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Science in the Jury Box: Jurors' Views and Understanding of Mitochondrial DNA Evidence

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Abstract

Policy makers, pundits, and scholars have all raised questions about how jurors understand and apply scientific evidence. In the current study, 480 jury pool members observed a mock trial that included expert testimony about mitochondrial DNA (mtDNA) evidence purportedly linking a defendant to a crime. As a group, the jurors showed moderately good command of the biological facts relating to mtDNA evidence, although some jurors made errors in defining mtDNA and in making inferences about its relevance to the trial. Comprehension was higher after jury deliberation and among jurors with more education. A minority of jurors expressed reservations about science, concern about the reliability of the mtDNA evidence, and suspicion that the mtDNA evidence was contaminated.

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Complex scientific evidence has become ubiquitous in both civil and criminal trials (Faigman et al., 2005-2006; Gross, 1991). In the words of one judge: "The demand for expert testimony by litigants has become insatiable" and "an astounding number of 'expert' consultants and professional witnesses in virtually every field of human endeavor have arrived on the scene" (*Loeffel Steel Products, Inc. v. Delta Brands, Inc.,* 2005:1106).

Yet, lawyers, litigants, and policy makers have voiced concerns about whether juries can comprehend and properly apply complex scientific or technical evidence (for reviews see Cheng, 2005; Diamond & Rose, 2005; Kaye, 2004). These concerns underlie a remarkable trilogy of Supreme Court cases and an amendment to the Federal Rules of Evidence limiting the evidence that juries may hear (*Daubert v. Merrell Dow Pharmaceuticals, Inc*., 1993; *General Electric v. Joiner*, 1997; *Kumho Tire Co. v. Carmichael*, 1999; Federal Rule of Evidence 702). Doubts about the capacities of lay jurors have even prompted the consideration of a "complexity exception" to the right to trial by jury in civil cases (*In re Japanese Electronic Products Antitrust Litigation*, 1980; Lempert, 1981-1982; Lilly, 2001). Lilly, for example, argues that a complexity exception "seems especially appropriate . . . when a forthcoming trial is likely to be protracted and involve difficult technical or scientific issues" (Lilly, 2001:80).

On the criminal justice side, prosecutors and journalists have offered the view that exposure to television shows like CSI have led jurors to become extraordinarily demanding in criminal cases, insisting on nearly infallible scientific evidence linking a defendant to a crime before they will convict (Podlas, 2006; Shelton, Kim & Barak, 2006; Schweitzer & Saks, 2007; Tyler, 2006). Empirical study of the CSI effect is in its infancy and the results are mixed. Schweitzer & Saks (2007), for instance, found that undergraduate students who watched CSI were more critical of forensic evidence than their nonviewer colleagues. In contrast, Podlas (2006) found no significant relationship between viewing CSI and treatment of forensic evidence. Shelton et al. (2006) surveyed jury pool members and found an inconsistent pattern of television viewing and expectations about forensic evidence, but pointed out that close to half of the summoned jurors expected that the prosecutor would offer some form of scientific evidence in every criminal case. The debates over jury competence and the conflicting data over the influence of popular culture indicate that on both practical and theoretical grounds, it is worthwhile to develop a robust understanding of the factors that influence juror expectations, comprehension, and use of scientific evidence.

Jury Comprehension of Scientific Evidence

Many research studies of actual juries conclude that their fact finding is basically sound, even in cases with complex evidence (Diamond, 2006; Kalven & Zeisel, 1966; Myers, 1979; Hans & Vidmar, 2004; Vidmar, 1998). Research shows, for example, that the strength of the evidence presented at trial is the prime determinant of the jury's verdict (Hannaford-Agor et al., 2002; Hans et al., 2003; Eisenberg et al., 2005; Myers, 1979; Visher, 1987). A number of studies have documented that trial judges who preside over criminal jury trials agree with the vast majority of jury verdicts (Hannaford et al., 2002; Kalven & Zeisel, 1966). The agreement rate with the jury's verdict is about the same whether the trial evidence is low or high in complexity (Heuer & Penrod, 1994; Kalven & Zeisel, 1966; Eisenberg et al., 2005). Taken together, this work suggests that whatever problems jurors might have with comprehending trial evidence are not severe enough to produce distinctly different outcomes from the assessments of ordinary judges across a range of cases.

Interviews with jurors and case studies produce more mixed impressions. Jurors themselves say that scientific, statistical, and technical expert evidence is challenging (Cecil, Hans & Wiggins, 1991). After questioning the jurors in a tort case involving toxicological and epidemiological evidence, Sanders concluded that the jury's deliberations did not reflect a full understanding of the case but that the defense lawyers' presentation and the judge's instructions to the jury may have been contributing factors (Sanders, 1998). From post-trial interviews with jurors who decided an asbestos case, Selvin and Picus (1987) likewise reported that jurors misunderstood some of the scientific evidence about the development of asbestosis. Lempert's (1993) review of 13 complex jury trials, a number of which included scientific and technical evidence, uncovered some mistakes in jury comprehension but observed that they were often traceable to problems in the attorneys' presentations of complex evidence or by jury instructions. He concluded that nonetheless juries usually reached defensible verdicts.

Experimental mock jury research also identifies areas of vulnerability in lay citizens' use of scientific evidence. Thompson and his colleagues have undertaken a series of experiments to determine how lay citizens use statistical and scientific evidence (Thompson & Schumann, 1987; Thompson, 1989; Kaasa, Peterson, Morris & Thompson, 2007). Participants in several of these studies have fallen prey to fallacious reasoning about statistical arguments (Thompson & Schumann, 1987; Thompson, 1989). Kaasa et al. (2007) discovered that although mock jurors as a group used statistics appropriately, giving differential weight in line with the diagnosticity of the forensic evidence, a subgroup of jurors who expressed concerns about their ability to handle statistical reasoning did not correctly differentiate between evidence that varied in diagnosticity.

The introduction of DNA as forensic evidence has spawned a number of experimental studies designed to examine how lay persons evaluate the presence of a match between DNA samples from a defendant and from a crime scene. In general, the research shows that study participants tend to give statistical information about the DNA match less weight than might be prescribed by probability theory (see, for example, Koehler, 2001; Nance & Morris, 2002, 2005; Schklar & Diamond, 1999). Schklar and Diamond's (1999) important study found that their participants were concerned about laboratory error and other problems with the forensic DNA samples. The authors pointed out that in evaluating juror competence against a probability model, one needed to take into account jurors' expectations and presumptions about the quality and integrity of DNA evidence, not simply its statistical power.

Thus, taken as a whole, the body of research suggests that juries are likely to be reasonably competent in handling scientific evidence, but that in some circumstances, particularly when statistics are presented, jurors may make systematic errors.

Citizens, Science and the Law

An inquiry into jurors' treatment of scientific evidence is important not only because of its practical and policy significance, but also because it has the potential to deepen theoretical understanding of how citizens rely on science within the distinctive context of legal decision making. Scientific evidence is typically presented by experts whose claims rest on broad assumptions about the legitimacy of the underlying science. Jasanoff (1995) writes that while scientific expertise is often seen as straightforward and autonomous, operating outside of the law, this is a simplistic view that ignores the institutional setting of a legal trial: “scientific claims, especially those that are implicated in legal controversies, are highly contested, contingent on particular localized circumstances, and freighted with buried presumptions about the social world in which they are deployed” (Jasanoff, 1995, p. xiv). The selection and preparation of expert witnesses and the adversarial setting within which they testify all shape the content and meaning of expert testimony about scientific evidence (Gross, 1991).

