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A Right To Rational Juries?
How Jury Instructions Create The “Bionic Juror” In Criminal Proceedings Involving DNA Match Evidence

Pooja Chaudhuri*

This Note explores the intersections of science and the law in trials involving DNA evidence. The DNA match process is a forensic technique used to identify unknown individuals by the characteristics of their DNA. This procedure is extremely useful in criminal cases where the identity of the perpetrator is in question. While use of DNA match evidence in criminal trials is on the rise, jurors are not equipped to understand complex and manipulable DNA probabilities. Specifically, there exist three impediments to juror comprehension. First, match statistics are incredibly difficult to understand unless jurors have a background in mathematics or statistics. Second, jurors are unaware of inherent biases, including the risk of false positive matches in DNA typing. Third, jurors are at a high risk of being carried away by the significance of a match because DNA has been touted as the gold standard of biometric evidence. Nevertheless, while DNA evidence does have drawbacks, prosecutors, defense attorneys, and judges agree that it has improved accuracy in criminal trials.

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Given these barriers, many scholars have grappled with the issue of how to increase juror comprehension, but few have been able to provide practical solutions. In that respect, this Note aims to bridge the gap between a normative and practical answer to the problem. Normatively, the ideal juror in DNA cases ought to be “bionic,” meaning that they will have ordinary cognitive powers enhanced by the help of electromechanical DNA typing devices. Because DNA trials are unique in their melding of science and law, the bionic juror represents a new, important standard of rationality. As a way to practically create the bionic juror, this Note proposes a set of cautionary DNA jury instructions to ensure that criminal defendants receive fair trials by rational jurors.

“Evidence also has been a prolific field for the unchecked jurisprudence of conceptions. But one example must suffice. The decisions by which in a majority of jurisdictions jurors are not permitted to learn directly the views of standard texts upon scientific and technical subjects, but must pass upon the conflicting opinions of experts without the aid of impartial sources of information to which any common-sense man would resort in practice, carry out a conception of the competency of evidence at the expense of the end of evidence.”

- Roscoe Pound

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INTRODUCTION

Science and law are deeply interconnected. This relationship is highlighted in criminal cases involving DNA evidence obtained from a crime scene. DNA, or deoxyribonucleic acid, can be used to determine the identity of unknown perpetrators through a forensic technique called DNA profiling. Profiling works by taking a DNA sample from the crime scene and generating a profile that is then compared with the suspect’s DNA. While forensic scientists normally conduct comparisons between two profiles, new computer interpretation methods have allowed machines to take over the task of calculating the likelihood of a match by generating more precise probabilities. These technologies have profoundly impacted the law by raising new scientific and ethical issues related to the ever-increasing role of machine testimony in criminal prosecutions. Forensic DNA testing has also enabled prosecutors to bring cases that would otherwise be difficult to prosecute, and on the flipside, helped to free individuals who were wrongfully imprisoned for crimes they did not commit.

General consensus in the scientific, academic, and law enforcement communities is that DNA typing is the “gold standard” for determining a suspect’s identity, more so than fingerprint, bite-mark, and facial recognition techniques. Part of the accuracy and reliability of DNA forensics has to do with the DNA molecule itself. Theoretically, DNA can capture a distinctive identity for every living individual on our planet. As a molecule, DNA can be preserved for hundreds of years, and it is easy to obtain. Every cell of the human body, strand of hair, cheek swab, or “seal of an envelope licked and mailed” contains DNA.

3. Id.
4. Id.
5. Id. at 775 (arguing that although DNA technologies “appear so irrefutably probative,” they also “allow criminal cases to be built on little more than forensic proof: for instance, charges are routinely brought based upon only a ‘cold hit’ DNA match”).
8. JAMES WATSON ET AL., MOLECULAR BIOLOGY OF THE GENE (5th ed. 2004); Randy James, DNA Testing, TIME (June 19, 2009), http://content.time.com/time/nation/article/0,8599,1905706,00.html [https://perma.cc/L4JU-V7AS].
9. See Matt Kaplan, DNA Has a 521-Year Half-Life, NATURE (Oct. 10, 2012), http://www.nature.com/news/dna-has-a-521-year-half-life-1.11555 [https://perma.cc/EJ6B-QPTP] (researchers have found that if properly preserved, DNA as old as 1.5 million to 6.8 million years can be readable).
10. See Lila Shapiro, We May Resurrect the Mammoth Sooner Than You Think, HUFFINGTON POST (Dec. 18, 2015), http://www.huffingtonpost.com/entry/woolly-mammoth-crispr-climate_us_567313f3e4b0648fe302a45e [https://perma.cc/QE7L-9XGS].
Understandably, DNA is touted as the “ultimate truth machine” and “infallible.”

