juror Number _____ [fill in], Presiding Juror

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Appendix B. Trial Script and Juror Reform Materials

Mock Jury Trial Script
DVD/VHS Copy of Mock Jury Trial (Hard Copy)
Expert mtDNA PowerPoint Slides
MtDNA Checklist
Jury Notebook (Hard Copy)

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NIJ RESEARCH PROJECT: TESTING THE EFFECTS OF SELECTED JURY TRIAL INNOVATIONS ON JUROR COMPREHENSION OF CONTESTED MTDNA EVIDENCE

MOCK JURY TRIAL SCRIPT

STATE V. KEVIN JONES

Judge's Preliminary Jury Instructions—Mike Dann

First, a word of welcome to our jurors. I am Judge Michael Dann, and I will be presiding over the case you jurors will hear and decide.

The defendant, Kevin Jones, is charged with armed robbery of a local bank. Now that the trial is beginning, there are some important preliminary matters I would like to share with you so that you will better understand what will happen during the trial.

As jurors, you have three major duties. The first is to carefully listen to and look at the evidence and decide what happened in this case. Second, you must carefully listen to and follow the law that applies in the case. Finally, you will reach a verdict on the question whether the defendant is guilty or not guilty of the crime charged.

Every defendant is presumed by law to be innocent. The prosecution has the burden of proving the defendant guilty beyond a reasonable doubt. Proof "beyond a reasonable doubt" is proof that leaves you firmly convinced of the defendant's guilt.

On the other hand, the law does not require proof that overcomes every doubt. If, based on your consideration of all the evidence, in light of the law that applies, you are firmly convinced that the defendant is guilty of the crime charged, a guilty verdict is authorized. However, if you think, based on the evidence or the lack of it, that there is a real possibility that he is not guilty, you must give him the benefit of the doubt and find him not guilty.

The defendant in this case is charged with the crime of armed robbery. Before he can be found guilty of armed robbery, the prosecution must prove all of the following four things beyond a reasonable doubt:

1. The defendant took property belonging to another;
2. The taking of the property was against another person's will;
3. The defendant used force, or the threat of force, against a person with the intent either to force surrender of the property or to prevent resistance to his taking or keeping the property; and
4. The defendant was armed with a deadly weapon or simulated deadly weapon.

All 3 Interventions: Note Taking, Juror Questions, Use of Checklist and Juror Notebooks:

Note Taking:

You jurors will be able to take notes during the trial. If you do, you will have them with you during jury deliberations, when you will discuss the case with other jurors and vote on a verdict.

Materials have been provided in case you wish to take notes. No juror is required to take notes. If you do, do not let note taking or your notes interfere with the hearing and evaluation of ongoing testimony. Notes are intended to help you remember testimony needed for your verdict. If you take no notes at all, you run the risk of forgetting important testimony needed for your verdict.

Please remember the number on the cover of your notepad. If you do not take it with you during breaks in the trial, simply leave it on your chair. When your service as a juror has ended, leave the notebook on your chair. The notes will be collected and used only for purposes of this scientific study.

Juror Questions:

You will also be able to ask questions of the two expert witnesses. While the attorneys will ask the expert witnesses all the questions they feel are necessary, you may have an important question of your own. The kinds of things you may ask the experts about include, but are not limited to: (1) asking the witness to repeat an answer (2) asking the expert to explain an answer or particular terms used in an answer, and (3) asking for an additional fact or expert opinion which you feel might be helpful to an understanding of any evidence in the case.

If you have such a question, please write it down on a blank page of your notepad, do not sign it, and hand it to the attendant. I will be informed of your question and will discuss it with the lawyers.

I will review your question and consider it in light of the legal rules of the trial. The same legal rules that apply to questions asked by the lawyers will apply to your questions as well. If I determine that the legal rules allow the question to be asked, the lawyers or witness will attempt to answer your question." If your question is not answered, do not try to guess why, do not wonder what the answer might have been, and do not take it personally. If your question is answered, do not attach special weight to the answer just because you asked the question. Give all of the testimony the weight it truly deserves regardless of who asked the question.

There will be two breaks in the videotaped trial to allow you opportunities to hand any questions to the attendant. In addition to the mid-trial break, another ten minute recess will by taken after all the witnesses have testified, but before I bring the evidence portion of the trial to a close.

Checklist for DNA Issues:

Each of you has been given a written checklist that relates to some of the DNA evidence in the trial. You may use the checklist in any way you find helpful during the testimony and during jury deliberations. I suggest, and this is merely a suggestion, that you attempt to answer as many of the questions you can after you've heard both experts testify and both attorneys make their closing arguments summing up the case for you.

Juror Notebooks:

Each of you has been given a notebook containing some background materials about the case. The notebooks contain blank paper for note taking, the checklist I just referred to, a glossary defining the DNA terminology in the case, copies of the experts slides that are used and a witness list. You will have these notebooks and materials during the testimony and during jury deliberations. Use them in any way you find helpful.

The trial will last about 70 minutes. We will take a ten-minute break about mid-way through.

All of the witnesses took their oaths before the jury was seated. I'll now call on the two attorneys for their brief opening statements. The prosecutor, Mr. James Metcalfe, will go first, followed by the defendant's attorney, Mr. Robert Moody IV.

Mr. Metcalfe?

PROSECUTOR'S OPENING STATEMENT: (James Metcalfe)

Thank you, your honor. Members of the jury. First, let me introduce myself. My name is James Metcalfe. I am a prosecutor with the District Attorney's Office for Middletown County.

Let me take just a minute to give you a brief overview of the case. The state has charged defendant, Kevin Jones, with the crime of armed robbery. Through our evidence, we will prove that the defendant robbed the Middletown Citizens' Bank, while armed with a handgun, on December 15, 2002. That morning, he entered the bank, held the bank employees and customers at bay with his gun, and stole over $5,000 from the bank. He fled from the bank, and discarded a sweatshirt—dropping some of the stolen cash on the ground in the process.

A bank teller named Katherine Blessing will describe what she saw and heard, including a general description of the robber and a glimpse of his face when he lifted his mask. She will tell you about seeing an unmistakable scar on the suspect's left cheek.

The defendant managed to avoid arrest that day, but was arrested and charged a month later, when as a result of a citizen's tip and good detective work, the Middletown Police Department discovered his identity and he was arrested. Detective Webb will explain how the investigation unfolded and what was discovered.

The other prosecution witness will be an expert on DNA analysis from the Federal Bureau of Investigation Crime Laboratory in Quantico, Virginia. Special Agent Jaye will tell you of a DNA analysis done on some human hair found on the discarded sweatshirt worn during the bank robbery and on samples of defendant's hair collected by the local police. The two DNA samples were found to match exactly. The FBI analyst will also tell you that the defendant's DNA profile is very rare, has never been observed in the FBI's database of such profiles and is different from the profiles of almost all other Caucasian people. He will explain that nearly 99.98 percent of the Caucasian population can be excluded as the possible contributors of the hairs found in the hood of the sweatshirt.

The DNA evidence will be so telling that, when considered with all the other evidence that you'll hear from Detective Webb, you will be satisfied that the defendant committed this crime. At the end of the trial, I will ask you to return a verdict of guilty.

Thank you.

JUDGE: Thank you. Mr. Moody for the defendant?

DEFENSE'S OPENING STATEMENT: (Robert Moody)

Ladies and gentlemen. Just as Mr. Metcalfe did, let me begin with introductions. My client, Kevin Jones, is seated next to me at counsel table. You will hear from him later today, since he will state under oath that he had nothing to do with this robbery. My name is Robert Moody, and I practice law here in Middletown.

After you have heard all the witnesses in this case, and that includes my client and our own DNA expert, I will ask you to find Kevin not guilty of bank robbery, since the government will not be able to satisfy you of his guilt beyond a reasonable doubt. As the judge just explained, when the prosecution fails to meet its heavy burden of proof the duty of the jury is to acquit the defendant.

First, the evidence that you will hear from Detective Webb amounts to nothing more than bits and pieces of circumstantial evidence—a series of wholly innocent facts and circumstances the government claims points to Kevin. However, you will see that, at most, the circumstances relied on by the prosecutor, even when considered all together, create nothing more that a mere suspicion and will not resolve all reasonable doubts about whether my client committed this robbery.

As far the DNA evidence is concerned, I should tell you, since Mr. Metcalfe didn't, that the testing done on the hairs was not the kind of DNA testing that you have probably heard about—the kind that is very discriminating and supposedly produces a profile of a person's DNA that is unique to that person and a powerful identifier. That kind of DNA is called "nuclear DNA." Well, that wasn't done in this case. There was not enough nuclear DNA in the hairs to allow testing for nuclear DNA.

What the government has brought you is a relatively new form of DNA testing called mitochondrial DNA testing, or mtDNA for short. Both the FBI and our expert agree that mtDNA is not unique to each person and can only tell that the person that supplied that form of DNA is a member of a group, or class, of people who could have the same mtDNA. As a matter of fact, we will show that up to as many as 57 Caucasian men in the Middletown metro area could have been the source of the hair found on the prosecution's sweatshirt. A criminal conviction cannot rest on those kinds of odds and coincidences.

At the end of the case, I will also ask you for a verdict. But Kevin and I will ask you to do your duty and find him not guilty since the government will not be able to prove guilt beyond a reasonable doubt. Thank you.

JUDGE: Thank you counsel. Now, we'll begin with the evidence. The prosecution may call its first witness.

Prosecutor: Your honor, the state calls Katherine Blessing:

Q: Please tell us your full name and where you reside.
A: My name is Katherine, with a "K," Blessing, and I live here in Middletown.

Q: Are you employed?
A: Yes, I am a customer service representative with Citizens' Bank.

Q: Did you work for Citizens' Bank in December 2002?
A: Yes. At that time, I worked as a bank teller.

Q: Were you working as a teller on December 15 of that year, when something unusual happened?
A: Yes.

Q: Tell us what you observed.
A: Soon after we opened, and customers had started to come in, a man entered carrying a handgun and yelled, "This is a hold-up!" Everyone just froze. He put the gun in his front pocket and vaulted right over the tellers' counter into our work area. He took his gun out again, holding it in his right hand, and motioned us with his gun to get away from our cash drawers. He took all the cash from my drawer and Jesse Snyder's, who was right next to me. He stuffed the cash into his pockets and down the front of his pants. He climbed back over the counter and ran from the bank.

Q: Can you please describe the robber as best you can?
A: OK. He was average height and build—about six feet, 170 pounds. He was white and, judging from his voice and what little I saw of his face, seemed to be fairly young—maybe 20, 25 years old.

Q: What was he wearing?
A: He was dressed in what appeared to be a two-piece dark blue sweat suit that had a hood and matching blue sweat pants. The hood was up covering his head. He also had a piece of material fastened to the hood. Most of the time I could only see his eyes and the parts of his face surrounding the eyes. He wore green gloves the whole time. When he was taking the cash from my drawer, he raised the face cloth with one hand and wiped his face with the back of his other hand. At that moment, I noticed a reddish scar—an inch or so long on his cheek—let's see—that would be his left cheek.

Q: Ms. Blessing, based on what you did see, is there anyone in the courtroom today who resembles the robber?
A: I am not sure I could ever identify the robber even if he stood in front of me again.

Q: Well, look around, and do your best. Wait a minute, Judge, could we please have the defendant stand and move closer to the witness so she can get a good look at his face?

JUDGE: Yes, the defendant will please stand about five or six feet in front of the witness.

THE DEFENDANT DOES SO.

Q: Now, Ms. Blessing. Is this defendant about the same height, weight and age as the man who robbed the bank?
A: Yes, he is.

Q: Do you recognize anything in particular?
A: Yes, this man's scar looks exactly like the one I saw on the man who robbed the bank—same location and size.

Q: No further questions.

JUDGE: Cross-examination?

DEFENSE COUNSEL: Your Honor, may the defendant resume sitting again?

JUDGE: Yes, of course. Please be seated, Mr. Jones.

Q: Ma'am, You're not saying that my client is definitely the man who robbed the bank that day, are you?
A: No. Like I said, I didn't get a good enough look at the robber's face. All I'm saying is that he could be the robber, given his general appearance. And the scar on his face is definitely familiar.

Q: When you saw Kevin, my client, in a lineup at the police station held before this trial, you did not identify him then as the robber either, did you?
A: No. I couldn't make a positive identification. All the men looked pretty much alike and I didn't see their faces close up.

Q: And last, Ms. Blessing, the scar on the robber's cheek. How big was it and what color?
A It was about an inch long, ran across his cheek, not up and down, and it was red or dark pink.
Q: That's all I have, your honor.

PROSECUTOR: May the witness be excused, judge?

JUDGE: Yes, thank you, Ms. Blessing, you are finished and may step down. Mr. Metcalfe, your next witness?

PROSECUTOR: The State calls Detective Jack Webb.

Police Detective Jack Webb

Q: Please state your name and describe your employment.
A: My name is Jack Webb, and I am a detective with the Middletown police department and am assigned to the robbery detail.

Q: Were you the lead detective assigned to the investigation of the robbery of the Middletown Citizens' Bank in December of 2002?
A: Yes, I was.

Q: Do you have your report with you, and does it contain the results of your investigation?
A: Yes, I have it here.

Q: Would you please tell the jury of your department's work, starting the day of the robbery?
A: All right. Let me refer to my report. On December 15, 2002, my police department received an alarm signal from Citizens' Bank indicating that a bank robbery was in progress. The report explains that Police units were dispatched to the bank and the surrounding neighborhood. According to the bank employees and customers present at the time the gunman entered, he yelled, "This is a hold-up." He held a small black revolver in his right hand. He jumped over the tellers' counter and removed all the currency, including the bait money, from two tellers' cash drawers, stuffing the money into his sweatshirt front pocket and into his pants. He used his left hand to handle the cash. He then jumped back over the counter and ran from the bank toward the railroad tracks south of the bank.

Q: Can you explain what bait money is, Detective?
A: Yes, bait money is a package of currency that is connected to a silent alarm. Serial numbers and other information about the bills in the bait money are also recorded in advance. During a robbery, the teller is supposed to give the bait money package to the robber. Removing the currency triggers a silent alarm to the police station that a bank robbery is in progress.

Q: Thank you. Now did you get a description of the robber from any witnesses as part of your investigation?
A: Yes, we did. We radioed their descriptions of the robber to the police dispatcher. The report explains that two patrol cars assigned to search the neighborhood did not see anyone resembling the bank robber. However, officers searching along the railroad tracks near the bank found a blue sweatshirt with a hood, one green glove and several pieces of currency scattered on the ground near the sweatshirt. Later investigation revealed that the serial numbers on some of the currency found along the tracks matched the serial numbers in the bank's bait money records. When shown the blue sweatshirt, the eyewitnesses said it looked just like the one worn by the robber. In addition, the crime lab examiners later found two hairs inside the hood of the blue sweatshirt. The police did not find any fingerprints at the bank thought to have been left by the suspect.