Confronted with science in the courtroom, jurors face two often competing sources of authority, science and law. Examining how jurors consider and assess scientific expert testimony can provide a window into citizens’ thinking about these domains of expertise. Systematic study of public attitudes toward science present an intriguing and complex picture. National survey data (National Science Board, 2004; 2006) indicate that most Americans hold very positive general views toward science and technology. Yet, they also reveal that a significant proportion of Americans expresses reservations about science and its potential for destructive social change. Furthermore, many Americans have poor understanding of scientific concepts (National Science Board, 2004). In these circumstances, one may well wonder how citizens with different background assumptions about the nature and potential of science evaluate scientific evidence in the contested domain of a legal dispute.

The current project explores questions about citizens and science through a mock jury study, employing a criminal trial with expert testimony on mitochondrial DNA (mtDNA) sequencing. The type of DNA testing typically used in crime investigations analyzes nuclear DNA (nDNA) coiled in the nuclei of most types of human cells (Adams, 2005; Kaye & Sensabaugh, 2000). Outside the nucleus is other DNA, contained in organelles known as mitochondria. Although the mitochondrial DNA sequence is about 200,000 times shorter than the nuclear DNA sequence, a human cell contains hundreds or thousands of mitochondria but only one nucleus. Consequently, when the number of cells in biological material recovered from a crime scene is insufficient for nDNA analysis to be performed, mtDNA sequencing is often feasible (U.S. Department of Justice, 2006). MtDNA sequencing can be conducted with DNA extracted from teeth, bones, and even a few strands of human hair. MtDNA is passed through the maternal line, and all individuals in this line of descent have the same mtDNA sequence. Because of its shorter sequence and its maternal lineage, mtDNA is less individualizing than is nDNA. Nonetheless, it has proved useful in forensic identification, and mtDNA evidence has been presented in many American courts (Faigman et al., 2005-2006).

The study was designed to ascertain whether members of a jury pool were able to understand this evidence, and how they used it in deliberations and in decision making in a mock jury trial. Findings from the research study are used in the present article to explore the dimensions of juror understanding about biological science in the context of a criminal case and to examine what shapes lay judgments of science in the courtroom. The study also tested the impact of a variety of jury innovations on the decision making of mock jurors. Those results have been presented elsewhere and are not considered in this article.

MtDNA evidence is well suited to investigating the theoretical and policy questions raised in this article. One attraction of using mtDNA evidence was that, at the time of the experimental study, it constituted a novel form of scientific evidence that had not been used extensively in the courtroom (Cheng, 2005). In fact, most of our study participants said they had not previously heard about mtDNA. Thus, a case using mtDNA as forensic evidence provided an opportunity to observe how jurors confront a new scientific topic presented in an adversarial context. The biological underpinnings of mtDNA are complex and thus provide a good vehicle for assessing how jurors from a wide range of backgrounds handle the complex expert testimony. Furthermore it offers a concrete setting in which to examine the impact of both positive and negative attitudes toward science.

An interesting aspect of mtDNA is that it bears some relationship to the more widely known nuclear DNA. The relationship between mtDNA and nDNA evidence could potentially assist jurors by providing a familiar framework for the understanding of a new scientific concept. However, the relationship to nDNA could also make evidence evaluation more challenging by introducing a source of confusion. The likely pre-existing belief of lay jurors is that DNA permits precise identification of individuals. The full sequence of the three billion or so base pairs of DNA encapsulated in the nucleus of a human cell is unique to each individual (with the exception of identical twins). Even though very little of the full genome is analyzed in forensic testing, the number of sites of variation that can be analyzed in an ordinary case are sufficient to distinguish among virtually everyone other than identical twins. However, mtDNA is not unique, and the existing tests of nDNA are more powerful for individualization than is mtDNA sequencing. Do jurors appreciate this difference, or do they think mtDNA evidence is as revealing as nDNA evidence? How is its reliability calibrated? Or do jurors simply dismiss mtDNA evidence as unreliable, since it is not as informative as nDNA?

Method

Participants

A total of 480 jurors, 60 mock juries of eight persons, participated in the study. The participants were drawn from Wilmington, Delaware, residents who appeared at the New Castle County Courthouse in response to summonses for jury duty from October 14 through December 16, 2003. Potential jurors volunteered to participate in the study if they were not needed to serve on a regular jury.

After jury pool members received their usual orientation from the court, one of the researchers addressed the jury pool, describing the research project and the chance for individuals from the jury venire to participate in the study if they were not needed for jury duty. The purpose of the study, the approximate time commitment, the fact that the jurors 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 $50 as remuneration were all described. During the subsequent roll call, a jury-office staff member typically 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. On four separate days, the volunteer rate, calculated as the proportion of volunteers to the total number of jurors present, was an average of 74%, ranging from a low of 64% to a high of 97%.When it was clear that no more jurors or only a small number would be needed for actual trials, court staff randomly selected a set of jurors from their master list of the remaining jurors who had previously volunteered for the mock jury study. Typically, there were at least sixteen volunteers, enough for two eight-person mock juries.

Demographic Characteristics. The demographic characteristics of the mock jurors and the pool of jurors who reported for jury duty during the period of our study were comparable. A total of 3,381 jurors reported for jury duty during that time period. We compared the gender, race, and age proportions in the mock jury sample and in the full pool of people reporting for jury duty. Women comprised 53% of the pool and 52% of the sample; whites were 77% of the pool and 79% of the sample. Likewise, the representation of specific age ranges for the two samples were all within one to two percentage points of each other.

Reported educational attainment was somewhat different in the two groups. However, the differences at the lowest and highest education levels were modest, and the other reported education differences were most likely due to the fact that the court's jury pool questionnaire and our study questionnaire differed in the options provided. (The research project questionnaire included the "some college" option but the jury pool questionnaire did not.) Five percent of the jury pool and 2% of the mock jury sample said they had less than a high school degree; 49% of the jury pool reported a high school degree whereas 55% of the mock jurors said they were either a high school graduate or had some college courses; 33% of the jury pool and 29% of the mock jurors had college degrees; and 12% of the jury pool and 14% of the mock jurors had post-graduate education. In any event, a good range of educational backgrounds was represented.

In sum, the mock jury sample constituted a reasonably close reflection of the jury pool in New Castle County, Delaware. Like the jury pool, it was predominantly white, about half female, and included a variety of educational backgrounds and ages.

Jurors' Background in Science. Most mock jurors had at least some high school courses in science and mathematics. They reported an average of 10 mathematics and science courses in high school and college, with a mode of 4 courses. The range was relatively wide, stretching from zero to 48 courses.

A substantial proportion (196, or 43%) of the mock jurors reported some job experience related to mathematics or science. Of these, 77 said that the experience was moderate or substantial. The relevant job experience included the following: insurance-risk management work, chemistry, biotechnology, electrical engineering, science and mathematics teaching, dirt-grade calculations and ground-water contamination studies, medical technology, new drug testing, cardiac surgery, research science at a large research organization, computer programming, nursing, and laboratory technology for research and development of monoclonal antibodies. In sum, most jurors had taken at least some mathematics and science courses in high school or college and about a fifth of the sample had substantial mathematics or science experience on the job.