But, the effect of such rhetoric is to substitute DNA as a proxy to human decision making, including juror decision making. For example, in one case the government argued to the jury that “[the defendant] had left a DNA signature in his semen at each crime scene. . . . [And] [t]he jury could properly have found that this identified him as surely as if he left a card with his name and social security number with each victim.”

By analogizing DNA to a social security card number, the prosecution suggested that the match proved that the defendant was guilty of the crime. This rhetoric gives a false power and agency to the DNA match as conclusive evidence of guilt or innocence. Normally, it is the jury who, based on an individualized evaluation of the evidence and situation as a whole, renders the verdict. When a DNA match is presented as irrefutable proof of guilt, it threatens to replace the task of a human jury to render a verdict.

Another example of DNA’s potential to replace the task of jurors is the “cold hit” case. A cold hit involves finding a suspect through a match between crime scene DNA and a database that contains the DNA profiles of thousands of people.

In such cases, there is often no other circumstantial evidence linking a suspect to the crime scene except for evidence that their DNA happened to be in a database and coincidentally matched with the DNA at the crime scene. This example of cold hit prosecutions draws attention to the potential for using DNA matches from offender databases to obtain convictions, without any additional evidence. In other words, in such cases, the jury’s determination may be solely based on the DNA match alone. Law enforcement typically celebrates the “mechanical virtues” of cold hits because they promise a “gadget-like form of proof [that] increases crime detection, a determinable proxy for criminality increases convictions, or an actuarial instrument increases the length of detentions . . . .”

These examples illustrate that both the rhetoric surrounding DNA typing and the selective ways that prosecutors employ the technology as evidence tending to prove guilt threaten to replace juror rationality with machine objectivity, which has its own embedded errors and biases.

12. See LYNCH ET AL., supra note 7, at 256, 340.
15. Id.
16. Andrea Roth, Safety in Numbers? Deciding When DNA Alone is Enough to Convict, 85 N.Y.U. L. REV. 1130, 1131 (2010) (citing to the cold hit case of John Puckett, a man who was charged in 2004 with a 1972 murder of a young nurse in San Francisco. The government’s primary case was based on an erroneous cold hit DNA match between the crime scene sample and a California database which contained 338,000 offender profiles. The database match led police to track down the “then seventy-one-year old John Puckett, a wheelchair-bound man in Stockton”).
But attempting to replace human jurors in the context of DNA evidence is a mistake. The jury is an important institution in criminal trials. The Constitution guarantees criminal defendants a right to trial by a jury—presumably a human jury.\textsuperscript{18} And unlike machines, jurors can contextualize situations in a way that DNA typing machines cannot. In terms of juror decision making, many scholars use the story model to describe how jurors construct a story based on the evidence.\textsuperscript{19} A large part of the story model relies on jurors’ abilities to use human rationality in conjunction with their own views about the world to piece together a story of how a crime may have occurred.\textsuperscript{20}

This ability to contextualize evidence is highly important in DNA cases where the identity of the perpetrator is often one missing piece of a larger evidentiary puzzle. In such situations, where there is a complex patchwork of evidence and storylines, the power of DNA typing machines is limited. Machines can provide one piece of the information in the form of match probabilities, but they are often projected as providing conclusive evidence of guilt or innocence.\textsuperscript{21} Although juror decision making is imperfect—and in many instances fraught with racism and sexism—the idea that silent instruments like DNA typing machines alone can determine a verdict raises moral and ethical issues.\textsuperscript{22} Because DNA machines do not have the capacity to contextualize or attach significance to evidence, human logic and reasoning are more promising than the cold hard testimony of DNA machines.