Q: What happened next?
A: About three weeks after the robbery, the police department received a call on the "Tip Line," suggesting we contact a Kevin Jones about the recent bank robbery. The caller told us where Jones was employed. Officers contacted Jones by phone, but he was not willing to submit to an interview.

The police then talked with friends and co-workers of Jones. He had been employed at a Burger King in town. His co-workers at the restaurant told police that Jones was Caucasian, of medium build, and that around December of last year Jones quit his job for a period after showing them a lot of money, described by one as a large roll of currency—a lot of 20s, 50s and 100 dollar bills. It was very unusual for him to have so much money. He bragged that he had more where that came from and told his friends that the money had come from a friend who owed him money. Jones had quit his job a second time just a couple of days before the employee interviews.

After reviewing the witness statements in the Citizens' Bank robbery case, I contacted Jones's co-workers again and learned that Jones used to wear a blue hooded sweatshirt to work in cold weather, and that for as long as they knew him, he had a noticeable scar on his left cheek.

Q: Is that right?
A: Jones was brought to the police station for questioning. After being advised of his rights, Jones denied committing the bank robbery. He told us he had never been in Citizens' Bank and concluded the interrogation. A sample of his head hair was collected by combing out loose hairs, after which he was placed under arrest and booked for the robbery.

Later, two bank tellers and a customer were present at a lineup of six individuals, including the defendant. They did not make a positive identification of any of the men in the lineup. The witnesses, including teller Katherine Blessing, stood about twenty-five feet away from the lineup and were separated by a plate glass window.

The hairs found in the hood of the blue sweatshirt and those taken from Jones were sent to the FBI crime lab for analysis.

JUDGE: Cross-examination?

DEFENSE COUNSEL: Yes, your honor, I have just a couple of questions.

Q: Detective Webb. I want the record to be clear on at least one thing: At no time did my client, Kevin Jones, admit or in any way imply, that he had anything to do with the bank robbery, isn't that correct?
A: That's correct.

Q: When you interrogated Kevin following his arrest, did he seem rather nervous to you?
A: About average, I guess. Of course, most people are stressed and nervous at that point.

Q: And the eyewitnesses who were present at the lineup, including the bank employee who just testified—no one has made a positive identification of anyone, including my client, as the person who robbed the bank?
A: That's also correct.

Q: Last, aside from the sweatshirt, glove and money your officers found along the railroad tracks—and the hairs that were in the hood of the sweatshirt and collected from the defendant--no other physical evidence—such as fingerprints or bodily fluids used for scientific testing or bank videotape—was discovered as part of the investigation. Isn't that true?
A: You are right. Just the items I mentioned here today. Unfortunately, the bank's video equipment was shut down for repair. No gun or additional money were ever found.

DEFENSE COUNSEL: That's all I have of the detective, your honor.

JUDGE: Detective Webb. Thank you, sir, you are excused. Mr. Metcalfe, your next witness?

Prosecutor: The State calls Special Agent Jaye.

Testimony of FBI Special Agent (David Jaye)

Q: Agent Jaye, would you please tell the judge and jury your full name and your employment.
A: My name is David Jaye, and I am a Special Agent with the FBI, the Federal Bureau of Investigation.

Q: What do you do for the FBI?
A: I am an analyst at the FBI Crime Laboratory in Quantico, Virginia, and I specialize in analyzing DNA and offering testimony when necessary.

Q: How long have you been with the FBI?
A. I have been an analyst for about 15 years now.

Q: Tell us a little bit about your background.
A: I have bachelor's and master's degrees in biology with an emphasis on molecular biology. I have finished all of the course work for my Ph.D. in the field, and am presently finalizing my doctoral dissertation. I got my first two degrees at Arizona State University and will obtain my doctorate at George Washington University in Washington, D.C. When I first joined the FBI, I specialized in the microscopic and chemical analysis of hairs—human and non-human—then moved over to the DNA side as that work developed and expanded.

Q: What are you doing your dissertation on?
A: The forensic, or courtroom, uses of mitochondrial DNA, which is called "mtDNA" for short. It's all done and has been conditionally accepted. As a matter of fact, this time next week I will be defending the dissertation at the orals.

Q: Have you written and published any articles on DNA for professional peer-reviewed journals?
A: Yes, I have, several. The two most recent articles described my lab's work with mtDNA.

Q: Have you testified as an expert witness on the subject of DNA evidence in other courts, and in other cases?
A: Yes, at least 25 cases in the state and federal courts of at least 20 states.

Q: And, do you regularly attend continuing education courses and ongoing training to stay current in the field of forensic DNA?
A: Yes, I attend three or four professional conferences a year and have made presentations at many of them.

Q: Apart from your efforts to stay current, what quality control checks are run at the FBI lab, where these samples were analyzed, to ensure that the lab procedures are up to snuff?
A: The lab undergoes proficiency tests three or four times a year. We have never failed a test, but improvements continue to be made. And, we always monitor the operation of the laboratory equipment by running test samples as controls.

Q: Agent Jaye, tell us what DNA is and how it is used as an identifier.
A: DNA is a molecule found in every living organism. It is basically the blueprint, or the genetic material of the organism. In human beings, most of this information is found in the nucleus of the cell. All of us inherit DNA from our biological parents, one-half of the nuclear DNA from our father and one-half from our mother. This DNA determines for each of us our own individual physical characteristics. Although most of the DNA is the same for everyone, there are small but significant differences from one person to another, and the accepted wisdom is that each person's nuclear DNA is unique.

Q: Did you bring with you some slides that you can use to help us understand DNA?
A: Yes, I brought a computer that will show the slides.

Q: Would you show us the first slide?
A: Yes, it gives a little information about the DNA molecule. The molecule has two strands that are a little bit like a spiral staircase, or a twisted ladder. The ladder rungs are made of pairs of "bases." There are four of these basic building blocks of DNA, abbreviated G, C, A, and T. The G on one side of the ladder always pairs with a C on the other. Same thing with the A and T. That is why we call them "base pairs."

Now, the order of these base pairs is important. We call this the sequence, and it is how the genetic information is kept in the DNA. It is a lot like your telephone number. You telephone number depends on the order of the digits in it. If you dial 123-1234, you get a different person than if you dial 321-4321. So, it is the sequence of the base pairs – the Gs, Cs, As, and Ts – that count.

Q: Do you want to do the next slide?
A: This is a picture of where the DNA is located in a human cell. In the center is the nucleus of the cell. It contains very long molecules of DNA, 23 from the mother and 23 from the father. There is only one nucleus in a cell, and hence, only one copy of all this DNA. But outside the nucleus are hundreds or thousands of peanut-shaped structures called mitochondria. These are where chemical reactions take place that give the cell the energy it needs to function. The mitochondria have their own kind of DNA. It is much shorter than the nuclear DNA molecules, and it is organized differently, but it has the As, Ts, Gs and Cs, and they pair up the same way.

Q: Now, what kind of DNA did you analyze in this case?
A: We used mitochondrial DNA only. We would have preferred to use nuclear DNA, because it can uniquely identify people, but we received from the local police department only the two human head hairs that were on the sweatshirt—we call that the "questioned sample." These hairs had only a few cells, and there was not enough nuclear DNA to type. But remember I said that for every copy of nuclear DNA, there are hundreds or thousands of copies of the smaller mitochondrial DNA. So we had enough mitochondrial DNA to work with.

Q: You said that the mitochondrial DNA does not identify people uniquely. Why is that?
A: Well, there are two reasons. As the next slide shows, the mitochondria are passed from mother to child. The father's DNA is not involved. Therefore, all people who are descended from the same mother, grandmother, etc., have the same mitochondrial DNA type. Second, the mitochondrial DNA itself is tiny compared to the nuclear DNA. There is not as much room for variations to occur. There are two regions in the mitochondria that are the most variable, and in forensic testing we look at these regions to differentiate individuals from each other. Each region is about 300 base pairs long, so we look at these 600 or so base pairs.

Q: You say you "look at" the base pairs. Can you explain for the jury what you do to look at them?
A: In this case, we had two samples to compare. I mentioned that the police department provided the questioned sample of two hairs. They also sent us about 30 hairs combed from the head of the defendant in this case. We call this the "known sample" because we know where it came from. First, I examined the hairs in both samples using a microscope. My purpose was to see if they were both human head hairs and to see if they looked similar when magnified. They did. Because I could not exclude the defendant as the source of the questioned hairs with the microscopic examination, I began the process of analyzing the DNA from the two samples.

Q: Please describe that process for the jury.
A: Okay, it gets pretty technical at this stage, but I will take you through the steps we follow in the lab. It is a three-step process to get a DNA sequence. The steps are extraction, amplification, and sequencing.

First, extraction just means getting the DNA out of the sample. We go through some chemical processes to isolate the DNA from everything that is present. Second, we amplify the DNA with a method known as the polymerase chain reaction. Basically, we add chemicals that copy the DNA molecules over and over, so we end up with millions of copies of the molecules we started with. The third step is sequencing. Today there are automated DNA sequencers that use fluorescent chemicals of four different colors to mark where there is an A, a T, a G, and a C. They are used in laboratories across the world. Once we have amplified enough DNA, we run it through the machine numerous times, to verify that it all has the same sequence.

Q: Thank you, Agent Jaye. Before we get to the results in this case, can you explain how the FBI lab safeguards against sample contamination and lab error?
A: Hair, as you can imagine, can be contaminated with things like blood or saliva. So before we extract the DNA from a hair, we wash it to remove any adhering contamination. This washing is a lot more than you can do in your kitchen sink. We put the hair in an ultrasonic water bath, with detergent. The sound waves together with the detergents release anything sticking to the outside of the hair, and all that goes into solution. Then we take the hair, and rinse it repeatedly to make everything on the surface is gone.

Q: Is there anything more you do to avoid contamination?
A: Absolutely. We never handle the questioned and the known samples together. We do the questioned sample first, and then start over with the known sample. We wear gloves and masks to prevent our DNA from getting mixed up with anything. We check further by running controls that tell us whether there is any stray DNA in the chemicals we use or elsewhere.

Q: How many controls do you run?
A: Four. There are reagent blank controls, negative controls, amplification positive controls, and sequencing controls. The reagent blank controls are checked at each step to make sure that no DNA has gotten on the glassware, the lab bench, and so on. The negative control ensures that no DNA started out in the amplification reagents. The positive control is a known sequence that is included in analysis. If it does not show up, we know something is wrong, and we start over. Finally, the sequencing control shows that the sequencing machine is working properly.

Q: Were all of these steps performed and all of the safeguards followed in this case?
A: Yes, they were performed by me personally or under my direct supervision.

Q: Are you confident that DNA sequences you obtained are those of the DNA in the hairs in the questioned and known samples?
A: Yes, I am.
Q: What did you learn from these sequences? Does your next slide show that?
A: The questioned sample and the known sample had the same sequences. That kind of situation is shown on the slide. It means that Mr. Jones, the defendant, cannot be excluded as the source of the questioned sample.

Q: The "questioned sample" being the hairs the police found on the sweatshirt?
A: That's right. He has the same DNA sequence as those hairs.

Q: You said earlier that this sequence was more than 600 base pairs long?
A: Yes, we sequence all those base pairs.

Q: Would the average person match at all those points?
A: Certainly not. Our studies have shown that within the regions we sequence, the average Caucasian differs at about 8 base pairs.

Q: So the average person would be excluded by your testing?
A: Yes, that would be the situation shown on the left-hand side of the slide.

Q: Is there a way to tell what fraction of the population would be excluded?
A: Yes, the next slide shows how we determine how rare the sequence is. We assemble the sequences from a sample of the population into a database, and we compare the defendant's sequence with those in this database.

Q: What did you find when you made this comparison?
A: Our database consists of 5,071 Caucasian mtDNA samples collected over the past few years from hospitals, blood banks, paternity cases, and other sources. We could not find this particular sequence in our database. This was the first time we ever saw it.

Q. And what does this tell you about how rare this DNA type is?
A. Well, it was not present in the database. That means that 5,071 individuals did not have the type, and one (Mr. Jones) did. Therefore, our data indicate that this particular sequence arises in maybe 1 out of every 5,072 Caucasians.

Q: Expressed in percentage terms, Agent Jaye, what number of randomly selected Caucasians would you expect to have a different mtDNA profile than the defendant's?
A: That's the third line on the slide. 1/5,072 is less than two-hundredths of one percent. To put it another way, more than 99.98% of all Caucasians would be excluded. But, someone in the same maternal line as the defendant should have the same mtDNA profile and could not be excluded as the possible source.

Q: That's all I have, your honor.

Court: Thank you, Mr. Metcalfe. Cross-examination by defense counsel, Mr. Moody?

[Cross-examination by Robert Moody:]

Q: Mr. Jaye, you told us that this relatively new form of evidence, mtDNA, is not as precise as nuclear DNA, is that right?
A: That's right. Because we look at just one long sequence in the mtDNA, as compared to several locations, or loci, when analyzing nuclear DNA, the numbers tend not to be as large as those used when describing the significance of a match of nuclear DNA.

Q: That was not my question. MtDNA is not as powerful an identifier as nuclear DNA, is it?
A: That's true as a general proposition.

Q: And it's also true, isn't it, that mtDNA typing is more prone to error due to contamination than ordinary DNA typing that starts with much larger amounts of nuclear DNA?
A: That can be the case, and that is why we take great care to detect contamination and make sure that it does not affect the results.

Q: Going back to the fact that mtDNA is not as good an identifier as nuclear DNA, since mtDNA is not a unique identifier, the most you can say is that the defendant is merely one of a group, or class, of people who have the same mtDNA profile?
A: Yes, but a member of a relatively small group.

Q: Well, let's explore that a bit further. You used the database of five thousand or so individuals to arrive at this conclusion, didn't you?
A: That's right.

Q: Is the database a random sample?
A: It is a sample from different groups, like people who give blood at blood banks and people who are involved in paternity cases. So it is a convenience sample, but one that is representative of the population.

Q: Again, Agent Jaye, I would appreciate it if you would answer my questions yes or no, if you can. This is not a random sample, is it?
A: No, the FBI does not go door-to-door, picking people out at random to give DNA samples.

Q: It is not even a sample of people from Middletown, is it?
A: No, it is a national sample.

Q: Thank you. There will be testimony later that the Caucasian population of this immediate area is just under 58,000. Assume, for a moment, that about half of those are males. Isn't it true that, accepting your figures as correct, that .02% of the Caucasian population cannot be excluded

as the source of the mtDNA found in the sweatshirt hairs, that leaves about 6 white males just in this metro area as the possible source of those hairs?
A: Let me see. Yes that seems right, but¼¼¼.