Procedure

After a group of jurors had been assembled, the participants were taken to conference rooms in the courthouse equipped for displaying a videotaped mock trial and for recording their deliberations. Here, the jurors completed an initial questionnaire asking for individual 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.” Jurors also responded to 7 items taken from the National Science Board (2004; 2006) to measure attitudes toward science. Four items aimed to assess the promise of science, while three items measured reservations about science. (Table 1 provides the items.) These items used a 4-point scale ranging from strongly agree to strongly disagree.

The videotaped trial was then played for the jury, and jurors completed a second questionnaire that asked for initial reactions to the trial and mtDNA evidence. The researcher then provided each jury with a Jury Verdict form, instructed the jury to select a foreperson or presiding juror, turned on the video camera to record the group discussion, and left the room to await the completion of the jury’s deliberation. 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. Following completion of the final questionnaire, the mock jurors were debriefed and received payment.

The videotapes of 57 of the 60 group deliberations were transcribed, and the software program Atlas.ti was used to examine mock juror deliberations qualitatively. Videotapes of the remaining three deliberations were defective and could not be transcribed.

Materials: The State v. Jones Mock Trial

The mock trial was based on *State v. Pappas* (2001), the first appeal in Connecticut from a successful prosecution relying on mtDNA evidence. We adapted material from the trial transcript and the reported decision of the Connecticut Supreme Court upholding both the admission of the mtDNA evidence and the defendant's conviction. However, as described below, some evidentiary details were modified for the purposes of our research. The mock trial, filmed in a courtroom, 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 legal instructions by the judge. An actual judge and practicing attorneys played those roles; the experts were a law professor specializing in forensic use of DNA and a biology professor. Other roles were played by actors.

The mock trial pertained to an armed robbery of a bank by a lone, masked gunman who fled from the bank, pursued by local police. The police found the robber's discarded blue sweatshirt and stolen currency. Laboratory examination of the sweatshirt revealed two human head hairs in the hood. An anonymous call directed the police to the defendant, Kevin Jones. 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 trial, the jury heard only from the prosecution's expert witness regarding the mtDNA evidence; the defendant did not present an expert.

We modified the nonscientific factual evidence so that it was more ambiguous, making the mtDNA evidence more crucial to the jury's decision. We also modified the prosecution's expert witness testimony and added testimony from a defense expert who disputed the prosecution expert on several points. PowerPoint slides developed by the FBI were adapted for use by the prosecution expert witness; and we produced additional slides for the defense expert witness. The prosecution and defense expert slides were shown in the videotape during the experts' testimony.

Results

Jurors' Attitudes toward Science

The initial questionnaire administered to jurors in the study included the seven National Science Board (2004; 2006) items tapping attitudes toward science (four on the promise of science, and three on reservations about science). As described earlier, the national survey data indicated that most Americans hold very positive general views toward science and technology. The same held true for our mock jury sample, as shown in Table 1. For instance, in 2004, 91% of a national sample agreed that "[s]cience and technology are making our lives healthier, easier, and more comfortable." A comparable 95% of our mock jurors agreed with that statement. Similarly, 86% of a 2004 national sample and 82% of the mock jurors agreed with the statement that "[b]ecause of science and technology, there will be more opportunities for the next generation."

-- Table 1 --

The National Science Board data (2004; 2006) also revealed that a significant proportion of Americans have reservations about science. That was also true of our sample. Thirty-three percent of the 2004 national sample, for instance, agreed that "[s]cience makes our way of life change too fast," compared to 30% of our mock jurors. In the 2004 national sample, 56% agreed that "[w]e depend too much on science and not enough on faith," compared to 40% of our sample.

Jurors' responses to the four items dealing with the promise of science were recoded as necessary and combined to form an "Index of Scientific Promise" (*M* = 3.03; *SE* = .02; Cronbach's ά = .58). Higher numbers on the index indicate greater belief in the promise and potential of science. The other three items, dealing with negative views about science, were combined into an "Index of Scientific Reservation" (*M* = 2.20; *SE* = .02; Cronbach's ά = .49). Higher scores on this index reflect greater concerns about the negative aspects and dangers of science. While the alpha values are not as high as we would desire, it should be noted that the items derive from a national research project and the indices use a small number of items. Although, on their face, the Promise and Reservation indices seem to represent two distinct constructs, they show a slight negative correlation ($r(478) = -.11$, $p < .05$).

Two multiple regression analyses of jurors' demographic characteristics as the predictor variables and the index scores as the dependent variables showed divergent results for the two indices. Scores on the Index of Scientific Promise did not vary significantly by education level, gender, race, age, total mathematics and science courses, or political orientation ($F < 1$, *ns*). However, the Index of Scientific Reservation varied across some demographic groups. A multiple regression analysis using the Index of Scientific Reservation as the dependent variable and education level, gender, race, age, total mathematics and science courses, and political views as independent variables showed that education level ($\beta = -.14$, $p = .01$), race (white/nonwhite) ($\beta = .16$, $p = .001$), age ($\beta = .09$, $p = .05$), mathematics and science courses ($\beta = -.12$, p = .03), and political identification ($\beta = .11$, $p = .02$) contributed to reservations about science (F (6, 434) = 8.65, $p < .0001$; total $R^2 = .11$). Older participants, nonwhite participants, participants with lower levels of education, and those with more politically conservative leanings are more likely to possess reservations toward science and technology.

In sum, the jurors' views about science were quite similar to those reported in national surveys, with widespread positive views about the benefits of science along with a significant minority who expressed concerns about science. Participants' age, race, education, and political conservatism were all related to concerns about the negative impact of science.

Initial Views about the Reliability of DNA Evidence

Before hearing the evidence in the mock trial, participants judged the reliability of DNA evidence to be the highest of all general categories of evidence provided to them. Figure 1 presents juror rankings of evidence reliability in greater detail.

-- Figure 1 --

Fully 64% of the mock jurors rated DNA evidence as extremely reliable. By way of comparison, expert testimony was identified as extremely reliable by only 14% of the jurors, 8% saw police testimony as extremely reliable; and 6% rated victims' testimony as extremely reliable. Just 5% of jurors described eyewitness testimony as extremely reliable. Thus, prior to hearing specific testimony about mtDNA evidence, they judged DNA evidence as a general category of evidence to be much more reliable than any of the other forms of evidence.

Comprehension of the Testimony on the Biology of mtDNA

A number of questions probed jurors' comprehension of the mtDNA evidence. After listening to the expert presentations about mtDNA within the mock trial context, 40% said that it was easy to follow the presentation. Fully 47% said they understood the mtDNA evidence well or very well after hearing about it. About half of those jurors who said that they were having trouble following some of the testimony specifically mentioned the mtDNA evidence as difficult. Not surprisingly, those with more formal education were more likely to say they understood the mtDNA evidence ($r(476) = .21$, $p < .001$); the same is true of jurors with more mathematics and science courses ($r(450) = .33$, $p < .001$).

To examine the jurors' actual comprehension, we asked them to write a definition of mitochondrial DNA evidence after they listened to the mock trial but before they deliberated. The question asked, "[i]n your own words, what is mitochondrial DNA (mtDNA) evidence?" A coding system was developed to reflect the substance, completeness, and accuracy of these written definitions. The content of the definitions was coded for the presence of statements falling into different substantive categories. To obtain a measure of the reliability of the content codes, half of all of the definitions were coded for content by two raters. The level of agreement between the raters was 83%.