The first half of this Note examines the relationship between juror decision making in DNA cases and the role that DNA machine typing is starting to play in criminal prosecutions and adjudications. While testimony from DNA typing has made criminal prosecution and exoneration more accurate, this Note cautions against DNA machine testimony replacing juror decision making. The broader question this Note addresses is: Can we create a man-machine collaboration in which jurors can fully comprehend and use the testimony of machines to render informed verdicts?

Professor Andrea Roth, an evidence scholar, provides a framework for envisioning this man-machine collaboration. The framework is called the “biotechnic approach,” which is based on the premise that “humans are sometimes their best selves when checked by or intertwined with machines, and

\begin{itemize}
\item \textsuperscript{18} U.S. CONST. amend. VI; see also Tanner v. United States, 483 U.S. 107, 126 (1987) (interpreting the Sixth Amendment of the Constitution to guarantee a fair trial before an impartial and competent jury).
\item \textsuperscript{20} Id.
\item \textsuperscript{21} Id. at 1274 (discussing how the creators of the DNA typing machine, TrueAllele, have described the technology as being foolproof, “always” giving the right answer, and “always” making “full use” of the data).
\item \textsuperscript{22} Id. at 1253 (describing that over the last 150 years, machines have overtaken human decision making as the “importance of the human senses” has given way to the “silent testimony of instruments”).
\end{itemize}
This approach requires thinking on how to create a "man-machine interface" where the machine does not stand apart from people but is deeply embedded in human and social networks. Another way to conceptualize this idea of the "bionic juror" is to think of a human juror who is enhanced by the power of a machine. Metaphorically, the human juror would become part machine, but more literally, it would mean that a human juror could understand and use testimony from machines to increase the accuracy of their "complex, individualized judgment requiring tacit understanding and knowledge." Thus, the bionic juror presents a new standard for what elements will help jurors make rational decisions in criminal trials featuring testimony from DNA typing machines.

The second half of this Note addresses the issue of how to create the bionic juror. Anyone can be a bionic juror, as long as the person is equipped with the right framework for integrating evidence from machine testimony into their decision making. Unfortunately, DNA evidence is complex, and to transform into bionic jurors, a member of the jury would benefit from having a framework for understanding the evidence. This would make it easier for jurors to scrutinize and give correct weight to DNA evidence presented at trial. The complexity of DNA evidence has to do with the way that it is presented. A DNA match is "essentially meaningless" without a probability assessment that gives the jury "some sense of how unusual [the match] is." These probabilities can become so elaborate that they leave ordinary jurors "hopelessly confused" unless they have a background in mathematics or statistics. Moreover, battling experts, whose opinions and interpretations often depend on which side is paying them, also do little in the way of equipping jurors with a neutral framework to understand DNA matches. In that sense, Roscoe Pound’s quotation carries great import: without a source of impartial information, jurors can only be

23. Id. at 1252, 1296.
24. Id. at 1297.
25. Id. at 1297.
26. Id. at 1296.
28. Roth, supra note 16, at 1136 (citing to United States v. Yee, 134 F.R.D. 161, 181 (N.D. Ohio 1991) for the proposition that "[w]ithout the probability assessment, the jury does not know . . . whether the patterns are as common as pictures with two eyes, or unique as a Mona Lisa").
29. Richard Lempert, Some Caveats Concerning DNA as Criminal Identification Evidence: With Thanks to the Reverend Bayes, 13 Cardozo L. Rev. 303, 325 (1991) (For example, Lempert observes that "jurors provided with a laboratory's false positive rate and with information about the likelihood, assuming no testing error of a match if the evidence DNA is not the defendant’s, are likely to be hopelessly confused about the weight to accord to the testimony").
expected to carry out a mere “conception of the competency” of match probabilities.\textsuperscript{31}

In an effort to address the problem of juror comprehension in DNA trials, scholars have advocated for better training of jurors and judges by scientist experts,\textsuperscript{32} or more reliance on experts.\textsuperscript{33} However, no one in the academic community has made a case for using jury instructions as the educational tool to help jurors understand match statistics. Some of the reasons given against instructions of this sort are that they would require judges to transcend their role as impartial adjudicators in commenting on the evidence\textsuperscript{34} or promote scientific exceptionalism of DNA over other types of forensic evidence.\textsuperscript{35} These and several other similar counterarguments have yet to be dismantled.