Q: Thank you, sir, you've answered my question. I also want to be clear about what you mean when you say that a person is not excluded. Does a defendant have to have every base pair in the same place as the questioned sample for you to declare a match?
A: Yes, they have to be identical, but from time to time, mutations occur. When this happens, an individual can have a mixture of mtDNA consisting of the original sequence and other, mutated ones that have been copied as the cell divides. If the mutated copies are numerous enough, we would find two different bases at a site. One base would be in the original sequence. The other would be in the mutated sequence. The presence of the two types in the same individual is known as "heteroplasmy." Therefore, to be on the safe side, we would not report that a defendant is excluded if he differs from the questioned sample at only a single base pair. We regard that as inconclusive.

Q: And, Mr. Jaye, one last question–you haven't been told anything about the defendant's family, have you? For example, you don't know whether he has any brothers, do you?
A: No as to both questions. We don't usually learn that.

DEFENSE COUNSEL: No further questions, your honor.

JUDGE: Any re-direct, Mr. Metcalfe?

PROSECUTOR: Just a few questions, your honor. Agent Jaye, have you heard anything in your cross-examination that would cause you to change the percentage of the white male population that would be excluded as the possible source of the mtDNA profile you found in the sweatshirt hairs and the hairs that were taken from the defendant?
A: No, the number is still over 99.98 percent.

Q: What about these mutations, this heteroplasmy, you were asked about?
A: That has nothing to do with this case. Both the questioned sample and the known sample had only one DNA sequence, and it was the same for each of them. I mean, there were no ambiguous base pairs at all.

Q: That's all I have, your honor. May the agent be excused?

JUDGE: Yes, the witness is excused. Your next witness, Mr. Metcalfe?

Mr. Metcalfe: The State rests, your honor.

Ladies and gentlemen of the jury, counsel, we will take a ten minute recess, or break, at this point.

JUDGE: Thank you, everyone. The prosecution having rested its case, we now turn to the defense. Mr. Moody?

Robert Moody: Your honor, the defense calls the defendant himself as its first witness.

Testimony of Defendant Kevin Jones

Q: First, tell us who you are.
A: OK. My name is Kevin Scott Jones.

Q: Kevin, did you go into the Citizens' Bank with a gun and hold up the bank?
A: No, I did not.

Q: Have you ever been in the bank for any reason?
A: Well, yes. Several months ago I used to go there to cash my paychecks.

Q: Why did you tell Detective Webb that you had never been in the bank?
A: Well¼.because I was nervous and just forgot.

Q: Kevin, have you been able to reconstruct where you were and what you were doing the morning hours of December 15, 2002, when someone robbed the bank?
A: No, I have not. It was a work day, though, and I assume I was at work.

Q: Kevin, do you have a half-brother about your same age?
A: Yes, his name is Brad Jones.

Q: Where is he now?
A: He's in prison now. He's been there since the first of this year.

Q: In December 2002, when someone robbed the Citizens' Bank, where did your brother live?
A: He lived here in Middletown with his girlfriend.

Q: Are you two about the same height and build?
A: Yes.

Q: Now, Kevin, you've had some legal problems in the past haven't you? You're not telling the jury that you've been an angel all your life, are you?
A: No, I'm not. When I was 19 and drinking too much, I was arrested for felony driving while intoxicated.

Q: Did you plead guilty?
A: Yes, I did.

Q: Why did you plead guilty?
A: Because I was guilty.

Robert Moody: That's all I have at this time, your honor.

Judge: Mr. Metcalfe, you may cross-examine.

ON CROSS-EXAMINATION BY PROSECUTOR:

Q: This half-brother of yours, did you ever ask him if he committed this bank robbery?
A: No, I haven't been allowed to visit or write him after my arrest in this case.

Q: And by the way, how are you related to this half-brother? On your mother's side?
A: No. From my Dad's second marriage—his second wife's boy.

Q: Now, Mr. Jones, you have a scar under your left eye on your cheek there, don't you?
A: I guess so.

Q: How long have you had that?
A: A couple of years, I guess.

Q: For the record, wouldn't you agree that it's about an inch long and runs left to right, or horizontal, under your left eye?
A: Yes.

Q: By the way, what is your height, weight, age and, for the record, your race?
A: Well, I'm 5 feet 11 inches, I weigh about 165 pounds, and I'm 21 years old. I'm white.

Q: Isn't it true that there's no visible scar on your brother's face? Or, at least when you last saw him?
A: I guess not.

Q: Did you, in December 2002, own a blue cotton sweatshirt with a hood?
A: I believe I did, but I don't remember the material it was made of.

Q: Do you have the sweatshirt now?
A: No, it was worn out, and I threw it away.

Q. When was that?
A. The summer, I guess.

Q: This money you had and showed your friends at the restaurant around the time the bank was robbed. You claim that was from a friend who owed you that kind of money?
A: Yeah, that's right.

Q: If that's so, did you try to get him to come to court to support your story?
A: No. I didn't think it would be necessary.

Q: Mr. Jones, you are right-handed, aren't you?

A: Yes I am.

Q: And last, you lived and worked here in Middletown at the Burger King back in December 2002, when the bank was robbed, didn't you?
A: Yes.

Prosecutor: No further questions.

JUDGE: Thank you, Mr. Jones, you may step down and rejoin counsel.

JUDGE: Mr. Moody?

Robert Moody: I have one more witness your honor. The defense calls Dr. Elizabeth Allison.

Testimony of Defense Expert (Elizabeth Allison)

Q: Please tell us your name and occupation.
A: Elizabeth Allison, and I am a professor in the Life Sciences Department at Rutgers University.

Q: Do you have a specialty within the subject of Life Sciences, like human biology or something like that?
A: I specialize in molecular and developmental genetics. In my research I study how certain genes are regulated, that is, how they are turned on and off.

Q: How long have you been teaching in the field?
A: About 10 years.

Q: And, tell us about your education.
A: Okay. I took my degrees, bachelor's and master's, in molecular biology at Ohio State University. In 1992, I received my Ph.D. from the University of Minnesota.

Q: Have you testified in courts as an expert in DNA matters and offered your opinions in cases?
A: Yes, at least a dozen times in various states.

Q: Dr. Allison, are you familiar with the FBI's methods of mitochondrial DNA analysis?
A: Yes, I have studied the FBI protocols, reviewed some FBI case files and studied its report in this case.

Q: Doctor, in general terms, how does mtDNA compare to the DNA testing we've heard about over the past several years in terms of its power, or ability, to identify or lead to a particular individual?
A: It's relatively new and unlike the work with nuclear DNA, the usual form, mtDNA cannot be traced to a particular individual. All persons in the same maternal line as the known donor, along with others who happen to have the same mtDNA, could have contributed the suspect sample.

Q: Do you take issue with the FBI's database of 5,071 mtDNA profiles that was used in this case?
A: I have some concerns about how representative it is, and I also disagree with some of the calculations.

Q: Could you explain about the calculations, please?
A: Of course. The most recent studies have shown that human hairs are especially prone to heteroplasmy, that is, where the mtDNA from a given person's hair varies at least at one base pair. As many as 10 or 20 percent of white males could have heteroplasmy. Indeed, at some level, everyone probably is heteroplasmic. The FBI knows this, and that is why their protocol does not let them exclude an individual who differs at only one point in the sequence. There is a small chance that a hair from these individuals would only show the sequence in the crime-scene sample. So rather than exclude these suspects, they report that the test is "inconclusive." Because these individuals are not definitively excluded, they must be counted along with those who are clearly excluded. But the FBI did not do that in this case. It stopped when it found that the sequence here was not represented in its database. It should have counted all the sequences in the database that were only one base pair away from this sequence.

Q: Have you performed this computation?
A: Yes, I have an overhead that explains it. There were 9 sequences in the Caucasian database that were within one base pair of the sequence in the hairs from the sweatshirt. And there was the defendant's sequence that also matched. Thus, the total number is 10.

Q: And what does this tell you about how many people in Middletown the DNA test would exclude?
A: Well, first, you have to make a big assumption – that the FBI's database is representative of Caucasians in Middletown. Personally, I'd be hesitant to jump to that conclusion. But if we can make that assumption, then we could say that some 10 out of every 5,072 white men in Middletown would have a DNA sequence that could not be excluded from that of the hairs in this case. That's almost 0.2% of the Caucasian population of Middletown.

Q: Dr. Allison, at my request, did you consult the most recent U.S. census for the Middletown area?
A: Yes, I did.

Q: And how many Caucasian males lived in the Middletown area, according to the most recent census?
A: Well, it says there was a total of about 58,000 Caucasians, just under half of whom, or about 29,000, were males.

Q: What do you conclude about the number of white men who could not be excluded by this new form of DNA testing?
A: The result is given on my second slide. Just under .2 percent of these 29,000 – that's about 57 – Caucasian males in the Middletown metro area could not be excluded as the source of the hairs found on the sweatshirt.

Q: The FBI estimates that the number is only 6. In your opinion as a geneticist, is that a reasonable figure?
A: In my opinion, it is much too low. It ignores the high rate of heteroplasmy in human hairs.

DEFENSE COUNSEL: That's all that I have of Dr. Allison, Judge.

JUDGE: Cross-examination?

PROSECUTOR (Mr. Metcalfe): Dr. Allsion, your testimony in previous cases—you've always appeared as a defense witness, have you not?

A: Well, yes. That's the way it works. The prosecution usually calls on someone from the public crime lab that did the work in the case, and the defense relies on experts from the private sector.

Q: Do you agree that this defendant did not exhibit any heteroplasmy?
A: I agree that the FBI did not find that he was heteroplasmic. But the problem with the estimate of the number of people who would not be excluded has nothing to do with whether or not this particular defendant is heteroplasmic. It has to do with how the FBI counts people in its database—whether they should be counted as necessarily excluded as the possible contributor or whether they could have contributed the suspect sample. Because of the possible existence of heteroplasmy in a substantial percentage of white males, I am of the view that the FBI's figure for the percentage of the white male population that can be excluded as the source of the sweatshirt hairs is too high.

Q: You agree, do you not, that only two hundredths of a percent of the white male population has the same DNA sequence as the one that the hairs from the sweatshirt have?
A: Yes, to the extent that the FBI database is representative, that is true. But the point is that a lot more people than those can't be excluded. Their sequences are not identical, but they are so close that, when one considers the possibility of heteroplasmy, they cannot be excluded.

Q: But you do not deny that the database shows that only two hundredths of a percent have the sequence of the two hairs in this case, do you?
A: I accept the arithmetic.

Q. And you also agree that the precise DNA sequence found in both the defendant here and the sweatshirt hairs had never been recorded before in the FBI's database?
A: Yes, I agree with that.

Q: I have no further questions.

JUDGE: Thank you, Doctor, you may step down.

Defense Counsel: I have nothing further, your honor. The defense rests.

Final Jury Instructions—Mike Dann

Now that you jurors have heard the evidence in the case, and before the attorneys make their closing arguments, I want to instruct you on the law that you must follow in deciding this case. I may repeat what I stated at the outset of the trial because of the importance of what was said.

You must now reach a verdict on the question whether the defendant is guilty or not guilty of the crime charged. You must not think the defendant is guilty because he has been arrested for or charged with a crime. Those are merely procedural means of bring the case and the defendant to court.

Every defendant is presumed by law to be innocent. The prosecution has the burden of proving the defendant guilty beyond a reasonable doubt. Proof "beyond a reasonable doubt" is proof that leaves you firmly convinced of the defendant's guilt.

On the other hand, the law does not require proof that overcomes every doubt. If, based on your consideration of all the evidence, in light of the law that applies, you are firmly convinced that the defendant is guilty of the crime charged. a guilty verdict is authorized. However, if you think, based on the evidence or the lack of it, that there is a real possibility that he is not guilty, you must give him the benefit of the doubt and find him not guilty.

The defendant in this case is charged with the crime of armed robbery. Before he can by found guilty of armed robbery, the prosecution must prove all of the following four things beyond a reasonable doubt:

1. The defendant took property belonging to another;
2. The taking of the property was against another person's will;
3. The defendant used force, or the threat of force, against a person with the intent either to force surrender of the property or to prevent resistance to his taking or keeping the property; and
4. The defendant was armed with a deadly weapon or simulated deadly weapon.

With that said, I'll now call on the two attorneys for their brief closing arguments. The prosecutor, Mr. Metcalfe, will go first, followed by the defendant's attorney, Mr. Moody.

Mr. Metcalfe?

PROSECUTOR'S CLOSING ARGUMENT:

Ladies and gentlemen. There are two types of evidence in this case—the non-scientific and the scientific DNA evidence—and they are both very strong.

Let's take the non-scientific evidence first. Although it is circumstantial in nature, when you consider all of it together it is really quite incriminating.

1. The defendant lived and worked in town on the date of the robbery.
2. He owned and used to wear a blue sweatshirt like the one in evidence.
3. At about the same time of the robbery, the defendant showed his friends at work a large amount of cash, a roll of large bills—something unusual for him--and he had no good explanation for how he came by it. Where is the evidence to support his story about being repaid a large loan?
4. He lied to the police about never having been in the Citizens' Bank.
5. He told you he now remembers going in the bank a couple of times around the time of the robbery to suggest a reason why the teller thought the robber had a scar on his face and that he could be the robber.
6. The defendant fits the description given by all the witnesses—especially that of Ms. Blessing, the teller who saw a reddish colored scar in the same location as the defendant's scar. She didn't get a good look at the suspect's entire face, but she was pretty certain about the scar.
7. The defendant is right-handed, as the bank robber probably was.

You can infer from all this evidence that the defendant is the person who robbed the bank. But this is not all the prosecution has.

The DNA evidence also shows that the defendant's hair was found on the blue sweatshirt found along the railroad tracks just minutes after the robbery. The mtDNA found in the hair taken from him by the detective matched the DNA in the hairs found in the hood of the sweatshirt. The two samples were identical at all 610 points of comparison. His mtDNA profile is so rare that it has not been observed in the FBI's database of over 5,071 samples. Over 99.98 per cent of white males can be excluded as the source of the hairs. Of course, there could be some other white males in this metro area with similar mtDNA. But the DNA evidence confirms what all the other evidence says – everything points to this defendant.

As far as the defendant's DNA witness is concerned, she simply wanted to count all DNA results that would be discarded as inconclusive as "nonexclusions." Since she agreed with the FBI analyst that the defendant is not heteroplasmic. Her conclusions and her calculations should be disregarded. They are simply not relevant to this case.