-- Figure 2 --

Figure 2 shows the frequency of content included in the definitions that jurors generated. The most common information jurors included in their definitions, mentioned by 38% of all jurors, was the fact that mtDNA is not unique to an individual. This is an important issue discussed without any disagreement by all the experts and the attorneys in the mock trial. Second most frequent, noted by 34% of jurors, was the maternal inheritance of mtDNA, another undisputed and emphasized point. Twenty-nine percent of the jurors provided other basic biological information about mtDNA (for example, that mitochondria are found outside the cell nucleus). About a fifth of the jurors made 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, were mentioned by relatively few study participants. Just 2% mentioned heteroplasmy, which occurs when some of a person's mtDNA has one sequence, while other mtDNA molecules in the same individual have a different sequence. Although the prosecution expert only touched on the subject, heteroplasmy was a major focus of the defense expert testimony and an issue used to try to undermine the prosecution expert's conclusions about the statistical match.

We counted all correct and all incorrect statements and subtracted wrong from right to generate a net accuracy score. The resulting scores ranged from -1 to +3. To assess the reliability of the accuracy coding, half of all of the definitions were coded for accuracy by two raters. The level of agreement between the raters was 72%. One of the study authors, a legal expert with knowledge of the science underlying mtDNA analysis, also coded each of the participants' definitions for the presence of accurate statements about mtDNA. These "expert" ratings were highly correlated with the other accuracy measures ($r(480) = .79$, $p < .0001$, for the number of correct statements, and $r(480) = .68$, $p < .0001$, for the net accuracy score).

Looking at the correct and incorrect statements in the mtDNA definitions, we find that 82% of the participants made at least one correct statement about mtDNA. Conversely, about one out of every five jurors (19%) made one or more errors in defining mtDNA. The average net accuracy, that is, the number of accurate statements minus the number of inaccurate statements, was 1.42. The accuracy of jurors' mtDNA definitions was linked to jurors' age ($\beta = -.09$, $p = .04$), gender ($\beta = .19$, $p < .0001$), race ($\beta = -.13$, p

= .002), education level (β = .24, $p < .0001$), and total number of mathematics and science courses (β = .22, $p < .0001$) (F (6, 435) = 24.51, $p < .0001$; total $R^2 = .25$). Younger jurors, women, whites, those with more formal education, and those with more mathematics and science courses were more accurate, on average. Definitional accuracy was unrelated to political orientation.

After providing their open-ended definitions of mtDNA, jurors answered factual questions about aspects of mtDNA evidence covered by the prosecution and defense expert witnesses. In addition, they responded to the prosecutor's and the defense attorney's adversarial claims about the meaning and relevance of the mtDNA evidence. Mock jurors could respond "true," "false," or "don't know" to these questions. Questions about mtDNA were asked both before and after the jury deliberation, offering an opportunity to determine whether and how group discussion affected juror comprehension of mtDNA.

-- Table 2 --

Table 2 gives the percentage of correct responses to the factual specific-knowledge questions. As Table 2 shows, in response to basic mtDNA knowledge questions, jurors usually gave a solid majority of correct responses. Eighty-nine percent of the mock jurors, for example, were able to respond correctly to the basic question, "[d]o 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 noted the superiority of nDNA testing, and it was obviously communicated well to the mock jurors. Even before deliberation, 89% were able to correctly identify nuclear DNA as the better source; just 3% said mtDNA is better; and the remainder either said they are the same or that they did not know. The numbers were virtually the same after deliberation, with 89% again correctly identifying nDNA as superior.

Examinations of juror deliberations lend support to these quantitative findings. Throughout the deliberation process many jurors mentioned and discussed the superiority of nuclear DNA in comparison to mitochondrial DNA. For jurors, nuclear DNA's reliability and precision gave it the edge, reasonably so. The following juror comments illustrate this phenomenon:

> J6-1: Most of those cases that were, uh, refuted on the DNA were a while back before the new technologies. Nuclear DNA is almost totally completely acceptable now. The mitochondrial isn't, and that was the DNA in this case. I mean nuclear DNA just brings it to the individual, you're unique, you're one into something like three hundred trillion. More people than have ever lived.
>
> J2-91: I don't know nothing about it, but I trusted the-, the-, the nuclear DNA (J2-4: Oh sure.) I mean I trust that a lot more than I trust the other one.
>
> J37-2: Because they said if they had the nuclear, if they had enough hairs they would be able to do nuclear DNA test, which is actually more reliable than the other.
>
> J45-7: The nuclear DNA, it's more exact, but this is not nuclear -- this is mitochondrial.

Well over half of the mock jurors knew, after hearing the experts and before deliberation, 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. There was also good understanding of the maternal lineage of mtDNA and the implications of maternal inheritance. This issue was discussed by both experts and by both lawyers.

We purposefully included in the defendant's testimony a reference to a half-brother who lived in the area and who had the same father but not the same mother. This half-brother was a "red herring." Not being in the same maternal line, he would not be expected to share the defendant's mtDNA sequence. Both experts talked about the maternal inheritance of mtDNA, but they were not questioned about and did not discuss the exclusion of the half-brother. Likewise, neither attorney mentioned 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.

The reference to the half-brother, however, did not confuse the jurors. Even before deliberation, most people (84%) correctly noted that mtDNA does not come from both mother and father, and after deliberation that proportion rose to 89%. Fully 90% correctly rejected 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.

Systematic analysis of the mock jury deliberations showed that all but three mock juries made direct mention of the half-brother. Most of these were accompanied by discussions of the fact that half-brother was outside of the defendant's maternal lineage. For instance, one juror (J21-8) explained to the group that "[s]ee, I eliminated the brother because they don't have the same mother." In another jury, one juror (J52-3) simply stated, "[w]ell, his brother's out of the question because he wasn't maternal." These analyses were readily accepted as correct. Other statements illustrate the jurors' approach:

> J18-3: Well, forgive me and correct me if I'm wrong, maybe one of you guys took more biology than I did. When I see the one slide, it tells me that everybody, that's his sibling, or cousin (J18-2: From his mother.)

> (J18-4: From his mother.) from his-, on his mother's side so the half-brother nonsense (J18-2: Is no good.) is a red herring [Several jurors say 'yeah,' 'right'] because it came from his [several jurors say "father's side"] paternal side. (J18-6: It's from his grandmother, great-grandmother, great-great-grandmother.)
>
> J19-4: I think one of the things was they tried to throw in there that he had a half brother that could be somewhere in this mix and he is in jail. The only thing is, then they say, how are you related to this guy? And it's like, he's my father's son. It's like, wait a minute it's all maternal and we know that.
>
> J38-4: His half brother was the father's child, and it goes through the mother.

Another question probed the juror's recall of the nature of heteroplasmy, an unfamiliar and intimidating term for the phenomenon of differences in mtDNA sequences in different mitochondria from the same individual. As one might expect, jurors did less well on this recall task; yet, about two-thirds of them were able to identify as correct a basic definition of heteroplasmy.

Of course, in most cases with expert testimony jurors must do more than recall uncontested facts and draw simple inferences from them. They must choose between competing claims and analyses. To test the jurors' performance in this task, we included certain differences in the presentations of each side and asked the jurors to resolve them.

One of the more complicated issues presented by the mtDNA experts, and a major focus of the defense expert, was 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 (Melton, 2004). The FBI analyst ignored heteroplasmy when he testified that only 1 in 5,072 Caucasian men have mtDNA types that match that of hairs from the sweatshirt. The prosecutor claimed, in his closing argument, that heteroplasmy is irrelevant because the defendant himself was not shown to be heteroplasmic. However, as the defense expert noted, whether the defendant is heteroplasmic is beside the point -- one must still consider the possibility of heteroplasmy in calculating the probability of a match. Because the FBI does not count a difference at a single base pair as an exclusion, the random-match probability is affected by the number of near matches as well as the number of exact matches.