Ultimately, this Note aims to challenge arguments against DNA instructions in an effort to break down the barriers that prevent legal innovators from better integrating mechanized DNA testimony with juror decision making. In that respect, this Note addresses two broader questions. First, what role will jury instructions play in educating jurors? And second, who is best situated to take on the task in a context where questions of guilt or innocence are at stake? In an attempt to answer these questions, this Note uses evidence scholar Andrea Roth’s biotechnic approach for justifying how and why DNA jury instructions would enhance juror decision making.\textsuperscript{36} Using Roth’s theory, this Note illustrates how cautionary, DNA-specific jury instructions can create the “bionic juror,” an ordinary person of human cognition who is able to make informed decisions based on full comprehension of the information generated by electronic devices.\textsuperscript{37} In turn, from this notion of the “bionic,” fully aware juror, emerges a theory for why DNA jury instructions can provide criminal defendants with intellectual due process.\textsuperscript{38}

Part I provides a background on the intricate legal, political, and scientific architectures put in place around DNA forensics in the United States. Part II illustrates what it means to be a bionic juror in DNA trials and how jury

\textsuperscript{31} See Pound, supra note 1, at 620.

\textsuperscript{32} Koehler, supra note 27, at 203. Koehler observes that “courts do not have the technical guidance needed to make sensible and consistent judgments concerning the admissibility” of DNA match statistics, that jurors are “overly impressed” with match statistics, and that forensic scientists need to draw judges and jurors’ attention to the “probative value” of DNA matches in particular. \textit{Id.}

\textsuperscript{33} \textit{Id.}


\textsuperscript{35} See State v. Roman Nose, 667 N.W.2d 386, 397 (Minn. 2003) (holding that it was not error to refuse to issue a cautionary instruction when the trial judge rightly feared that such an instruction would highlight the importance of DNA evidence over other evidence).

\textsuperscript{36} Roth, supra note 17, at 1304. As part of the biotechnic approach, Roth rightly encourages the legal community to balance the value of mechanized DNA matches, and the power of human moral judgments, noting that “[a]lthough mechanization holds much potential for enhancing accuracy and fairness in adjudication, we should not allow it to eliminate moral condemnation from the equation. Rather, we should harness it to better identify those worthy, or not worthy, of moral condemnation.” \textit{Id.}

\textsuperscript{37} See discussion \textit{infra} Part II.A.–B.

\textsuperscript{38} See discussion \textit{infra} Part IV.
instructions can help to create this juror. Part III addresses the arguments by judges who oppose the concept of DNA instructions. Part IV presents a due process argument that defendants deserve rational juries who understand DNA evidence and proposes a set of model instructions that prosecutors, defense attorneys, and trial courts can adopt in criminal adjudications involving DNA evidence.

I.

BACKGROUND

The legislative, scientific, and political architectures that have been built to accommodate DNA forensics into the legal world confirm that use of DNA evidence in criminal adjudication is here to stay. With the advent of new sequencing technologies, advances in data storing, and decreasing costs of data analysis, the introduction of DNA evidence in trials is likely to become even more commonplace.  

For example, all fifty states admit DNA evidence in criminal trials. Alabama, Alaska, Delaware, Idaho, Indiana, Louisiana, Maryland, Minnesota, North Dakota, Tennessee, and Virginia have enacted statutes governing the admission of DNA evidence in jury trials. Out of these eleven state statutes, six apply only to criminal cases, four pertain to civil and criminal cases, and Alaska’s bears only on civil cases. Maryland, for example, has one of the most comprehensive statutes that admits evidence of a “DNA profile” in any criminal proceeding “to prove or disprove the identity of any person.” These statutory frameworks reflect a general consensus among legislatures in many states that DNA is powerful, reliable, and probative in adjudications. In the remaining states where legislatures have not spoken on admissibility, DNA is routinely

39. For example, Next Generation Sequencing, such as Illumina technologies, can sequence millions of DNA fragments at one time. This has lowered DNA sequencing cost by a million fold from what it was in the 1990s. In 2001, the cost to sequence an entire human genome was three billion dollars. Now, sequencing technology companies are promising to deliver “full coverage human genomes for less than $1,000.” See Ericka Check Hayden, Is the $1000 Genome for Real?, NATURE (Jan. 15, 2014), http://www.nature.com/news/is-the-1-000-genome-for-real-1.14530 [https://perma.cc/B4PQ-TQJG].