The fact that the circumstantial evidence incriminates this defendant is no coincidence—the mtDNA tells us that. When you consider <u>all</u> of the evidence in the case, the defendant's guilt has been proven beyond a reasonable doubt.

I ask you for your verdict of guilty.

JUDGE: Thank you. Mr. Moody, you may make your closing argument on behalf of the defendant.

<u>DEFENSE CLOSING ARGUMENT:</u>

Members of the jury. This is a case of reasonable doubt. This evidence does not support a conviction of the serious crime of robbery.

First, let's take a look at the so-called "scientific" evidence in the case. The experts told us that mtDNA is not unique to an individual like nuclear DNA is—and nuclear DNA is the one we're used to hearing about. The prosecutor's DNA witness told us that he could not positively say that the defendant was the source of the DNA found in the hairs from the sweatshirt. Not only that. He also told us that anyone in the defendant's family would have the very same mtDNA.

Now, the DNA expert we called to testify for you had a very important point to make concerning the number of unrelated Caucasians one should expect to see with the same mtDNA profile as the two samples in the case. Her point is still valid even though she agrees that the defendant does not show signs of heteroplasmy. Doctor Allison told you that when you count samples in the FBI database that differ at only one base pair as "not excluded," then the percentage of Caucasians that could be excluded as the source of the mtDNA found in this case is. Lower than the number the state presented.

This means that about 57 other Caucasian males in the metro Middletown area—not to mention the much larger number of white men in the state or who might have been visiting in town at the time of the bank robbery—had the same mtDNA profile as the defendant and could have been the source of the hair on the sweatshirt. The defendant is just 1 of these 57 or so men who could have left the hairs on the sweatshirt. That doesn't add up to proof beyond a reasonable doubt. It is not even close.

The circumstantial evidence is just that—circumstantial—and it does not prove the defendant guilty either. First, the fact that he lived in the area at the time of the robbery and used to own a blue sweatshirt doesn't prove anything. Hundreds or thousands of other men in the area probably owned blue sweatshirts.

And, since when is it a crime to have a large amount of money on you? He didn't owe his fellow employees an explanation of where the money came from. Of course he was nervous when he was being grilled by the police. His failure to remember going to the bank before, to cash his payroll checks, is understandable too.

The bank employee did not have a good opportunity to view the suspect's face and admitted she did not identify anyone in the police lineup and could not be positive about identifying the robber.

Last, there's the suggestion that the robber had a scar on his face. Remember that the bank teller did not get a good look at the suspect's face, which was hidden behind a cloth. Besides, she was probably more concerned with the gun that was pointed at her that she was with his face. If she saw anything, it could have been an infection or a razor burn or cut.

All that the evidence leaves you with, if it adds up to anything at all, is a mere suspicion that the defendant could have, or might have committed this bank robbery. But the judge told you that a person cannot be convicted of a crime in this country on the basis of a suspicion. You

must be convinced of a person's guilt beyond a reasonable doubt. This evidence leaves substantial room for doubt. You must return a verdict of not guilty.

JUDGE: Ladies and gentlemen, that concludes the trial except for your deliberations and decision or verdict. You may now retire to deliberate. Thank you.

mtDNA EVIDENCE CHECKLIST

1. Was the blue hooded sweatshirt found by the police probably the one worn by the bank robber?

→ **No** → Then the FBI's DNA analysis of the hair will not assist you in identifying the robber.

Yes ↓

2. Did the FBI correctly identify the mtDNA sequences of the suspect (sweatshirt hood) and known (defendant's) samples of hair?

→ **No** → The results of the FBI's analysis of the hairs' mtDNA will not assist you in identifying the robber.

Yes ↓

3. Did the FBI correctly conclude that the mtDNA sequences of the two hair samples matched?

→ **No** → The results of the FBI's analysis of the hairs' mtDNA will not assist you in identifying the robber.

Yes ↓

4A. Did the FBI correctly calculate how often the hairs' mtDNA sequence is likely to occur in the Caucasian population?

→ **No** → 4B. Did the defendant's expert correctly calculate how often the hairs' mtDNA sequence is likely to occur in the Caucasian population?

Yes ↓

5A. What percent of the Caucasian population can be excluded as possible contributors of the mtDNA found on the sweatshirt hairs?
Answer _____%

No ↓

Neither expert's testimony will assist you in identifying the robber.

Yes ↓

5B. What percent of the Caucasian population can be excluded as contributors of the mtDNA found on the sweatshirt hairs? Answer: _____%

6. How many Caucasian males in Middletown area could have contributed the hairs found in the sweatshirt hood? [check one]

Answer: _____ 6 [prosecution expert estimate]
_____ 57 (defense expert estimate]
_____ Other number [your estimate: _____]

7. How likely is it that the defendant was the source of the hairs found in the sweatshirt hood? [check one]

_____ Extremely Likely

_____ Somewhat Likely

_____ Don't Know

_____ Somewhat Unlikely

_____ Extremely Unlikely

Appendix C. Study Participant Responses

Juror mtDNA Questions and Expert Responses
Study Participants' Definitions of mtDNA

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Juror Questions and Expert Answers

This appendix includes the specific questions that mock jurors posed, and the expert responses that were given, in the two experimental conditions (3 and 6) in which jurors were permitted to ask questions of the expert witnesses. In condition 3, mock jurors were allowed to take notes and ask questions, whereas in condition 6, they were permitted to take notes, ask questions, refer to a jury checklist, and refer to jury notebooks.

Jury 3 (Condition 3) Questions and Answers:

1. How new & widely used is mtDNA testing?
   A. Only used when nuclear unavail.?
   B. The diff. in reliability between 99.2 or 99.02? (Defense witn. & Pros. Wit.)
   C. How does it compare with fingerprint & nuclear reliability?

   Answer: mtDNA testing for court purposes is about 3 to 4 years old. However, mtDNA was discovered about 15 to 20 years ago. Used when nuclear not avail.

   Answer: The smaller number of those excluded means there are more possible contributions of the questioned sample – thus, the potential suspect group is larger.

   Answer: All 3 forms have proven reliable – but produce different results expressed using different numbers. The weight of the evidence differs according to form and the numbers used.

2. Is mtDNA used just when nuclear is not available? Is mtDNA used in court cases?

   Answer: mtDNA is used and tested usually because nuclear DNA is not available or because it has been contaminated. Sometimes, the mtDNA testing is used even where nuclear DNA is available and used.

   Answer: mtDNA has been allowed in evidence in all the reported court cases in which it has been offered, that is, the jury has been allowed to hear and consider it and give it the weight the jurors decide.

3. Explain hetro plasmia.

   Answer: Variations of at least one base pair of mtDNA as a result of mutation. More often found in human hair than other tissue. Because of possible heteroplasmy, cannot exclude person with the condition as a possible contributor of the questioned sample.

Jury 4 (Condition 6) Questions and Answers

1. Out of the 5071 sample, how many of them have a rare DNA?

Answer: The exact numbers are not available at this time; but the slide entitled "Compare Sequence to Database Sequences" illustrates approximate variation and size.

2. Can we see the Blue Sweatshirt? Is the sweatshirt a University of Delaware Blue Sweatshirt?

Answer: There is no additional evidence concerning the sweatshirt.

Jury 7 (Condition 6) No Questions

Jury 12 (Condition 3) Questions and Answers

1. Was there proof that the defendant was at work at the time of the robbery?

Answer: Sorry, but this question cannot be answered. Decide this issue on the basis of the evidence you heard.

2. Define heteroplasma.

Heteroplasmy is the condition where, due to mutation of a cell, and multiplication of the mutated cell, one's mtDNA varied from the rest of his/her mtDNA at least one (or more) base pair(s).

3.a. Would the defendant's expert witness require a double mutation to explain the findings of a single sequence?
3.b. If not would she accept the prosecutions conclusions?

Answer: No. She does not explain away the fact that only a single sequence was found on account of a double mutation. She accepts that the two samples' sequences matched. Her position regarding the number of people that cannot be excluded has nothing to do with these two sequences.

Answer: She still does not accept the prosecutor's conclusion regarding the number of possible contributors (6) versus her position (57).

Jury 14 (Condition 6) No Questions

Jury 18 (Condition 3) Questions and Answers

1. Why was the friend not in court that repaid the loan? Who is the friends name?

Answer: Only questions for the two experts can be asked and answered. As for these two questions, please base your decision in the case on the evidence that you have heard, or the lack of evidence.

Jury 21 (Condition 3) Questions -- No answers provided because they were not for experts.

1. How far was the railroad tacks from the bank and the Burger King?

2. What's he in jail for? The brothers. What's the brothers' build?

3. How far was the bank teller from the robber?

4. Was the whole sweatshirt analyzed or "just" the hair?

5. Prove he was or wasn't at work.

Jury 23 (Condition 6) Questions and Answers

1. How many base pairs total are compared in the mtDNA and how many in the nDNA?

   Answer: Over 600 base pairs are compared in the mtDNA testing. They were found to match in the two samples in this case.

   Answer: Many more base pairs are compared using nuclear DNA, as it is much "longer."

2. Why did the hair have only a few mitochondrial cells?

   Answer: Every strand/piece of hair has thousands of cells. Each cell has a nucleus, where the nuclear DNA is found. Outside the nucleus are thousands of mitochondria for each cell. Mitochondrial DNA, or mtDNA for short, is found in each mitochondria. In this case, only two (2) sweatshirt hairs were analyzed. There wasn't enough nuclear DNA to test, so that the mtDNA from those two hairs, plus the defendant's known hair, were tested.

3. Kevin Jones claimed to have been at work on the day of the crime. Is there any evidence that his employer has a record of that? Was this presented by the defense?

   Answer: Not Answered

4. Was the gun found?

   Answer: Not Answered

Jury 27 (Condition 3) No Questions

Jury 28 (Condition 6) Questions and Answers

1. How many total mtDNA types do you have on record from your database of 5071 people?

   Answer: About 2000 different types or profiles.

2. Does the validity (& therefore success) of your PhD. Thesis depend on the acceptability of this identifier?

Answer: No

3. Explain the "mother" lineage of the DNA again.

Answer: Nuclear DNA comes from both the mother and the father. Mitochondrial DNA, or mtDNA, the kind analyzed in this case, comes only from the mother. The father does not contribute to the mtDNA at all. A child has mtDNA from his mother. In turn, his mother inherits the mtDNA of her mother. So, mtDNA is passed along from mother to child.

4. Was there any DNA on the money?

Answer: No, the FBI expert only analyzed the mtDNA of the 2 human head hairs. He was not asked to analyze any other samples.

5. How many Caucasian (males) were in the FBI database?

Answer: All of the samples in the database came from Caucasians, about one-half of whom are males.

Jury 35 (Condition 6) No questions

Jury 36 (Condition 3) Questions and Answers

1. What were the odds that you would have found a match in the mtDNA database samples?

Answer: Cannot be answered definitively because some mtDNA profiles are not represented in the database. The odds that some Caucasian male other than the defendant left the mtDNA found in the sweatshirt hairs are 5,702 to 1.

Jury 38 (Condition 3) Questions and Answers

1. For Dr. Allison?, and Mr. David Jay: 1. Do you consider 600 base pairs sufficient material to determine unique identity in mitochondrial DNA?

Answer: Yes, testing the 610 base pairs in each mtDNA molecule is acceptable for comparing mtDNA profiles. Remember, however, that mtDNA unlike nuclear DNA does not necessarily produce a profile "unique" to a particular individual.

2. What is the appropriate number of base pairs to determine uniqueness?

Answer: See answer to question 1 above.

Jury 42 (Condition 6) Questions and Answers

1. Why is the FBI databases for mito. DNA so small?

   Answer: MtDNA testing for use in court is relatively recent. Collecting samples from blood banks, paternIty cases, hospitIls, and thI like takes time. The dItabase is increasing all the time. The FBI has no authority to require people to give DNA samples.

2. What about non-Caucasians?

   Answer: Separate databases are maintained for different racial and ethnic types. Only the Caucasians database is relevant here.

3. What about secondary testing outside FBI for confirmation?

   Answer: None was requested by the defense and none was done.

4. No DNA collected from skin flakes, sweat?

   Answer: No, none.

5. No DNA within green glove?

   Answer: No, none.

6. How many types of pre-cataloged DNA have variations similar to the question DNA?

   Answer: None in the database of 5071 Caucasians. Over 2000 different mtDNA profiles are represented in the database of 5071 profiles.

7. Why wasn't a sector of the Middletown community sampled for DNA and compared to defendent DNA?

   Answer: The FBI and local police have no authority to collect samples in the local communities where crimes or trials occur. The FBI's mtDNA database used for this case is a nation-wide collection of Caucasian samples, male and female.

Jury 46 (Condition 3) No Questions

Jury 48 (Condition 6) Questions and Answers

1. Did the detective ever find Kevin Jones blue hooded sweatshirt in his possession?

   Answer: Not answered since it was not a question for an expert. Told to rely on memory of the evidence.

2. Why does the defense expert think that the database is not representative?

Answer: She has two concerns about the representativeness of the database: 1. It is a national sample, not a local sample of Middletown, and 2. It is a convenience sample rather than a random sample. That is, the samples in the FBI database were gathered from hospitals, blood banks and paternity cases from around the country as opposed to a randomly collected sample from the general population.

Jury 50 (Condition 6) Questions and Answers

1. Question how do they known that the two hairs found are his? Did they test his hair to see or not, because it could be someone else hair or it may be his.

Answer: First, the hairs were examined and compared using a microscope. They were both human hair and appeared similar, or from the same source.

Answer: Subsequent mtDNA analysis revealed that the two hair samples had the same mtDNA profiles, identically matching at over 600 base pairs of comparison.

Answer: You may also consider the evidence concerning the sweatshirt, e.g., when, where and how it was found and the eyewitness' testimony, in deciding whether it was the defendant's sweatshirt and his hair in its hood.

2. Does the def. have a history of crime?

Answer: This question cannot be answered. Only questions for the DNA experts are being accepted.

3. Color of def. eyes? Trial date? Brothers? Did they find def. sweat shirt @ home?

Answer: These questions cannot be answered beyond the evidence that you have heard or will hear. Only questions for the DNA experts are being accepted.

4. Have any cases prior shown that the mtDNA as unreliable or unproven method?

Answer: No.

5. Is there any reason to believe that a random sampling of DNA would give different results? (As far as percentages, etc.)

Answer: No. The FBI database has been compared to other mt databases and there are no appreciable differences.

6. Mt testing is "conditionally accepted"…what are the conditions?

   Answer: Mt testing is accepted in courts if the laboratory protocols and safeguards are carefully followed. Those are the conditions.

7. How much more hair strands would have been need to have nuclear DNA?

   Answer: Without hair roots, it doesn't matter how many strands of hair one has to work with. No nuclear testing on hair is possible without roots. There were no roots in the present case.