About two-thirds of jurors, responding after deliberation, correctly asserted it was still necessary to consider heteroplasmy even though the defendant is not heteroplasmic. This finding would support the contention that jurors appreciated the fact that heteroplasmy needed to be considered in their assessment of the mtDNA evidence. However, examination of jury deliberations revealed greater variability in the jurors' command of the concept of heteroplasmy. Deliberation analysis revealed that jurors recognized the importance of heteroplamsy, but sometimes discounted its value by incorrectly concluding that because the defendant and the sample found in the sweatshirt were not heteroplasmic, the disagreement between the two experts was not a significant issue in deciding the guilt or innocence of the defendant. The following quotations illustrate jurors debating the issue of heteroplasmy:

> J1-6: Yeah, but what she talked about was heteroplasmy, which did not really have anything to do with this case (J1-2 Right.) because in this case neither of the sample in the sweatshirt or the kid's sample. So what she was really doing was talking about that fact that there could be in a sample 57 others with one change. (J1-1: in the area.) That's where my question was; it didn't sound to me like it even applied in this case, and so-.
>
> J9-2: But the ones that didn't have the exact match, they-, [J9-2 looks at notes] they blamed it on whatever this hemoglobin or something that can be-, (J9-3: heteroplasmy.) which they said he didn't have. (J9-3: Right.) He didn't have that, they acknowledged that.

> J10-3: Which is why the mitochondrial DNA it narrows the population to a manageable number. (J10-6: Right.) You can't analyze everybody in the whole town, but you can analyze 57 people and the likelihood there. And then, um, the fact that it comes through the mother. If it's heteroplasmic, then that's all out the window because it could be someone else's mother, but he doesn't have any siblings or male siblings that, uh, who have the same mother as he does. Therefore he is the one, he's it, there isn't anybody else.
>
> J14-5: Yeah, it kind of washes away a lot of the defense case, you know, (J14-7: Right.) when he was not heteroplasmy.
>
> J23-8: Now even with the two expert witnesses, they both, I didn't hear them, one of them, say anything about the nuclear DNA. But they were both agreed that he didn't have the heteroplasmy [struggles to pronounce], or whatever. And that it was an exact match, of the, I think he said they looked at eight bands of all the mtDNA. So, if eight of them matched, I don't, she was saying that the other um, [pause] that you couldn't exclude people who that only had one difference. Because of the heteroplasmy. She admitted that he does not have that. So with him not having that, to me I can exclude those. Which leads me back to the 99.98% that it was from him.

Thus some jurors appeared to go along with – or at least find worth mentioning -- the prosecutor's incorrect claim about the irrelevance of heteroplasmy in the case.

Predictors of Good Comprehension of the Biology of mtDNA

Our data provide some insights into the factors that are related to better comprehension of the scientific evidence. To examine more systematically the associations between comprehension of the science and other factors, we combined the eight factual knowledge items about mtDNA found in Table 2 to develop an overall measure of juror comprehension. 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 therefore could range from 0 (no correct answers) to 8 (all correct answers).

-- Figure 3 --

Figure 3 shows how the juror's educational level and the opportunity to participate in jury deliberation relate to performance on the Juror Comprehension Scale. Before deliberation, the average Juror Comprehension score was 5.6 (*SD* = 1.69). Before deliberation, three people in our study provided no correct answers; 62 people answered all eight questions correctly. After deliberation, the Juror Comprehension scale scores increased slightly to 5.8 questions correct (*SD* = 1.59), with similar numbers getting none and all the items correct. 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 found both deliberation and juror education significantly improved juror comprehension. Deliberation $F(1, 474) = 7.72$, $p = .006$; Education $F(1, 474) = 20.37$, $p < .001$. A juror's educational attainment had the stronger effect. Not surprisingly, as formal education rose, so did the comprehension scores.

Likewise, people who reported a larger number of science and mathematics courses in high school and college had higher Juror Comprehension scores even when the juror's overall education level was taken into account (Science and Mathematics Courses $F(1, 450) = 33.30$, $p < .001$). Mock jurors who said they had job experience in mathematics or science also performed better in a repeated measures analysis, controlling for overall education level ($F(1, 475) = 8.27$, $p = .004$), but once the juror's number of mathematics and science courses was entered as a covariate, the job experience was no longer statistically significant.

To explore the potential links between Juror Comprehension scores and other demographic and attitudinal factors, including views about science, we performed a regression analysis that used the Juror Comprehension score as the dependent variable and the Index of Scientific Promise scores, Index of Scientific Reservation scores, educational level, age, gender, race, number of mathematics and science courses, and political orientation as predictor variables. To simplify the analysis we used pre-deliberation Juror Comprehension scores. (Similar results were found in an analysis using post-deliberation scores). This additional analysis confirmed the association with the juror's education level ($\beta = .16$, $p = .002$), race ($\beta = -.18$, $p < .0001$), and number of mathematics and science courses ($\beta = .17$, $p = .001$), but also showed a significant role for science attitudes measured by the Index of Scientific Reservation ($\beta = -.23$, $p < .0001$); ($F (8, 431) = 17.95$, $p < .0001$; total $R^2 = .25$). The more concerns people expressed about science, the worse they tended to do on the mtDNA comprehension questions. Yet, the Index of Scientific Promise showed no significant association with Juror Comprehension; nor did the juror's gender, age, or political views.

Concerns about Laboratory Error and Contamination of mtDNA

The prosecution expert in *State v. Jones* stated that because of the laboratory procedures for isolating and replicating mtDNA, contamination was a potential issue, and he outlined the steps taken to avoid and detect any possible contamination in the laboratory. Although the defense expert observed, as did the prosecution expert, that mtDNA is not as discriminating an identifier as nDNA, she did not raise the possibility of laboratory error. Thus, contamination was not an issue seriously debated by the opposing experts. Nevertheless, purposeful or accidental contamination of nDNA 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 mtDNA.

We examined jurors' judgments of the general reliability of the mtDNA evidence and beliefs about the likelihood of its contamination in the present case. (To avoid alerting participants to reliability and contamination issues, we asked these questions after deliberation.) More than one-fourth (28%) of the study participants saw the mtDNA evidence as "not at all" or only "slightly" reliable. Another 37% thought it was "somewhat" reliable. The remaining 35% asserted that it was "very" or "extremely" reliable. In contrast, it will be recalled that initially 64% of the participants identified "DNA evidence" as extremely reliable. Mitochondrial DNA evidence, at least that offered in *State v. Jones*, is a poor cousin.

We also asked "[h]ow likely is it that the mtDNA evidence was contaminated in this case?" Three-quarters of the study participants reported that the likelihood of contamination of the mtDNA evidence presented in the trial was "not at all likely" or only "slightly likely." Nineteen percent of the jurors rated contamination as "somewhat likely," and another 5% said that contamination was "very likely" or "extremely likely." Analysis of the mock jury deliberations converged with the majority view that contamination was not a problem. The topic rarely entered into group discussions. When it was brought up, it was not often characterized as a serious concern in jurors' evaluation of the evidence.