41. Alabama admits DNA evidence if it meets the general requirements for use of expert testimony as set by the U.S. Supreme Court. See ALA. CODE § 36-18-30. Alaska admits DNA evidence if it is scientifically valid only in civil cases. See ALASKA STAT. § 9.25.051. Indiana and Tennessee statutes specify that DNA evidence is admissible without using expert testimony to show its reliability as a means of identifying an individual’s genetic material. See IND. CODE § 35-37-4-13; TENN. CODE ANN. § 24-7-118(b)(1) (1991). Delaware, North Dakota, and Virginia deem DNA testing a reliable scientific technique and specify that DNA profile comparison may be admitted to prove or disprove the identity of any person in any criminal proceeding. The statutes urge courts to consider any other relevant evidence of identity. See DEL. CODE ANN. tit. 29, § 4713; N.D. CENT. CODE § 31-13-02 (1995); VA. CODE ANN. § 19.2-270.5 (1997).

42. MD. CODE ANN., CTS. & JUD. PROC. § 10-915 (West 1997).
introduced under either the *Frye* or *Daubert* standards, which govern admission of scientific evidence at trial.

Chemically, DNA is composed of four nucleotide bases—adenine (A), thymine (T), guanine (G) and cytosine (C)—connected through phosphodiester bonds. DNA can uncover layers of data on an individual, from predicting the person’s susceptibility to diseases to providing information on identity. The uniqueness of DNA to every human being, based on thousands of potential combinations of A, T, G, C’s in DNA fragments of different lengths within one DNA molecule, has made it an important tool in investigation and criminal prosecution. The FBI, for example, has identified thirteen loci in human DNA whose precise sequence can be determined for any individual. Since each locus is present in two copies, there are twenty-six alleles that can be used for matching purposes at these thirteen loci. Accordingly, DNA evidence found at a crime scene is sequenced at these regions to render a DNA profile that is then matched against a potential suspect’s DNA.

In the last twenty years, research, verification, and expansion of profiling techniques have further made DNA a staple in the legal world, particularly in the criminal realm. The National Research Council (NRC) on DNA Forensic Science has commissioned studies on profiling and has set out recommendations on methods of estimating match frequencies. The NRC’s recommendations carry substantial weight in the legal community as judges and experts routinely rely on them when ruling on DNA evidence.

These technological developments in DNA forensics have paved the way for political action, where Congress has authorized a network of DNA databases that contain hundreds and thousands of individual DNA profiles. In 1994,

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43. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923) (holding that expert opinion based on a scientific technique is admissible only where the technique is generally accepted as reliable in the relevant scientific community).

44. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (expert scientific knowledge admissible only when testimony is (1) scientific in nature, (2) assists the trier of fact in understanding the evidence, (3) based on sufficient facts or data, (4) a product of reliable principles, and (5) reliably applied to the facts of the case). *Daubert* is codified under Rule 702 of the Federal Rules of Evidence. See *Fed. R. Evid.* 702.


47. *Id.* at 495.

48. *Id.* Technically, an FBI profile is incomplete as it only reveals allelic frequencies at certain fragments of human DNA, and does not contain the entire human DNA sequence.


50. See *State v. Roman Nose*, 667 N.W.2d 386, 396–97 (Minn. 2003) (referring to NRC’s recommendation in adopting the ceiling method to calculate the random match probability statistic in DNA testing); 42 U.S.C. § 14131 (2012) (statute gives authority to the director of the FBI to appoint the NRC advisory board responsible for DNA quality assurance standards).