8. Can the mtDNA & sequence be passed only from the mother or is it always a mix of mother and father?

   Answer: MtDNA is only passed down by the mother – the father's mtDNA is not involved.

9. Is the texture, color, etc. of the tow hairs found match that of the def.?

   Answer: When the hair was examined under a microscope the texture & color was similar to that of the defendants.

Jury 51 (Condition 3) Questions and Answers

1. Why use two hairs for the DNA exam? Why not more to get more research?

   Answer: The "question sample" consisted of only the two hairs found in the hood of the blue sweatshirt. Those were the only hairs found in or on the sweatshirt.

   Answer: The "known sample" consisted of over 30 loose hairs combed from the defendant's head. Two hairs have proven sufficient for use in mtDNA testing and analysis.

2. On one person's head are all hair strands alike or can some be hedroplasmic?

   Answer: On any given person's head, one or more hair's mtDNA may vary at at least one base pair. That is called heteroplasmy. Base pairs that vary due to mutation as cells grow and multiply are called heteroplasmic. When the two samples were analyzed in this case, all the base pairs were identical when compared. The FBI did not find any heteroplasmy.

Jury 57 (Condition 3) No Questions

Jury 59 (Condition 6) Questions and Answers

1. How much hair was collected from the crime scene (sweatshirt)?

    Answer: Tow head hairs were collected from the sweatshirt and that was not enough for nuclear DNA testing.

2. Why was there not enough present for nuclear DNA testing?

    Answer: About 20 hairs with roots are the minimum for nuclear DNA testing.

3. How much hair would normally, on the average, be needed to obtain a good sample for nuclear testing?

    Answer: If there are not roots, you can only do mtDNA testing.

4. Why wasn't both nuclear and mtDNA test done? If mtDNA test was not random and only narrowing the suspects to a specific group, why didn't the prosecution use nuclear DNA testing so the test would be undeniably conclusive?

    Answer: There were only 2 head hairs in the questioned sample, so there was not enough biological material to perform nuclear DNA testing.

5. DNA used in this case % reliability vs. nuclear?

    Answer: There is no reported case where mtDNA has been found by a court to be unreliable. If you have appropriate controls, mtDNA is reliable.

    But it's not as discriminating as nDNA which can uniquely identify people.

6. Does extraction amplification sequencing change DNA in any way?

    No, as long as you haven't contaminated the sample, you should get a true reading of the person's DNA. Quality controls can tell you if you have a contamination problem.

Study Participants' Definitions of mtDNA

Responses to Question 12: "In your own words, what is mtDNA evidence?" {Blank} = no response

Juror 1-1
A DNA that can come from mother's side of the family (crossed out). Don't know.

Juror 1-2
The DNA extracted only from the maternal side of your genes. They can only give a group or class of people race of people and that the contamination errors processing this is much greater.

Juror 1-3
{Blank}

Juror 1-4
MtDNA is a specific type of DNA evidence that is the same family of nuclear evidence. Mitochondrial material is outside the nucleus and found only from one side of the family (maternal?).

Juror 1-5
{Blank}

Juror 1-6
Genetic material that appears outside the nucleus and is not contributed by both mother and father and does not reflect as unique as a code as nuclear DNA.

Juror 1-7
This is the matching of cells from evidence given (known) to evidence or sample taken and matched.

Juror 1-8
Another molecules outside of nucleus that are from maternal DNA only not definitive to one person-can include others in family?

Juror 2-1
DNA from maternal line-sibling would have same MDNA. Am not so sure about the random mutation element.

Juror 2-2
It is evidence taken from outside of the nucleus of a cell. It is passed along maternally and is not unique to an individual.

Juror 2-3
2nd guess – not as inclusive-higher % of being infected by others.

Juror 2-4
Since there was not enough of the hair sample to test for nuclear DNA, mtDNA testing need to be completed. 600 base pairs 3 steps taken to get DNA 1) extraction 2) amplification-they add chemicals to copy the DNA- millions of samples and then 3) sequencing – A.G.T (etc.) to verify the same sequences – Fraction of the people were excluded 5,071 mtDNA samples – could not find the same sequence- not present in the data base Data indicates 1 in 5,072 individuals with same sequence.

Juror 2-5
Mitochondrial DNA is only passed on to a person by their mother. This DNA is NOT as conclusive as nuclear DNA in that it can not specifically identify and individual. If the mitochondrial DNA cells have hertoplsmga, it is even more difficult to determine the % of the population that could have committed the crime

Juror 2-6
This type of DNA differs from nuclear DNA.
Nuclear DNA pin points an individual.
Mitochondrial DNA pin points a type or class.

Juror 2-7
DNA samples from outside the cell nucleus. It is passed to descendants maternally. It is less reliable then nuclear DNA evidence because it has shorter strands.

Juror 2-8
An alternate source of DNA evidence nearly as conclusive as nuclear DNA.

Juror 3-1
A broader cell structural analyst of a substance human or animal or plant?

Juror 3-2
Its evidence that is either from hair and can be proved as evidence from the crime scene for longer periods of time than regular nuclear DNA testing.

Juror 3-3
DNA that is used when nuclear DNA is not available that multiplies cells to be tested.

Juror 3-4
Housed the genetic make-up of an individual and is unique to a large amt. of people but not totally, Can be found in bodily fluids or hair of an individual.

Juror 3-5
Evidence that has been tainted or no longer available as evidence – can be tested MT DNA.

Juror 3-6
Based on maternal D.N.A. molecules which I don't understand.

Juror 3-7
A comparison of a small strand of DNA located in the mitochondria of a cell in the tissue of a person against a sample collected at a crime scene. Even if these two DNA strands match, mitochondrial DNA is so similar from person to person that it only excludes people that are unrelated through maternal lineage.

Juror 3-8
DNA sample usually retrived from human hair tissue. The mt DNA strand has fewer base pairs than a nuclear strand of DNA. Mt DNA is not unique to an individual and can be used to exclude a population/group as a contributing source.

Juror 4-1
Looking at an individual mitochondria DNA-comparing sequences for match-can't identify unique individual but can link "like" to maternal line.

Juror 4-2
Not as good as nuclear DNA but a blueprint representing maternal inheritance.

Juror 4-3
You can only detect a group that comes from a maternal member. It is not something that can be uniquely detect DNA matches. (MtDNA how can you dect…:crossed out).

Juror 4-4
DNA evidence that is not the most correct.

Juror 4-5
Does not identify people uniquely and is from the mother's side not father's side.

Juror 4-6
MtDNA can not ID/pin point the suspect due to there are other factors can influence the result. The final result population is larger than nDNA.

Juror 4-7
I guess it means it can go either way.

Juror 4-8
In my understanding DNA is when it mack to people.

Juror 5-1
Its cell DNA that can match a group of people.

Juror 5-2
It is the particles that surround nuclear DNA. They are in strand format. They are the DNA that is passed from mother to child. Father's DNA is only found in nuclear.

Juror 5-3
The DNA present outside the nuclear. It does not identify a particular person, out a group of individuals.

Juror 5-4
I can not tell you if is a exact match it can tell you that theres a good chance.

Juror 5-5
Does not identify person uniquely where nuclear DNA can identify the person. MTDNA does include mother DNA.

Juror 5-6
Have to do with gene match but not as accurate as nuclear DNA.

Juror 5-7
A way of matching up two samples w/elements.

Juror 5-8
DNA materal with a larger percentage of positive ID ability.

Juror 6-1
It shows degree of relationship + recency of common maternal ancestors of two or more different samples.

Juror 6-2
Molecular cell info found in strands of hair-yet not in nucleus of the cell.

Juror 6-3
-maternal side of family.
-four factors used (pairs).

Juror 6-4
DNA that is extracted from the mitochondria that is sequenced and matched to a database as to possible inclusion or exclusion of a suspect.

Juror 6-5
mtDNA evidence is the results of a comparison of a strand of mtDNA from a know source with a comparison of mtDNA from a unknown source. Limitations of this type of evidence include the shorter strands of data, causing identification of differences to be harder, and the higher the likelihood of mutations in mtDNA, causing comparisons to be inconclusive.

Juror 6-6
mtDNA evidence discards a certain percentage of the population to explain a remaining percent of people who would have a match of the DNA. The prosecution said there would only be 6 people who would have a match, the defense said there would be 57. Either way, its not many people when you figure there is 29,000 white males living in Middletown.

Juror 6-7
Smaller copies of the nuclear DNA, the chain is smaller, so it does not positively ID an individual.

Juror 6-8
M.T. DNA seems to be an abbreviated DNA sampling, fewer possible combonations will mean more possible matches.

Juror 7-1
That the cells around the nucleus matched that of the defendant

Juror 7-2
{Blank}

Juror 7-3
Maternally inherited DNA.
Looks at 600 base pairs.
Used when nuclear DNA cannot be used.

Juror 7-4
MTDNA is outer part of the cell that has it's own genetic make up but it is not exclusive to just one person.

Juror 7-5
The genetic makeup of the mitochondria cells in the hair follicles. Apparently they can duplicate and be similar to other peoples sequencing order, unlike the nucleic DNA.

Juror 7-6
An easier DNA sample to get Because the MT DNA can come from anyone with the maternal roots. Also it's not something, I should say, it's not a test that can convict on it's own. Nuclear DNA can.

Juror 7-7
The test can't rule out the suspect as the owner of the sweatshirt, but it also does – not prove that the hair was his.

Juror 7-8
It's a form in DNA testing that deal with hair testing specifically. Which is supposed to I.D. person.

Juror 8-1
The peanut shaped molecules that are in cells, inherited from only the mother.

Juror 8-2
Chemical chains of desorinibrend acid.

Juror 8-3
DNA that is preformed on a glaturative base next to more accurate testing.

Juror 8-4
Testing few (hairs) to get genetic profile + see if they match or are unique to that person.

Juror 8-5
DNA taken from a strand of hair, that can be used to identify an individual or individuals with a 99.98% accuracy. Any siblings from a maternal relation will have the same MT DNA. This can only be passed mother to child.

Juror 8-6
MTDNA is DNA handed from mother to child. And is unique to groups of people.

Juror 8-7
Maternally inherited (large number per cell).

Juror 8-8
The DNA that your mother gives to children when they are born.

Juror 9-1
Secondary DNA.

Juror 9-2
MtDNA is not as strong evidence as nuclear DNA. It is an identifier of the cellular makeup of an individual. It shows the same 'ATGC' patterns as nuclear DNA. Unlike nuclear DNA, it cannot match a unique individual. However, it is particular enough to limit the number of people likely to match. People with same maternal background would match their mtDNA.

Juror 9-3
DNA – consisting of 4 bases – that are passed down the maternal line.
Shorter sequence then nDNA so not able to pinpoint 1 individual.

Juror 9-4
The mitochondrial DNA occurs outside the nucleus of the cell. The strand is shorter and does not contain as much information. It does not positively identify a specific individual, but rather a portion of the population.

Juror 9-5
Partial DNA samples that do not utilize the nucleus of the cell therefore having "missing" elements and less reliable that core DNA.

Juror 9-6
The study of the outer layer of DNA.

Juror 9-7
{Blank}

Juror 9-8
It is the DNA found on the outer layer of the cell NOT in the nucleus. It is passed down by the mother. MTDNA is not unique to an individual.

Juror 10-1
MTDNA is the DNA found on the outside portion or (nucleus) each cell. It is not as accurate as nuclear DNA and whereas there are 2 nuclear DNA, there can be many many more (thousands?) MTDNA.

Juror 10-2
It is the process of taking someone's DNA and breaking down the particles to match others from the prospective of a certain pattern or type.

Juror 10-3
A more readily available but less conclusive source of DNA evidence. Can't absolutely pin down a single person but can narrow down the list of possible suspects very effectively. Non-nuclear-100X more plentiful than nuclear DNA.

Juror 10-4
Secondary DNA- remaining portions of cell not completely in line with nucleus somewhat less conclusive as evidence large# of people may have the same (MtDNA).

Juror 10-5
Not sure

Juror 10-6
The process doesn't pinpoint whose DNA is found only that it excludes a certain % of a group.

Juror 10-7
Not as accurate as the nuclear DNA which is a more positive identification.

Juror 10-8
DNA where someone else in your family-line could match (not exact to person alone).

Juror 11-1
Secondary DNA structures tend to follow nuclear?

Juror 11-2
A strand of DNA much like nuclear Dna but much shorter and cannot depict any individual.

Juror 11-3
Hair sample.

Juror 11-4
In the mitochondria (~1000 aval. around the nucleus) there are DNA chains, while not as complete as nuclear DNA, the pros. Was able to sequence 600 base pairs which were identical to the defendants. IT was either 99.98 or 99.8% conclusive.

Juror 11-5
Strands of individuals DNA that is Shorter and less unique to a specific individual. The less unique part is saying the DNA could possibly be found also in another family members cell. But in that only most likely on the mothers side.

Juror 11-6
(Drew a picture showing mtDNA is outside of nucleus) Can be a group of people like there are different races.

Juror 11-7
DNA structures form the nucleus include paternal and maternal strands and are a complete genome for an individual. Nucleic DNA is found in the protected nucleus of all and only 2 strands per cell.
Mitochondrial DNA is a shortened sequence that is strictly maternal in origin. It is in the less protected part of a cell and has potential 1000's of strands per cell. The evidence form the use of MTDNA vs. Nucleic DNA is that Nucleic DNA provides a positive ID of an individual. MTDNA provides identification that an individual is part of a small group.

Juror 11-8
Molecular DNA, anyone with the same mother would have the same MTDNA. Not specific to one individual.

Juror 12-1
Mitochondrial DNA is done through the mitochondrial + maternally.
Not as precise.
More contamination.

Juror 12-2
Not so sure.

Juror 12-3
The DNA sequence of 600 bp taken from hair mitochondria and the material transmission of the DNA high frequence of mutation rate among white males.

Juror 12-4
When different sequence matches.

Juror 12-5
The sequence pattern is compared to the evidence + the accussed.

Juror 12-6
Evidence based on possibility relates in this case to a limited database that is not random.

Juror 12-7
? don't know.

Juror 12-8
Do not know

Juror 13-1
MtDNA is passed down maternally – Not paternally although it doesn't identify specific individuals it can be used to eliminate certain % of the population.

Juror 13-2
A mew test to establish a link between people that cannot be traced to a specific person??? Still trying to find the benefit in using this instead of nuclear DNA.

Juror 13-3
No necular DNA passed from maternal side – does not change often.

Juror 13-4
99.98% certain to match a certain group not individual.

Juror 13-5
A less specific form of genetic characteristics passed on by the mother that is not specific to an individual.

Juror 13-6
The match of the same blood type as your mother. Not the same buy maybe a part of it?