Among the small number of specific comments about the issue of contamination during deliberations, several were statements that contamination was not a significant area of concern when evaluating the scientific evidence. The following four mock juror statements represent the various ways jurors voiced this perspective:

> J16-7: Actually all DNA is prone to contamination because … you're touching the evidence, but what they're saying … that's why he went to great lengths to tell you that … there is no way this sample was contaminated. You know, because they went and cleaned it, and washed it, and things like that.
>
> J25-4: …And it seems to me when they had all those-, the FBI had a lot of controls in place, I don't think there's any type of risk. I mean there's always risk, but I don't think that they really even questioned it [mtDNA] too much from the defense perspective that there was a contamination issue ... .
>
> J31-7: Yeah …she [defense expert witness] agreed that it wasn't contaminated.
>
> J53-4: Well, they said that they tested the solutions and everything to make sure there is no other DNA contamination.

The following two statements constitute the rare examples of a mock juror addressing a real concern for contamination. Yet, it seems that the juror's contamination concerns are associated with its characterization as a new technology and not any specific problems with the police or the laboratory:

> J16-6: It's [mtDNA] more prone to contamination.
>
> J46-5: I've got something that no one else talked about today. The statistic that was brought up about this type of DNA testing that it's not very accurate because it's very susceptible to contamination. Okay, we didn't talk about that at all, if we're hanging our hat on this smoking gun, it's so new they're not even using it that much because it's unpredict-, or unreliable.

The last comment reflects twin worries and perhaps the intermingling of ideas about mtDNA's contamination likelihood as well as its diagnosticity. The greater concern appears to be not so much doubts about laboratory or police procedures but about the lower discriminating power of mtDNA evidence. Examination of juror deliberations supports this contention, with many jurors voicing concern about the discriminatory power of mtDNA. The following quotations illustrate the concern many jurors expressed about the discriminatory power of mtDNA:

> J11-3: Nuclear can be 100% conclusive, but mtDNA is not. It's not unique to an individual; it's unique to a group, where nuclear is unique to an individual. So you can't tell me conclusively that it was his hair. It might very likely have been his hair, but you can't say to me conclusively it was.
>
> J15-2: It narrows it down to a group of people. We're not interested in a group; we are interested in one person.
>
> J26-8: I think it's inconclusive. For me, it was that you don't do the nuclear DNA, which is the [one word inaudible] form of the testing that you always hear about DNA evidence in trials as a positive ID, that's more um telling, but this other one [one or two words inaudible]. That's why it's a reasonable doubt.
>
> Juror 59-1: If they could show to me that they had refined the protocol and that their database was ready to go into court. 5,000 is a real small sample, tiny sample. If they had said "we compared his mtDNA to a database of 10 million people" and it still came up, you know, he only matches .2, that to me is, wooh, that's really close, you know, but 5,000, really small. Take into account heteroplasmy [and the] window gets bigger; take into account the fact that you know that, I just don't like their, I don't like the protocol. I don't like evidence the way they presented it.

Although these jurors focus on the limitation of mtDNA's discriminatory power when compared to nDNA, many jurors still recognized and valued mtDNA's ability to narrow the pool of potential suspects:

> J11-2: It narrows it down (J11-8: It narrows it down.) to 57 people instead of the five thousand people living in Middletown.

> J16-5: I thought the DNA evidence was very overwhelming, and maybe it didn't pinpoint him, but it certainly narrowed him to a real select pool of people. ... Right, I still see the DNA evidence as very valuable because it puts him in a very, very small pool of people that could have done it.
>
> J5-1: There's 57 people that fit the DNA profile, not the whole profile.

To examine demographic and attitudinal variables associated with worries about reliability and contamination, several analyses were conducted. First, simple correlations with the reliability question showed significant relationships with the juror's educational level ($r(478) = .15$, $p = .001$); total number of science and mathematics classes ($r(452) = .11$, $p = .02$), and race ($r(468) = -.17$; $p < .0001$. White jurors, those with more education, and those with more science and mathematics courses saw mtDNA as more reliable. These three variables were also linked to perceptions of contamination: the juror's educational level ($r(479) = -.18$, $p < .0001$); the juror's total number of science and mathematics classes ($r(453) = -.18$, $p < .0001$), and the juror's race ($r(477) = .20$; $p < .0001$. White jurors, those with more education, and those with more science and mathematics courses saw mtDNA as less likely to be contaminated. Furthermore, jurors who had more reservations about science, as measured by the Science Reservations index, were more likely to suspect contamination, $r(459) = .15$, $p = .001$.

Two separate regression analyses compared the relative impact of these attitudinal and demographic factors on reliability and contamination perceptions. The first used juror perceptions of mtDNA reliability as the dependent variable. It showed that that the juror's race ($\beta = -.11$, p = .004) and education level ($\beta = .12$, p = .04) had significant predictive power (F (8, 430) = 3.31, $p = .001$; total $R^2 = .06$). Jurors with higher levels of education were significantly more likely to report higher levels of mtDNA reliability than jurors with lower levels of education. In addition, white jurors were more likely to see mtDNA as reliable compared to nonwhite jurors. The factors of juror's age, gender, number of mathematics and science courses, political views, and attitudes towards science (Scientific Promise and Scientific Reservation) possessed no significant predictive power in the regression equation. In addition, note the modest R^2.

A similar regression analysis on juror perceptions of mtDNA contamination found that race ($\beta = .16$, $p = .002$) was the sole significant predictor of jurors' perceptions of mtDNA contamination likelihood (F (8, 431) = 4.86, $p < .0001$; total $R^2 = .08$). Although the majority of jurors of all racial groups believed contamination was not a problem, nonwhite jurors were more likely to say they had concerns about mtDNA contamination than white jurors. Age, gender, education level, the number of mathematics and science courses, political views, and attitudes towards science (Scientific Promise and Scientific Reservation) possessed no significant predictive power.

What is Associated with Better Comprehension?

Our data provide some insights into the case perceptions associated with better comprehension of the scientific evidence in the case. One notable finding is that jurors who exhibited better overall understanding of the mtDNA evidence tended to have higher estimated probabilities of guilt. Jurors who did better in defining mtDNA evidence in their own words and in responding to the factual questions about mtDNA judged the probability that the defendant is the robber to be higher. For instance, those whose definitions contained no correct statements about mtDNA on average rated the probability that the defendant is the robber at 55%, while those who included two or more correct statements in their mtDNA definitions rated the probability at 74%. The relationship between the mtDNA definition accuracy and probability judgments was statistically significant (F (4, 479) = 5.30, p = .001). In line with these findings, there was also a significant positive relationship between scores on the 8-item Juror Comprehension scale (r(480) = .27, p = .001) and the perceived probability of the defendant's guilt (Pre-Deliberation Measures). The better the understanding of mtDNA, the higher the probability judgment. These different probabilities translated into different initial verdicts. Jurors who voted guilty initially had average comprehension scores of 5.94, significantly higher than the jurors who voted not guilty or who were unsure (5.42 and 5.20 respectively; Jury Comprehension by Verdict F(2, 476) = 8.34, p < .0001).

This correlation between scientific comprehension and perceived probability of guilt suggests that those jurors who understood the scientific evidence better were more impressed with it and, hence, more persuaded by the prosecution's case. Other interpretations, however, are possible. Perhaps jurors who understood the scientific evidence more fully also appreciated the impact of the other evidence of guilt. Or, it could be that better educated jurors generally tend to favor the prosecution or prosecution witnesses in criminal cases.