Congress passed the DNA Identification Act, a statute that gives the FBI authority to establish a national DNA index. Since then, the FBI has created the Combined DNA Index System (CODIS), which houses the National DNA Index System (NDIS), a database that contains DNA profiles of convicted offenders and arrestees. The NDIS is compiled by federal and state authorities and participating forensic laboratories. The political and legislative structures responsible for these databases have made it easier to identify suspects and use DNA in criminal trials.

As DNA use has proliferated in the legal community, so have critiques against it. The first category of arguments questions the reliability of DNA evidence in general, describing it as “more like meteorology than mathematics.” The scholars in this camp point out that DNA testing is not 100 percent reliable, as evidenced by the erroneous matches from inadvertent transfer of cellular material during laboratory testing, risks of false incrimination due to coincidental matches, and misinterpretation of test results.

A second category purports to show that the mathematical methods used to compute DNA probabilities—such as the random match probability (RMP)—may be manipulated to mislead jurors. Among this group is Jonathan Jay Koehler, who argues that the current criminal trial setup is ill-equipped to handle the complexity of DNA match evidence. Koehler has shown that DNA match statistics can lead jurors to erroneous conclusions and increase the risk of prejudice toward criminal defendants.

Finally, a third category of critiques is aimed at whether DNA evidence, by itself, is sufficient to convict individuals of crimes. Andrea Roth, the leading scholar on this issue, has cautioned against using a DNA match to convict an unknown perpetrator unless there is a 99.9 percent probability that the suspect is the source of the DNA. In her more recent work, Roth has paired the use of mathematical evidence and human decision making to create a biotechnic framework that “consciously seeks to promote man-machine collaboration wherever it would best advance systemic values, and that allows man and DNA databases as a constitutional search under the Fourth Amendment, and discussing the validity of issuing arrest warrants against suspects whose name and identity remain unknown).

52. See 42 U.S.C. § 14132 (2012) (establishing a national index that stores DNA identification records of persons convicted or charged with crimes).
54. Id.
55. Murphy, supra note 46, at 491.
56. Id. at 497 (“Crime scene DNA samples do not come from a single source obtained in immaculate conditions; they are messy assortments of multiple unknown persons, often collected in the most difficult conditions.”); see THOMPSON, supra note 27, at 9–10.
57. See Koehler, supra note 27, at 203.
58. Id.
59. See Roth, supra note 17, at 1159.
machine to help each other be their best ‘selves.’” Roth conceptualizes these courtroom actors, including jurors and judges, as “bionic” individuals who are able to overcome “automation complacency” by remembering that their “human judgment is sometimes needed to stay on course.”

While Roth has provided a theoretical model (i.e., the biotechnic approach) for understanding how machines ought to fit into criminal trials, no one has applied her model to a problem. This Note shows why and how DNA-specific jury instructions can create the bionic juror whose main function is to safeguard the “reliability of machine output.”

II. CREATING THE BIONIC JUROR IN DNA TRIALS

A. The Bionic Juror in a Mechanized Criminal Trial

In a 1996 conference on cyberlaw at the University of Chicago, Judge Frank Easterbrook remarked rather facetiously, “I don’t know much about cyberspace; what I do know will be outdated in five years (if not five months!).” Judge Easterbrook’s comment illustrates the phenomenon that cyberspace is constantly shifting and expanding, and now plays a large role in many criminal trials. Specifically, the growing use of DNA evidence in the courtroom sheds light on interactions between cyberspace, genetics, and human judgment.

In recent years, software programs that interpret DNA evidence and produce a statistical likelihood of a match have threatened to replace the complex arena of human jury deliberations in DNA match interpretation. The issue of machine testimony based on DNA evidence replacing human decision making is a controversial one. This Note takes the position that it would be a mistake to replace jurors with machines because, unlike humans, machines do not have the capacity to contextualize information, weigh evidence, and render individualized decisions. While DNA typing machines have increased the “accuracy, objectivity and precision,” of matches, they are best used when combined with human judgment. Thus, as Roth points out, “instead of taking every task now completed by a human bailiff, clerk, probation officer, or parole board member and asking how it might be replaced by automation, we could be taking each task and asking how it might be humanely enhanced by automation.”