Juror 13-7
Tooler cells – not great evidence.

Juror 13-8
Evidence retrieved from a scene of a crime and proceed through a criminal lab by the police or "FBI".

Juror 14-1
The DNA matches exactly to the person. However, this particular test could have approximately 2% other persons with the same DNA. Could match family members.

Juror 14-2
Alternative DNA testing. Test on a wide scale.

Juror 14-3
DNA not unique to one individual, it is only maternal + does not come from the nucleus of the cell.

Juror 14-4
It is difficult to put into words. I'm not a scientist, but paying attention during the testimony the molecule match and the FBI witness is so credible you see the matching cells and it works.

Juror 14-5
DNA that is only linked from mother to child. Molecules that are found outside of the nucleus of a cell.

Juror 14-6
mtDNA is the outside part of the cell that can link a group of people together vs. one specific person.

Juror 14-7
It is a sequence related test that shows a DNA pattern of an item and how it compares to another sample, it can eliminate (exclude) a large number of potential matches leaving a higher percentage of possible matches.

Juror 14-8
DNA evidence that is retrieved fro the nucleus of the cell-but the outer layers-so it cannot be 100% pure.

Juror 15-1
Not shore.

Juror 15-2
No comment.

Juror 15-3
MtDNA.
In a cell outside the nucleus are mitochondrial DNA where you find over 1000 copies of DNA – This type is not unique in an individual. Many others may have the same or similar MtDNA. IF the known sample and the sample in question do not match you can exclude that person. If the known sample and the sample in question match you cannot exclude that person. If the 2 sequences are 1 off could be a mutation and is termed inconclusive.

Juror 15-4
Imprinting from the maternal side which is not exclusive to family members.

Juror 15-5
Evidence DNA not unique to one person.

Juror 15-6
It is the genes that are inside a person.

Juror 15-7
Non nuclear, or utilizing DNA material other than the nucleus of the molecule.

Juror 15-8
DNA results that are not as exact as a Nuclear DNA result. Can include people in maternal group, as well as others, as potential matches.

Juror 16-1
mtDNA is evidence tested and used to try and match up with one particular person (in this case). The results of testing mtDNA are not as accurate as nuclear DNA. If a sibling was born from the same mother, it is possible there can be the same base pairs that match and are identical.

Juror 16-2
Differs from nuclear DNA in that it cannot be traced to a particular individual. It is descended from the maternal side. It is a DNA sequence. A certain number (?) of pairs that differ would exclude a person.

Juror 16-3
mtDNA is one form of forensic testing to determine matches in cells. mtDNA is not a method of uniquely identifying an individual. mtDNA shows common sequences and predicts the likely hood of others w/ similar sequences.

Juror 16-4
It is evidence that cannot for sure positively identify somebody. Comes from the mother.

Juror 16-5
mtDNA is another, yet less precise, DNA test that can be preformed on samples that do not allow nuclear DNA to be captured. Provider same types of base pairings as the nuclear test, but in shorter sequences.

Juror 16-6
I believe that mtDNA is not specific to the individual, but represents many people in the same group. It is a matching of molecule sequencing. Since it is maternal, any decendant from mother's side of family could match.

Juror 16-7
Where DNA is found-enough to determine matching strands of DNA, but not enough for an individual identity. It would place the suspect in a "pool" of people w/ the same common strands. These strands are inherited by the mother, therefore only people related through the mother would have the same strand combination (heteroplasmy aside). Heteroplasmy takes in acct. peoples maternal mutations-however Kevin didn't show any sign of heteroplasmy.

Juror 16-8
DNA not taken from the nucleus of the cell, but from the mitochondria outside; which,through the sequences of the bases, can exclude a certain sample of population from the test, as being (in this case) guilty. Avg. person would be excluded and mtDNA cannot exclude people from same maternal line.

Juror 17-1
Samples taken from the evidence like hair from hats, coats, etc.

Juror 17-2
Plantif showed more conclusive with Kevins hair.
Defendant found unconclusive with more volume of people.

Juror 17-3
It can connect a person with a crime, but not without a shadow of a doubt.

Juror 17-4
DNA from the mothers side of the family & the siblings.

Juror 17-5
A form of DNA that doesn't provide an exact match such as nuclear DNA which is used in paternity test.

Juror 17-6
Evidence that groups individuals with the same DNA.

Juror 17-7
Testing for cell match.

Juror 17-8
It's not an exact match & that there could be others with the same/similar MTDNA.

Juror 18-1
Mitochondrial DNA doesn't I.D. person where the other DNA has a nuclear and you can use it more as proof.

Juror 18-2
Evidence of a small cross section of the population could have committed the crime.

Juror 18-3
Sequencing of base pairs which contain a larger number than the nucleus and cannot be used to narrow a search to one individual.

Juror 18-4
The DNA that resides outside the cell nucleus, not unique to the individual, but to groups. Inherited through mother only. Newer than nuclear DNA.

Juror 18-5
It is not as sure as DNA but I still think it is very good evidence.

Juror 18-6
Don't know.

Juror 18-7
It shows groups of people who have the same DNA.

Juror 18-8
Not too sure I understand mtDNA.

Juror 19-1.
I can't articulate.

Juror 19-2
It's not as accurate as nuclear DNA.

Juror 19-3.
MTDNA is a maternally passed genetic code that would be present in siblings or cousins. It is not as reliable as nuclear DNA, however this sample can reveal consistence present between suspects and evidence taken from the crime scene or evidence.

Juror 19-4
IF nuclear DNA is not available they can use the MTDNA and replicate it to match another DNA sample?

Juror 19-5
Genes passed from a mother to child.

Juror 19-6
When there is not enough DNA available to do a nuclear DNA exam, MTDNA is used. MtDNA is not as reliable as nuclear, with nuclear there is a much greater possibility of an exact match.

Juror 19-7
The identifying aspect of a cell that can narrow or rule out possible suspects although clear-out identification is not possible as it is w/ nuclear DNA.

Juror 19-8
DNA that is take from outside nucles, which doesn't identify one person, but a group of people.

Juror 20-1
mtDNA is from outside the nucleus, there is more of it than nuclear DNA and it cannot be traced to a specific individual. Its not as precise as nuclear DNA.

Juror 20-2
Shows blood from the maternal line in your family.

Juror 20-3
It's a testing of the mitochondrial around a nucleus of a single cell, but not the nucleus itself.

Juror 20-4
It is a small section of DNA take from the mitochondria of a cell. It is not a unique form of DNA and is only taken from the maternal side of the family. It is not as conclusive as nucleur DNA.

Juror 20-5
The DNA taken from the mitochondrial of the cell, which provides cells with energy. The strands are shorter, and while less unique than nuclear DNA, the mtDNA can be linked to a person through maternal means.

Juror 20-6
Molecule.

Juror 20-7
"blueprint" of a class/group of people on maternal side. Used to identify class, not individual.

Juror 20-8
The maternal matching of hair.

Juror 21-1
The study of the outer nuclear DNA its less convincing but still represents strong evidence.

Juror 21-2
DNA that comes from mitochondrial – not nuclear.
This DNA comes through the mother.
(Drew picture).

Juror 21-3
DNA taken from the mitochondria of a cell.
Its 300+ units in length, shorter than nuclear DNA strands. It cannot be linked with a specific individual, but can drastically narrow the field to rule out a large majority.

Juror 21-4
DNA that surrounds the nucleus where pairing is similar to the 26 pairs in the cell nucleus when sequenced.

Juror 21-5
When a pair of the hair is taken and put in test. And the more hair for the person in taken and put through the test.

Juror 21-6
Mitochondrial DNA identifies DNA as DNA belonging to a group of people who share the same mitochondrial DNA sample. Nuclear DNA can identify "individual" DNA as belonging to a specific person. Mitochondrial DNA is found outside the nucleui of the cell where as nuclear DNA is found inside the cell and therefore more exact. Mitochondrial DNA is passed on by maternal inheritance so therefore people who have a maternal link to one another may have the same MtDNA – hence they belong to the same group.

Juror 21-7
I think this was not the best source of the DNA to utilized, but this type of testing was choosen over the nuclear DNA.
Possible they did not have enough hair to run the other test.

Juror 21-8
DNA that is from the mitochondrial & not the nucleus from the maternal side only.
The differences are small but significant. 2 areas leave highly variable.
Use a 3 – step process.
Extract.
Amplification.
Sequence.

Juror 22-1
This is evidence taken from a smaller number of possible matching sequences since it comes from only one side, the maternal side, of the sample examined.

Juror 22-2
mtDNA is the make up of a cell that is passed down through the female side of the genes. The father does not contribute to the makeup of the mtDNA.

Juror 22-3
Used to identify and analyze a piece of a person's hair(cells) from a piece of hair.

Juror 22-4.
The DNA outside the central part of DNA cell. The "energy" on the outside of the main cell.

Juror 22-5
It is a DNA strand common to the mothers side of the family.

Juror 22-6
It could be the defendant's or it could a brother or sisters.

Juror 22-7
Mitochondrial DNA is DNA extracted from the energy producing mitochondria in the cells. It is more prevalent than nucleic DNA, but also based on only 600 pairs. mtDNA is only passed maternally from generation. Because there are only 600 pairs of AT/GC to compare, it will not uniquely identify one person but can only confirm a match to a sequence.

Juror 22-8
It is a group selection trait, such as hair color or blood type, that reduces the possible number of suspects for a crime.

Juror 23-1
{Blank}

Juror 23-2
Type of testing to identify and match certain types of DNA structure. MTDNA is the type of DNA used for the test.

Juror 23-3
Taking mitochondria from a sample, determining its pattern and comparing that to others. People from the same maternal lineage may have similar patterns.

Juror 23-4
n/a.

Juror 23-5
Not enough.

Juror 23-6
The many cells outside of the nucleic part of cell and has only maternal strings.

Juror 23-7
The base pair sequence in DNA from mitochondria (cell organelles) as apposed to DNA from nucleus of cells. MtDNA not as powerful as nuclear DNA for establishing uniqueness in identifying a specific individual.

Juror 23-8
DNA sample from portions of cell other than the nucleus. This sample varies from nuclear DNA because it is derived from the maternal genes only. As such, this will not be unique to a single person but only to a group.

Juror 24-1
n/a, don't know.

Juror 24-2
Maternal DNA, not traceable to a specific person, it can only identify groups.

Juror 24-3
It is matching the ancestry of a person, through their mother. So, anyone distatly related to one person through some shared matariach, would have similar if not the same mtDNA.

Juror 24-4
mtDNA is DNA passed down from your maternal side. It varies from person to person. But almost all people from the same maternal bloodline will have the same mtDNA.

Juror 24-5
Passed from mother to children, not formed in the nucleus (all would carry).

Juror 24-6
mtDNA showed sequence and was used to determine the order of bases. They look at the mitochondria of the cell not the nucleus.

Juror 24-7
Letter that match.

Juror 24-8
Mitochondrial found in the gl pairs of a living cell will have short-chain DNA compensates hat not enough unasues identifying infraction to modify individuals. It will permit classification to a group, not it is not a big enough molecule for any one specific base-group motfiy.

Juror 25-1
Is more prone to error.

Juror 25-2
How persons bodily items are compared to others.

Juror 25-3
DNA from mothers side of family.

Juror 25-4
Newer version of DNA evidence that can be used when "prototype" samples are not prevalent. If samples are limited, MtDNA can be used to narrow down potential suspects or categories of individuals. It is not as fool proof as nuclear DNA or as specific but does have the ability to focus.

Juror 25-5
mtDNA evidence presents a code of DNA that only is present in a certain portion of the population, although unlike nuclear DNA evidence, it cannot pinpoint one person.

Juror 25-6
To declair a match DNA have to the same (nuclear cells.)

Juror 25-7
It is the DNA outside of the nucleous that give a short strand of code which only categorizes a group of people not a specific individual.

Juror 25-8
Ability to reduce (exclude) segments of population as potential perpetrators of crime.

Juror 26-1
It is DNA analysis passed through only the mothers DNA that pts the analysis into a group in lieu of an individual and the sequencing matching is the key factor.

Juror 26-2
DNA based on evidence provided in which no nucleus is present in the sample. mtDNA is not able to pin point any one particular individual, yet can classify a group.

Juror 26-3
It is the DNA sequence inherited through maternal line, mother, grandmother, etc.

Juror 26-4
It is genetic material that comes from both the mother and the father.

Juror 26-5
?—only remember that nuclear DNA uniquely identified a person-mtDNA not a unique identifier.

Juror 26-6
Not as conclusive as reg. DNA. Can't pinpoint a specific person, but, can calculate a certain group.

Juror 26-7
Is DNA present in cell, but much shorter in length. Not as good as nuclear DNA, however base pair is same like nuclear DNA. mtDNA leads more to maternal DNA where as nuclear is 50/50 parents.

Juror 26-8
Evidence that a person's mtDNA has a particular sequence but that it is not unique to that person: this DNA type is passed down maternally so anyone with same mother could have mtDNA. It cannot therefore positively identify someone.

Juror 27-1
To hard to know about mtDNA to DNA.

Juror 27-2
DNA that is not as specific as NDNA. Can include more people from same family.

Juror 27-3
(cells).
Evidence taken form outside the nucleus of DNA. It is not unique & only indicates that the DNA is part of a group of others with similar DNA. Genetically it is passed from biological mother.

Juror 27-4
Matching samples from one (hair, etc.)
Suspect to samples left at crime.

Juror 27-5
Non – nuclear DNA found when a hair or other small evidence is collected. It is only on the mothers blood line so any male in that family can have the same MTDNA.

Juror 27-6
It is the sequence of the molecular structure of your cells. MT is not as precise as nuclear. MT is not individual it is maternal.

Juror 27-7
DNA that surrounds the nucleus. Passed down on mother's side.

Juror 27-8
DNA based on the mother's side – father has nothing to do with it.

Juror 28-1
Relatively unique evidence to identify a person

Juror 28-2
mtDNA evidence is evidence which matches an unknown to a known strain of mitochondrial DNA. It is not taken from the nucleus of a cell but the mitochondria. Because the DNA material in that part of the cell is tiny compared to the genetic information in the nucleus, it is less reliable (it only has available for examination 600 base pairs). Mitochondrial DNA is a relatively new way to identify genetic material and so the database by which it is correlated still very questionable. So, mtDNA evidence is evidence and should certainly be considered in a criminal case as evidence, but cannot reasonably be given much weight.

Juror 28-3
A pattern of matches that exist in our cells. It can exclude people given a sample from crime. It is not accurate as DNA evidence.

Juror 28-4
It's the DNA that is maternally inherited and is not unique to any one individual.