Discussion

This study supports the view that many lay juries are basically competent in handling the biological elements in expert evidence about mtDNA. The study participants generally reported feeling comfortable with the scientific presentation of mitochondrial DNA in the mock trial, and they did fairly well on the comprehension tests given both before and after deliberation. 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. The vast majority of the jurors appreciated the scientific fact that mtDNA evidence is less revealing than nuclear DNA evidence. Jury deliberations significantly improved comprehension.

That nine out of ten jurors recognized that nDNA is more individualizing than mtDNA is not that remarkable, considering that answering this question merely required some recall of the statements made by both experts, by the prosecutor, and by defense counsel. That the same large fraction of jurors correctly responded to the question concerning the half-brother is more impressive, for this question went beyond simple recall. It tested the juror's ability to draw a logical inference (albeit a simple one) from a fact that was the subject of testimony.

We regularly found that higher levels of education and scientific training contributed to more knowledgeable assessments of such evidence and greater trust in it. The more complete and accurate that a juror's statements of the scientific facts were, the higher the reported probability of guilt. The dynamics underlying the association between scientific knowledge and scientific evidence credibility could be complex. Jurors with less formal education know less, or learn less, about mtDNA during the trial, and are also less enamored of mtDNA as evidence. Whether they reject it as a reliable form of evidence, and therefore pay less attention to the trial presentation, or whether the lower level of knowledge about mtDNA leads to a lack of appreciation of its probative value, is not clear. Indeed, the causal arrow may go both ways in a self-reinforcing loop.

Nonetheless, that jurors with more formal years of education and greater science and mathematics background showed better command of the scientific evidence raises several interesting issues. First, could we convey some of these apparent benefits of education and training through tutorials for jurors given at the start of a complex trial? The tutorials might cover general science and mathematics background information pertinent to the scientific issues upon which they will hear competing expert claims (Munsterman, Hannaford-Agor & Whitehead, 2006).

Second, the advantage of education seen here suggests that in some complex cases, a blue-ribbon jury, chosen from people with college degrees or with specialized training, might be a more accurate factfinder than a jury chosen from the general population. Assuming there were no constitutional problems with empaneling the former type of jury, one would have to weigh the advantages accruing from better command of the scientific evidence against the factfinding advantages developed from a more diverse and broadly representative group of jurors.

In this case, as in many real-world trials, mtDNA evidence was offered by the prosecution to prove guilt. That is an important contextual factor. Those who are more suspicious of science may be wary of evidence presented by the prosecution at trial; arguments about the irrelevance of scientific of evidence offered by the defense may fall on particularly receptive ears. To tease apart the potentially related concerns about prosecution evidence and scientific evidence, it would be useful to design a similar study of scientific evidence offered by the defense, and criticized by the prosecution. Would the same demographic and attitudinal factors be related to doubts about the evidence?

The scientific evidence has much more credibility in the eyes of the jurors compared to the all-too-human and general categories of police officer, victim, and even expert. Also noteworthy is that, at least in the abstract as we measured it here, eyewitness testimony was seen as the least reliable type of evidence. Juror reliance on mistaken eyewitness identifications has been identified as problematic and as a key source of erroneous convictions (Cutler & Penrod, 1995; Scheck, Neufeld & Dwyer, 2000). Yet, a spate of highly publicized exonerations of convicted defendants – many of which were made possible by new analyses of nuclear DNA that excluded the convicted defendant – may have created greater popular appreciation of the potential fallibility of eyewitness claims.

Despite the positive regard for science in general, the jury pool, in line with the general public, harbors some suspicions and concerns about science. These broad findings of reservations about science are echoed in lower regard for scientific evidence in a courtroom environment. A number of jurors had reservations about the specific reliability of the mtDNA evidence and the testing procedures in the mock case. A minority expressed concerns about the possibility of contamination even though the defense did not argue that the reported mtDNA sequence was incorrect or likely to be contaminated. These findings reinforce the research results of Schklar and Diamond (1999) of concerns about laboratory error, underscoring the importance of considering views about evidence quality and reliability in assessing juror decision making about forensic evidence.

Also notable was the persistent effects of a juror's racial identity. Nonwhites were less sure of the scientific facts, and more worried about mtDNA's reliability and the possibility that it was contaminated. They also showed greater reservations about science in general. Perhaps this should be no surprise given the history of misuse of science against racial and ethnic minorities (Washington, 2006; Winston, 2004). There is also the well-documented fact that nonwhites in general, and blacks in particular, have less confidence in police and the courts (Pastore & Maguire, 2007). Against the general pattern of nonwhites having greater doubts about mtDNA evidence within the case, however, there were no initial differences between whites and nonwhites in their perceptions of the general reliability of DNA evidence. Both whites and nonwhites held it in high regard. One possibility is that nuclear DNA has become a tool not only for police and prosecutors, but also for the defense bar, which has used it effectively to clear wrongfully convicted defendants (Scheck et al., 2000).

The findings provide some indirect support for the sorts of claims made by those who believe watching shows like CSI increase juror expectations about forensic identification. Analysis of the participants' self-generated definitions of mtDNA showed that jurors regularly drew on their general knowledge of nuclear DNA – whether it was developed from classes, news stories, or crime shows – as they attempted to develop understanding of this novel form of forensic evidence. The comparison and contrast with the gold standard of nDNA seemed to undermine what was – from a scientific and probabilistic perspective -- a significant and important match of the suspect sample and crime scene sample of mtDNA. The appropriate calibration of mtDNA evidence may be particularly challenging because of its similarity and relationship to the other more powerful form of DNA, a problem that might not emerge as strongly with other types of forensic evidence.

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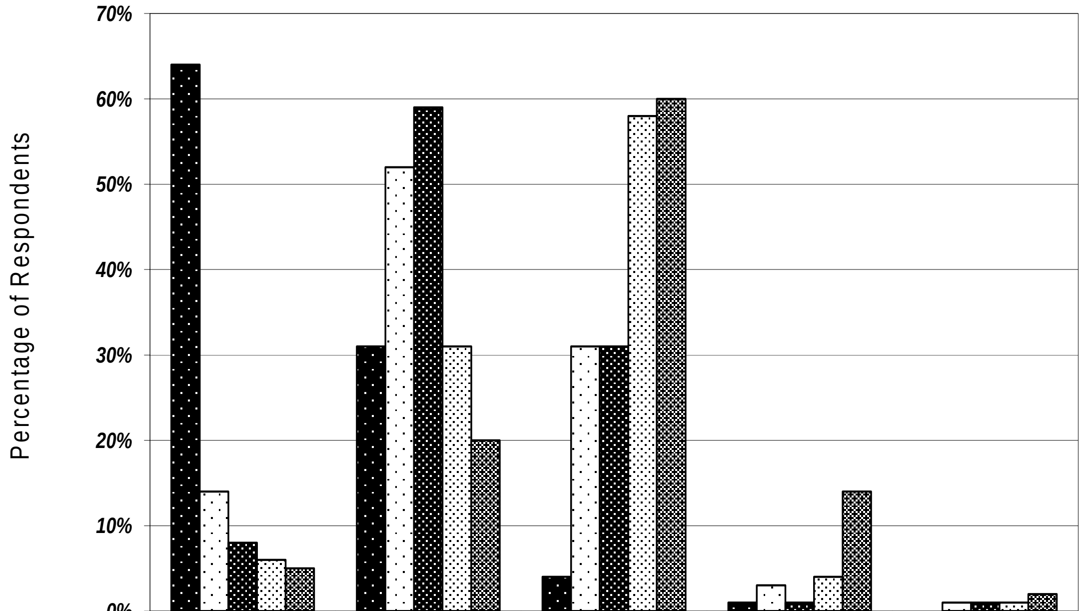
Table 1

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.



	Extremely Reliable	Very Reliable	Somewhat Reliable	Slightly Reliable	Not at all Reliable
DNA Evidence	64%	31%	4%	1%	0%
Expert Witness	14%	52%	31%	3%	1%
Police Evidence	8%	59%	31%	1%	1%
Victims' Evidence	6%	31%	58%	4%	1%
Eyewitness Evidence	5%	20%	60%	14%	2%

Figure 1. Jurors' Ratings of the Reliability of Categories of Evidence

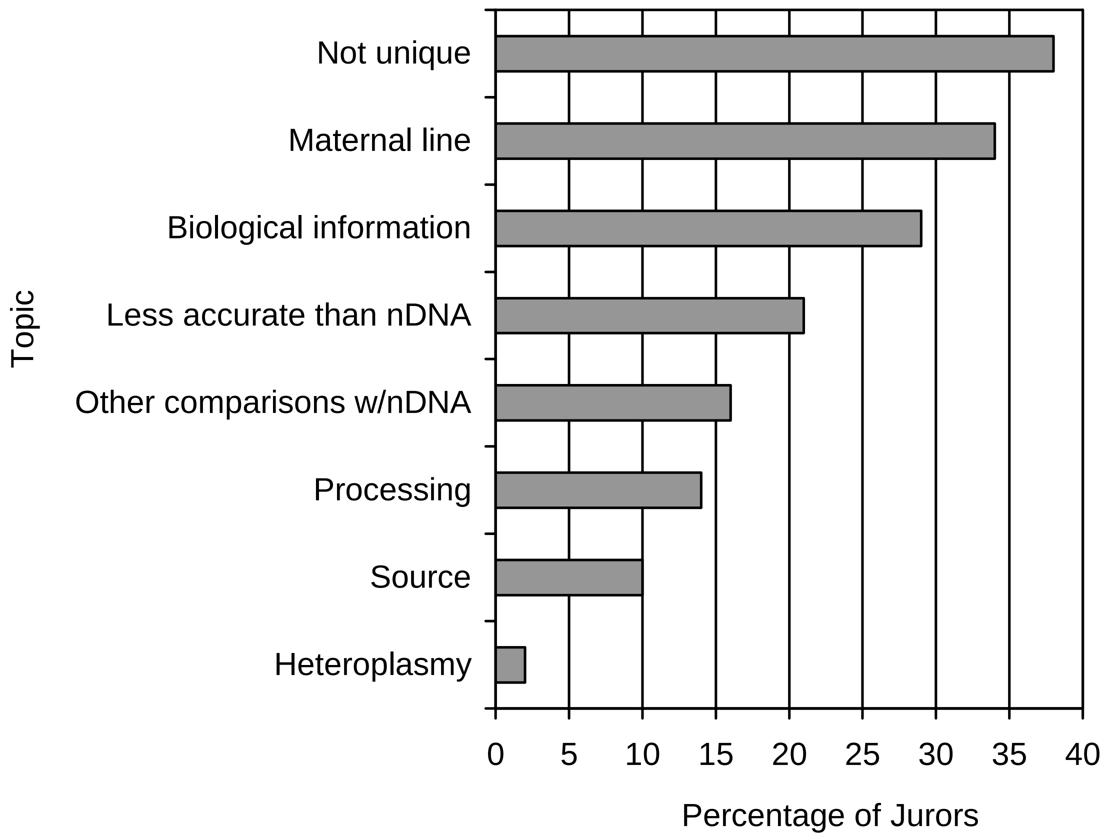


Figure 2. Topics Included in Jurors' MtDNA Definitions

Table 2

Responses to Specific Knowledge Questions about the Biology of mtDNA

Item	% Correct before deliberation	% Correct after deliberation
Do mtDNA and nDNA have the same ability to prove identity, or is one better than the other? [nDNA better]	89	89
Mitochondria are found inside the nucleus of every cell. [false]	70	67
A match is the same mtDNA sequence in two samples. [true]	59	67
When mtDNA evidence is analyzed, about 600 base pairs are compared. [true]	58	69
Heteroplasmy means that the same individual has mtDNA with different base pairs at certain points. [true]	68	69
The sequence of base pairs in mtDNA is important. [true]	84	83
A person's mtDNA comes from both the mother and the father. [false]	84	89
The mtDNA evidence is completely irrelevant because a substantial number of other people could also be the source of the hairs. [false]	51	51

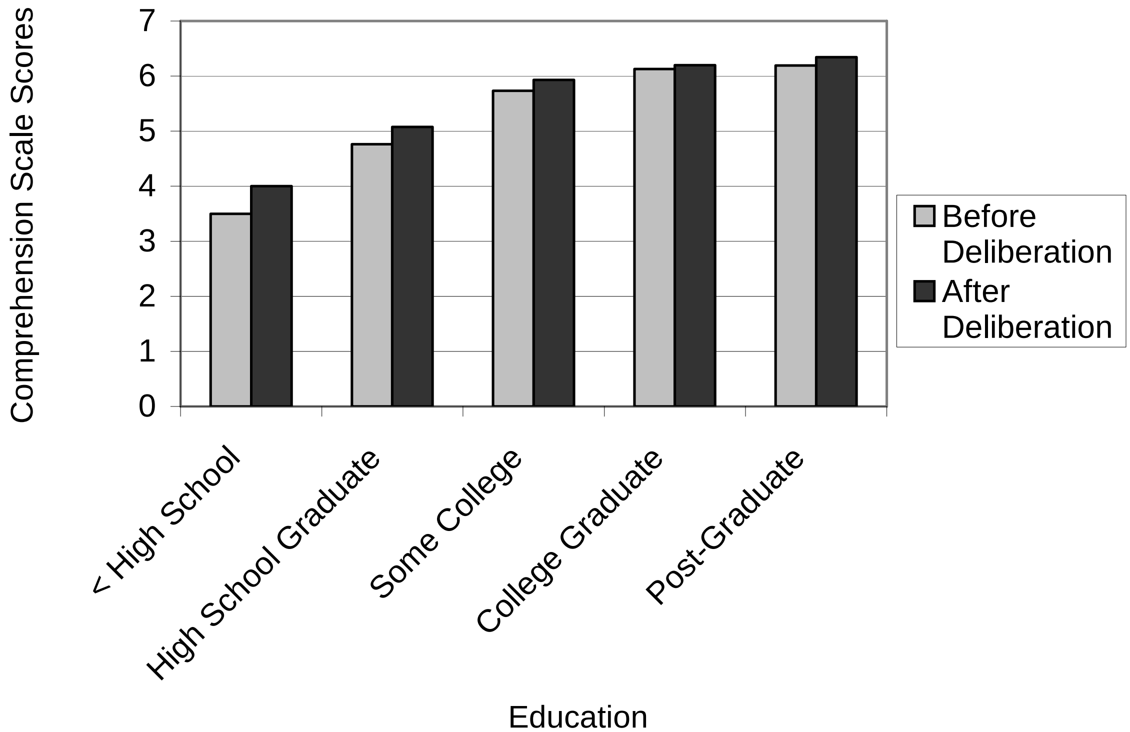


Figure 3. Juror Comprehension of MtDNA by Jurors' Educational Attainment and Timing