Juror 28-5
The part of the cellular makeout that is not totally unique to a particular individual as opposed to nuclear DNA. The mtDNA reduces the size of the group of possibilities.

Juror 28-6
It is nuclear material found in all living cells that has a particular coding sequence and it comes from your mother (pairing).

Juror 28-7
Mitochondrial if transferred from the mother and it depends on the sequence in which the cells run.

Juror 28-8
It shows the DNA in a tested individual that he/she can only have via their birth mother - theref– re positively verifying nuclear DNA positive results.

Juror 29-1
Out of the 2 types of testing the MtDNA is the more inferior and doesn't hold a lot of weight with me.

Juror 29-2
A DNA sampling taken from the miotchondria of the cell versus the nucleus of the cell. Mitochondrial DNA is not specific to one person, but is shared by all members of a maternal line. Nuclear DNA, however, is specific to one individual.

Juror 29-3
Have no idea.

Juror 29-4
It is a form of DNA that is inherited from maternal genes and is present with great abundance. Although not as significant as DNA is still an identifier of individuals and is accepted scientific evidence as testing was 20 yrs. apr.

Juror 29-5
A for of testing the will discover if the hair provided belongs to someone form a certain clause of people it is also fairly new and may have some discrepancies.

Juror 29-6
DNA that is representative of a group of people, passed on by maternal side. It is not exclusive to one individual.

Juror 29-7
- Unique DNA pattern to a few individuals.

Juror 29-8
A type of DNA evidence, not as reliable as neculear DNA.

Juror 30-1
Not good enough to use to conflict mtDNA is more general to individual.

Juror 30-2
Goes only from the mother to the child.

Juror 30-3
Not sure w/o consulting with my notes.

Juror 30-4
DNA from the mitochondria of the cell rather than from the nucleus. DNA is identified through paired sequences in strands of DNA. However, mtDNA is more of a science of ruling out possible DNA contributors rather than making an exact match. Sometimes a person can have different DNA sequence at difference sites when mtDNA is used.

Juror 30-5
It is breaking down of cells in sequence.

Juror30-6
Peanut shaped cells around the outside of nuclear DNA.

Juror 30-7
All I know is that its some sort of cell.

Juror 30-8
It is a process that is used to test the hair molecules (relateds to cell formation) for use in criminal cases; however, it is not as powerful as nuclear DNA, prove to error, and according to Dr. Allison, cannot be traced to a particular person. I didn't have a warm feeling that the Middletown Police Town.

Juror 31-1
It is a DNA process that does not use the nucleus of a cell, therefore is not as accurate to pinpoint 1 individual person.

Juror 31-2
IT is DNA that can't be traced to a specific person and only inherited by the mother.

Juror 31-3
3 step procedure.

Juror 31-4
MtDNA is a new type of DNA testing which is different than DNA.

Juror 31-5
Supportive, but not conclusive. It leaves to much unanswered, while giving me the misperception that this is the DNA we have all heard about. It appears to be an art not a science as yet!

Juror 31-6
IT is a blueprint of DNA based on the maternal part of DNA – Not exclusive to only one individual.

Juror 31-7
Sequence of base pairs safeguards against contamination comparison form maternal side only.

Juror 31-8
Mitochondrial DNA evidence was used as there was not enough hair to do Nuclear DNA – 3 steps were taken to test DNA – recutting in evidence that Mr. Jones cannot be excluded – His DNA was rare & only 0.2% of all male Caucasians would be included.

Juror 32-1
A wide area identifier.

Juror 32-2
DNA passed down through maternal side-relatively new.

Juror 32-3
Pieces of identifying evidence that classify into groupings.

Juror 32-4
The part of the molecule outside of the nucleus contains 100s-1000s of mitochondria. These carry short strands of DNA that are unique on maternal side-in that a mothers genes are passed one to child. The mtDNA is not entirely unique because it is short. Furthermore there is a risk in using mtDNA in that other miscellaneous DNA could be attached to the evidence. However, if there is a lack of cells where the more extensive DNA test can be used (nuclear), then the best DNA evidence that can be tested is mtDNA.

Juror 32-5
Its handed down through the mothers side of family.

Juror 32-6
The cell outside the nuclear cell, of the true DNA sample are taken. Mitochondrial DNA is to open on pin pointing.

Juror 32-7
mtDNA-a maternal part of a gene passed down to all offspring. Also does not identify a person

Juror 32-8
Cells found in a persons genes.

Juror 33-1
Evidence obtained by analyzing mitochondrial DNA why is found in the cytoplasm of the cell (not the nucleus) and has different characteristics than nuclear DNA which contains only 2 copies (1from each parent).

Juror 33-2
MtDNA is somewhat accurate in identifying an individual, but not as reliable as nuclear DNA. MtDNA can be identical in many members of the same family since it is passed maternally

Juror 33-3
DNA found outside the nucleus that is passed thru the maternal line.

Juror 33-4
I really didn't understand.

Juror 33-5
A stronger portion of DNA identification that can be used more efficiently when identifying potential carriers of that DNA.

Juror 33-6
DNA that is taken from the area around the nucleus (picture drawn).

Juror 33-7
Can't explain in own words.

Juror 33-8
Matching suspects DNA to evidence hairs.

Juror 34-1
Has according to experts to do primarily with your mother or grandmother.

Juror 34-2
1. a new way to measure DNA. 2. uses a less specific way to get a DNA match.

Juror 34-3
DNA evidence which puts people into select categories but is not conclusive.

Juror 34-4
Extract cells/to amplify by millions/to show a pattern or sequence reapeated.

Juror 34-5
mtDNA is the material that surrounds DNA cell nucleus. This DNA is not specific by person but specific to class of people in the same family or DNA sequence.

Juror 34-6
mtDNA carry from mothers side and not unique to individual.

Juror 34-7
DNA collected from particles of the human body

Juror 34-8
I do not understand the question. From one point of view t is a complex scientific procedure which can be used to confuse a jury. As a scientific method it is complex and one may ask-why not test for nuclear DNA when the mDNA result is so uncertain?

Juror 35-1
DNA matching using MTDNA which is outside the cell nucleus. It cannot pinpoint an individual conclusively by itself, but only narrow it to a very small group, with mother DNA influence.

Juror 35-2
I understand how it exists but I'm still a little unsure.

Juror 35-3
It is an analysis used to exclude or not to exclude a charged person in a crime.

Juror 35-4
Pair of bases in order like ladder.

Juror 35-5
Mitochondrial less likely, then nuclear.

Juror 35-6
DNA that is found in the outside part of the nucleus. It is passed from mother to all children & down that hereditary line.

Juror 35-7
A test procedure(s) that can exclude up to .2% of a population.

Juror 35-8
Don't know.

Juror 36-1
DNA outside the nucleus in a cell which only comes from maternal DNA and is the SAME in all maternal offspring.

Juror 36-2
Sequence of components of cells in a substance carrying a unique pattern.

Juror 36-3
Mitochondria DNA is DNA sequences derived from outside the cell's nucleus in which the sequences are much shorter than nuclear DNA. With these sequences being shorter, there is less total variations than nuclear DNA and cannot specifically conclude to 1 individual.

Juror 36-4
It is not a perfect match for the sample-the nuclear dna shows much larger sequence match-it seems more circumstantial, although by a small percentage, a sm. Percentage can be big. The mtDNA is a dna sample that is not as detailed, have as many sequences as a nuclear DNA sample.

Juror 36-5
It is passed from mom to the child and not as unique as nuclear.

Juror 36-6
Genetic coding unique to family members.

Juror 36-7
It is not nuclear in comparison to nuclear.

Juror 36-8
HA! HA! DNA which can be linked to other people in your family.

Juror 37-1
It's the DNA that doesn't come from the nucleus.

Juror 37-2
Newest version of DNA – supposedly a better genetic match then nuclear.

Juror 37-3
DNA that ties you to a certain group of people but not to an individual.

Juror 37-4
It is passed from mother to child but cannot be traced to a specific individual.

Juror 37-5
Mitochondrial DNA are energy cells on the outside of the cell, which are representative of the maternal side of the family. Although the mitochondrial cells are not totally specific to 1 person, just a maternal side, to many.

Juror 37-6
Evidence taken form the outer portion of the DNA sample – not the nucleus – and give only sequence pairs from the maternal side of the gene, therefore cannot show as broad a profile as a nuclear DNA sample.

Juror 37-7
Comparing the samples of hair molecules.

Juror 37-8
Evidence that is taken at or from crime scenes and used to compare with DNA from defendants.

Juror 38-1
A person's body makeup.

Juror 38-2
A match if 600 base pairs found in mitochondrial DNA between the question sample and a known source. This links a select group of individuals to a case.

Juror 38-3
DNA evidence if sequence similarity wherein the sample is derived from hair mitochondria.

Juror 38-4
It is a way of showing that a person is within the realm of possibility of being guilty. It should not be exclusive evidence used to convict a person. However, it can greatly narrow down the pool of potential guilty persons (for that crime).

Juror 38-5
Its as close as evidence in both as you can relate to.

Juror 38-6
I wouldn't call conclusive evidence with the little that is known about it at this time.

Juror 38-7
Cellular makeup of a person that is more ample to draw on.

Juror 38-8
Identifies base pairs-if you don't have big enough sample, must use this method
1.) extracting DNA.
2.) amplificate-add chemicals to make millions of copies.
3.) sequence-find the order of sequences.

Juror 39-1
Evidence genetic marker provided by mitochondria found in cells, passed on through the maternal family.

Juror 39-2
The strands of DNA outside the nucleus that is not as unique to a particular individual and stems from the mothers side.

Juror 39-3
Matching bands from the cell only from the mother that are in distinc ordere that can Identify a person (the hairs in the hood).

Juror 39-4
DNA evidence from outside the nucleus farily new but sounds reliable. I believe it was recently accepted in the Scott Peterson case. The brother (step) doesn't share maternal genes - so he – ould not have similar sequencing. FBI counts " inconclusive" differently than the defense scientist would. The mtDNA would be used to exclude persons based on difference in the sequencing "steps". May not be as individual as nuclear DNA or a fingerprint but still narrowly classifies people to a very high degree.

Juror 39-5
A method of indentifying an individual which is presumptive but not an exact.

Juror 39-6
Genetic material passed along the maternal like to children. Since it is maternally passed it is not unique to an individual. Others from the same maternal line will have the same genetic matter.

Juror 39-7
Not based on nucleus of DNA testing.
Not as reliable.
Not as individualized.

Juror 39-8
I think nuclear DNA is damn near an identity which is really is.
From what I've seen from MTDNA, I think it can only exclude people, but in no reasonable way can it include anyone.

Juror 40-1
-mtDNA was compared to nuclear DNA.
-apparently mtDNA is not completely unique to any person though.
-compared of components of mother and father.
-bottom line: after identifying the mtDNA, one is capable of reducing the potential suspects to a very small number by exclusion based on characteristics of the DNA.

Juror 40-2
Sequences of genetic pairs found in hair or body fluids.

Juror 40-3
The gene past from mother-through child and so on.

Juror 40-4
A linkage to DNA but unable to pin-point to one person. Containing paired groups of A-C-T-G. Grandmother; to child and canryon.

Juror 40-5
It is a breakdown in 100ths of the nuclear DNA. You take a certain amount of people (population) and group them together. Those chromozone sequence readings are lumped together I believe in numbers of 10. It is the chemical DNA of our genes, but it is not strong enough to pin point one person.

Juror 40-6
Tells about hair samples and who it belongs to.

Juror 40-7
Don't know.

Juror 40-8
A shorter version of the DNA sequence-having less points of accuracy.

Juror 41-1
A small sample of DNA building blocks. This DNA can not identify a specific individual; however, it can identify a small group.

Juror 41-2
For the purpose of deciding this case… it is a limited method for identifying a specific individual.

Juror 41-3
The chains formed by the base pairs and the order they appear in the chains.

Juror 41-4
This evidence allows for a maternal link, which may exclude a very large % of possible matches.

Juror 41-5
It ID's individuals who have the same seq. based on mother's DNA. Based on 600 seq. bases.

Juror 41-6
A gene sequence that resides in larger number outside the nucleus of the cell gotten form the maternal side of the parents.

Juror 41-7
As opposed to nuclear DNA – not as reliable, not unique to a single individual chains used for comparison not as long as that used for nuclear DNA comparisons according to defense witness – relatively new process.

Juror 41-8
A DNA type that is less specific that nuclear DNA which could be used to exclude a sample from a given population.

Juror 42-1

Not as specific as DNA-not unique to individual. Mitochondria are found outside the nucleus.

Juror 42-2
DNA that can only matched through maternal side but seems to be not all exclusive.

Juror 42-3
None-she said doesn't know.

Juror 42-4
Mt(DNA) not as strong as nuclear.

Juror 42-5
Mitochondrial DNA evidence is a fairly new process to identify an individual when the reliable and more distinct Nuclear DNA test can not be preformed due to lack of evidence. Though not as reliable, this process will narrow a suspect list considerably (i.e hundreds instead of millions).

Juror 42-6
It's a genetic form of personal identification outside the cell nucleus.

Juror 42-7
Found hair, sweatshirt.

Juror 42-8
Mitochondrial DNA follows a base sequence. A matches T and C always matches G. this gives an idea of what the sequence of the unknown evidence is. Compare this sequence to the unknown evidence. All of this gets compared to a group of people. Does anyone in that group have the same sequence? If so, how many? If not, this sequence is more unique to a more select group.

Juror 43-1
It can only exclude individuals – it cannot positively identify someone.

Juror 43-4
1000 of copies outside the nuclei DNA many base pairs.

Juror 43-3
Hair molecules match the ones in hat and defendant. The no# of people in location or area was to small not to be a match.

Juror 43-4
Mitochondrial DNA is the genetic material that passes through the maternal line. It is not specific to an individual + it is subject to heteroplasmy – mutations.

Juror 43-5
It is evidence that compares strands of matching patterns on DNA molecules.

Juror 43-6
It is a sequence of chemicals (acids) in pairs found in the mitochondria or cells (not the nuclei) which can determine similarities and differences between (hairs, tissue, etc.) samples.

Juror 43-7
It show that the person can take on its parents genes, mom or dads.

Juror 43-8
Evidence taken from an individuals hair or other such skin where the cells are looked at and compared with other peoples cells of same sample type to see if they match up to the persons accused of committing the crime or if it is different and can be someone else's.

Juror 44-1
A larger representation of DNA taken into consideration. This could leave questions.

Juror 44-2
DNA resides in the mitochondria of the cells, it is not unique to individuals, but can be used to place people into groups. The prosecution is arguing that the FBI database of 5000 or so samples does not have the same sequencing as the defendants and that means there is a 98.8% chance that he could be the robber if the hairs on the defendant match the hairs of the sample.

Juror 44-3
DNA test that gives a group concentration (a lot lower of DNA testing) Hard to determine an individual reading.

Juror 44-4
Evidence that can eliminate some people from likely being guilty.

Juror 44-5
It indicates the traits and characteristics you get from the biological side of your mother.

Juror 44-6
DNA evidence used when only a small amount, 2 strands, of hair provided. It matches base pairs of matches in a certain sequence that remains consistent through out the entire strand.

Juror 44-7
Make up of your molecules.

Juror 44-8
Something that needs more development.

Juror 45-1
The testing of hair to match the DNA sequence of an unknown source to a known source.

Juror 45-2
DNA found outside the nucleus of a cell which cannot identify an individual but can point to a specific group, namely family.

Juror 45-3
Short strands DNA from mother side.

Juror 45-4
A method to identify a group of people and not a single etity.

Juror 45-5
Evidence passed only from the mother to child.

Juror 45-6
Peanut shaped hundred or thousand of copies present in all people and passed down the maternal line.
Has CAGT parings (base pairs fewer then nuclear DNA.
Not as differentiating as nuclear DNA due to shorter sequence.

Juror 45-7
DNA evidence that is genetically inherited, passed on through the mother. Therefore, making it not as individually unique as Nuclear DNA, but still a reasonable way to link a person with a crime. Same individual – result of mutations which take place within the cell – it is not a factor in this case "heteroplasmy". MTDNA is not found in a cells nucleus but rather in the mitochondria located in the cell's cytoplasm, which surrounds the nucleus.

Juror 45-8
MTDNA everything in person's makeup must match.

Juror 46-1
It has to do with the maternal side.
Mother and son.
Does not apply to father.

Juror 46-2
Not as good as nuclear DNA but very close.

Juror 46-3
DNA taken from someone.

Juror 46-4
The makeup of the 2 different DNA's that are found which only comes from the mothers trait.

Juror 46-5
A signature of your DNA specific to your mothers genetic line.

Juror 46-6
-from maternal gene.
-not unique to individuals.
-needs same sequence.
-outside nucleus of cell.

Juror 46-7
Strands of DNA from 100's of mitochondria outside nucleus of cell-identifies people with same sequence of base pairs. Cant uniquely identify individuals, can be skewed by heteroplasmy, passed maternally.

Juror 46-8
It is evidence from the molecule-hundreds of peabut shaped pieces that can be tested-base sequencing can be matched. It doesn't uniquely ID people, but it sure does narrow it down. Decends on mother's side.

Juror 47-1
Not unique, no father only mothers maternal inheritance.

Juror 47-2
The matching of the other DNA in a more open field of error.

Juror 47-3
Sequence and pair matching of DNA outside the nucleolus (maternal line) against an established data base.

Juror 47-4
It is evd based on base pairs & sequences of genetic into ~ 1000 copies/cell can be transmitted through maternal line and can identify group or class w/similar sequencing, can be used to exclude but not to identify a unique.

Juror 47-5
DNA pulled from the mitochondria of cells present at the scene of crime.

Juror 47-6
Is basically the outside part of a DNA cell.

Juror 47-7
The hair sample matched the one after he was arrested.

Juror 47-8
DNA evidence extracted from the mitochondria within a cell. It is not the best identifier but is good in the absence of nuclear DNA.

Juror 48-1
The DNA that is formed from the parents DNA.

Juror 48-2
MTDNA is not unique to an individual family members on the maternal side can have similar sequencing.

Juror 48-3
DNA that is from mother to child.

Juror 48-4
It is one form of DNA testing. I believe it is too new and too inconclusive to be used as evidence.

Juror 48-5
DNA that is pretty new that can only be inherited by the mother. It is also not as reliable as the nuclear DNA (that is normally used).

Juror 48-6
DNA drawn from the body of cell which cannot identify an individual, but can identify people within a class (maternal) with similar DNA sequence.

Juror 48-7
It is the DNA in the rest of of DNA molecule (not the nuclear stuff) it is not absolutely unique to any given person and is all people within the same maternal lineage will have same mtDNA.

Juror 48-8
mtDNA is DNA from a cell's mitochondria, inherited from the mother. The DNA is not unique to an individual but can be used as a screen to eliminate groups of possible suspects.

Juror 49-1
MTDNA – is based broader basis for analysis where as DNA- zero's in on precise data. MTDNA- mixes in the larger population and singles out the same similarities among that population on abroad scales.

Juror 49-2
Mitochondrial DNA – are outside nucleus, those traits passed by mother.

Juror 49-3
Mitochondrial DNA evidence is strands of DNA that create a broad spectrum of peoples bodies. But is not always specific to each individual.

Juror 49-4
Molecule samples taken – several people could have the same.

Juror 49-5
Its DNA found in all living cells.

Juror 49-6
{Blank}

Juror 49-7
MTDNA is not as well an identifier for evidence as nuclear is.

Juror 49-8
Not a clue.

Juror 50-1
I really don't know right now yet.

Juror 50-2
It is the DNA or material outside the nucleus, this is focuses on the sequence of the base pairs.

Juror 50-3
mtDNA evidence has to do with DNA that are located outside the nucleus of a cell. This type of DNA is passed down maternally, through the mother. mtDNA differs from nuclear DNA in that it cannot pinpoint one individual—it can only narrow down from every human to a very specific group. mtDNA seems to be the 2nd choice of DNA evidence to be presented-to be used only when there is not enough genetic material present to conduct nuclear DNA tests.

Juror 50-4
Mitochondrial DNA was found outside the nucleus in the cell. It has very specific sequences when sliced and although it can categorize people with similarities it can be specific with texture and color when analyzed. Although nuclear DNA is 99.9% accurate mtDNA can have a very high success rate with accuracy.

Juror 50-5
It is DNA from your mothers side only.

Juror 50-6
DNA that comes only from the maternal side.

Juror 50-7
The scientific analysis of cell structure to identify an individual person.

Juror 50-8
Another test that is used when nuclear DNA is not available.

Juror 51-1
DNA that is not extracted from the nucleus of the cell rather the surrounding area.
Can not positively identify one person since it is maternally inherited.

Juror 51-2
A type of DNA that can link many people together.

Juror 51-3
DNA that comes from the mother and is not specific to a person but can give an idea of whether a person can be excluded or not.

Juror 51-4
Confused.

Juror 51-5
Maternal in origin.
-Found in mitochondria > organelles found in cytoplasm of cells, not nucleus.
Not unique to every individual, as is Nuclear DNA.

Juror 51-6
Not the same . different parents.

Juror 51-7
To find a group that can match but not a definite match to one particular person.

Juror 51-8
Not sure.

Juror 51-1
A part of what they analyze in nuclear DNA. And can not be considered to be from another person.

Juror 52-2
It's the common DNA traits found in a particular group of individuals, carried from the mothers genes. Siblings of the same mother and same father can have same mtDNA traits, but also similar traits can be evident in those of the same race or gender.

Juror 52-3
Everyone has a base DNA that will match but everyone has a certain pattern that is to each individual, kinda like a fingerprint. But is not able to narrow it so precise considering all the evidence and this type of DNA it is possibly enough to convince a jury.

Juror 52-4
It is evidence gathered from other then the nuclear part of your DNA, and is not as exclusive as the other but still usable and viable.

Juror 52-5
Evidence that can slim down the number of possible suspects in the case.

Juror 52-6
Samples collected, in which they have the same cells from the mother.

Juror 52-7
General DNA from the population can not identify an individual.

Juror 52-8
It is not DNA obtained from the nucleus-doesn't give definitive match? Anyone on maternal side can have (or has) the same mtDNA.

Juror 53-1
MTDNA is the DNA that floats in the cellular fluid outside the nucleus. Nuclear DNA is more reliable because it is protected within the nucleus. Mitochondrial DNA is constantly paring up and breaking back down again allowing for heterpla□eteroplasmytions.

Juror 53-2
DNA not taken form nucleus (where nuclear DNA is taken)

- Cannot uniquely ID individual.
- Follows maternal line vs. both parents in nuclear.
- Short sequence to verify.
- MT can be used to exclude.

Juror 53-3
It is the testing of DNA in the mitochondria which is not the same as nuc. DNA.

Juror 53-4
MTDNA is based on maternal DNA only – and is categorized in groups of people only – not individual – making this less useful than molecular DNA.

Juror 53-5
600 base pairs, not in nucleus of cell but the perimeter of the nucleus.

Juror 53-6
Samples of DNA that do not include the nucleus of the cell. This is a DNA sequence that follows the mothers side.

Juror 53-7
MTDNA is the DNA which is not unique form person to person.

Juror 53-8
MTDNA is DNA that is outside the nucleus and therefore more ambiguous it covers a smaller strand and less conclusive.

Juror 54-1
2 base cells outside the nucleus.

Juror 54-2
Good grief.

Juror 54-3
It is the DNA taken from the mitochondria of a cell. It only comes from the mother and maternal side and does not show unique characteristics.

Juror 54-4
-strands/sequence passed down from mother only.
-cannot uniquely isolate or identify.
-can exclude.

Juror 54-5
Scientific evidence that can be used to identify an individual…reliable, but not 100% accurate like nuclear DNA.

Juror 54-6
The percentage of chance it was his hair.

Juror 54-7
The fact that this DNA identifies a broader spectrum of DNA then nuclear DNA.

Juror 54-8
To match 4 sets of samples to find exact strands if not rt is inconclusive.

Juror 55-1
This is a DNA that cannot initially identify a person. It can by the way identify biological parents and some traights that match the person.

Juror 55-2
Characteristics (genetic) passed down from the maternal side to their children.

Juror 55-3
Non-nuclear DNA matching, DNA which come from the mother, does not identify an individual (not exclusive to only one person) but eliminates in this case 99.98% of the Caucasion population.

Juror 55-4
Evidence from Mother – to Mother not from father and Mother.

Juror 55-5
Passed only by the mother.
Deals with the Cells.
Best passed on the population around where you are searching.
Deals with the likelihood.

Juror 55-6
It is th part around the nuncls the can link you to family.

Juror 55-7
One sequence of hair.

Juror 55-8
mtDNA evidence is passed down via the mother's genetics. It is not as precise as nuclear DNA. According to the FBI expert, there was only 1 occurance found in the FBIs database of 5171 examples. The evidence comes from outside of a cell's nucleus. It does appear that mtDNA is really useful in eliminating a person rather than convicting a person on DNA alone.

Juror 56-1
Is what is outside the nucleus of the cell this DNA is not as …as nuclear DNA. Unable to provide a direct match but is able to narrow down the search.

Juror 56-2
Evidence not taken from core samples (blood) but from areas around nucleus.

Juror 56-3
It is evidence that helps but is not 100% and that nuclear DNA is more important.

Juror 56-4
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Juror 56-5
mtDNA is a secondary type of DNA evidence. Although not as persuasive as nuclear DNA, mtDNA does show the ability to determine guilt or innocence when combined with other evidence.

Juror 56-6
mtDNA is genetic evidence that the defendants known sample (hair samples) matches the hairs examined from the robbery with a 99.98% exclusion of the general population (or 99.8 according to the defense).

Juror 56-7
The analyzement of cells outside the nucleus of the DNA.

Juror 56-8
I am not shure.

Juror 57-1
A better show of the DNA sample by PHD.

Juror 57-2
Generally identifies a family line.

Juror 57-3
It is not as conclusive as the nuclear test. There are a small percentage of people who could also match.

Juror 57-4
Matching of evidence between knowed and sample.

Juror 57-5
Mt DNA-gives general information with grouping and sequencing – not specific.

Juror 57-6
Counting hairs or a group of hairs.

Juror 57-7
This does not identify an individual, but narrows them into a certain group.

Juror 57-8
A molecule with Maternal Inheritence passed from mother only (no trace of father moledule).

Juror 58-1
mtDNA is the scanning of evidence for comparison to a database setup in Quantico, VA at the FBI crime labs. It is used to narrow down the field to a list of unlikely suspects vs. likely suspects. But only on a wide scale, not specific like regular DNA test.

Juror 58-2
Evidence that is not very conclusive. It can not identify one individual.

Juror 58-3
It is a DNA test done on strains of hairs to pinpoint #'s of people with that same DNA not just one person.

Juror 58-4
It's DNA pasted down threw the mother DNA only.

Juror 58-5
DNA evidence involves the nucleus of a cell which is unique to each person. Mitochondrial evidence pertains to the mitochondrial structures in a cell that are not in the nucleus. Mitochondria is subject to mutatuions, which brings conclusions drawn by it into question. The 5,000 person sample the FBI used to compare the mitochondrial to was significantly inadequate and not representative of the male Caucasian population.

Juror 58-6
Testing of general database. Not testing the exact match of the individual but the likelihood to be in a group that matches.

Juror 58-7
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Juror 58-8
It has some of the identifiers in the DNA but not all. It's not the best way to identify traits.

Juror 59-1
mtDNA refers to DNA extracted from cell mitochondria. Unlike nuclear DNA testing, mtDNA can only provide a match for those who have inherited the mtDNA maternally.

Juror 59-2
Mitochondrial DNA is DNA used to narrow down a group of people having the same or similar sequences of DNA. People in the same line of the mother could have the same mtDNA.

Juror 59-3
DNA sample extracted from the mitochondria of a cell, not the nucleus. It's able to somewhat identify a person not exactly identify a person like DNA from the nucleus.

Juror 59-4
Evidence that can use DNA testing to put the defendant in a class of people that will narrow the search but not pin point the person with their own DNA blue print.

Juror 59-5
Identify hair samples and matching results to defendants mtDNA.

Juror 59-6
DNA test that only narrow into groups.

Juror 59-7
mtDNA evidence is obtained when there is less than the desirable amount of evidence to obtain a DNA match of the nucleus of the cell such as saliva, hair roots, skin, etc.

Juror 59-8
Dna outside the nucleous. Can still be a good match.

Juror 60-1
Family of genes.

Juror 60-2
mtDNA is located outside of the nucleus. Provide a chemical reaction that gives off energy to the cell.

Juror 60-3
The DNA of the mitochondrial elements in a cell that are passed down maternally and carry DNA signatures not exclusive to one person but to one family with the same maternal ancestor.

Juror 60-4
Testing of human hair to identify DNA of individual, but not as "intense" as nuclear DNA.

Juror 60-5
A biological maker that is passed down on the maternal line. The technology is relatively new and not as precise as nuclear DNA testing-while matching of mtDNA sequence may be used to eliminate suspects, it may not be truly able to specifically fully implicate ot identify one person.

Juror 60-6
DNA found outside of the nucleus, not as concrete as DNA.

Juror 60-7
I am not sure.

Juror 60-8
Which particular DNA this is seen in a family tree.

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