60. See id. at 1296.
61. Id. at 1297, 1279.
62. Id. at 1301.
64. See Roth, supra note 17, at 1292–93 (describing that while desire for accuracy in criminal prosecution has “led to checks on the jury’s complex human judgment in the form of mechanical proxies for criminality,” without additional checks, these mechanical proxies could replace trial by a complex human jury).
65. Id. at 1297.
TrueAllele is one such computer program that has the potential to replace the need for expert forensic interpretation as it paints a complete picture of cybergeneics right in the courtroom. TrueAllele’s software computes probabilities, generates graphs, and explains how likely it is that a random person from a population will match the DNA recovered from a crime scene. Proponents of the software argue that TrueAllele has been shown to produce conclusive results where human interpretation has failed. This view, however, ignores that TrueAllele has its own set of hidden subjectivities and biases stemming from the potential for error in match results. And even without TrueAllele, forensic experts who are hired to provide DNA match testimony rely greatly on the expertise of imperfect machines—from DNA sequencing technologies to CODIS software searches and profile matching algorithms. Each of these mechanizations has its own potential for error. It is this new cybergeneic courtroom terrain in which Roth’s bionic jurors, judges, and witnesses take shape. Specifically, in Roth’s theoretical model, bionic juries can enhance “preexisting human goals,” by “promoting a man-machine collaboration wherever it would best advance system values.”

If bionic juries are made of individual bionic jurors, how can we conceptualize these human bionic jurors? Martin Caidin’s 1972 novel, Cyborg, sheds some light on this question. Caidin’s story chronicles pilot Steve Austin’s transformation from an ordinary to bionic human. The novel details how the American government recruits Rudy Wells to rebuild a badly injured Austin using bionics, a new field that studies the replacement of human body parts with mechanical prosthetics that have the ability to augment the functions of original body parts. Austin’s transformation into a bionic human is both physically and psychologically painful—one that he vehemently rejects at first but comes to accept as he realizes that his superhuman abilities have become a part of him. While Cyborg features a bionic human who is created through physical alteration, Andrea Roth’s world of the “trial by cyborg” imagines the creation of bionic courtroom actors through psychological transformation. In this courtroom, the bionic juror is created when the information generated by

67. Id. at 1035–36.
68. Id. at 1035 (observing that in practice, “‘TrueAllele sometimes yields conclusive results of DNA samples when human interpretation of the same sample does not’”).
69. See Roth, supra note 17, at 1253, 1262, 1296–70. Roth observes that the Drunk-O-Meter, sentencing guideline formulas, and TrueAllele are machines that give the “silent testimony of instruments.” Id.
70. Id. at 1245.
71. Id.
73. Id. at 25.
74. Id. at 99.
75. Roth, supra note 17, at 1297.
machines like TrueAllele enhances human decision-making powers—the “biotechnic enhancement” is what contributes to cognitive change.\textsuperscript{76}

A physical cyborg transformation provides a metaphorical way of conceptualizing how a bionic juror comes into being. But how does the psychological transformation occur for the juror in a DNA trial? An ordinary juror can become bionic as they accumulate a basic vocabulary for comprehending electronic information, develop a framework to integrate the information, and create a mechanism with which to evaluate hidden biases. This transformation would mean that a human juror could understand and use testimony from machines to increase the accuracy of their “complex, individualized judgment. . .”\textsuperscript{77}

To achieve this shift in the context of DNA evidence, the juror would first need to overcome three barriers. First, the juror would have to understand that evidence in the form of numbers and statistics is prone to being as unreliable as human testimony. Second, they would have to become aware that software interpreting DNA evidence at different stages of the testing process is laden with hidden biases. Third, they would have to overcome the widespread misconception that DNA is the ultimate truth machine. These barriers are discussed in more detail below.

1. \textit{Complexity of Numbers As a Barrier}

Mark Twain’s phrase, “lies, damn lies and statistics,” is meant to convey that statistics can be manipulated to prove almost anything. The ordinary person will generally have difficulty applying a given statistic to make conclusions about the real world. And humans commonly misapply statistics by conflating probability and certainty. Statistics are a measure of how likely it is that something is true. Often, statistics are misrepresented to be a measure of absolute truth. Jurors need a framework for understanding what DNA match probabilities signify.

For example, suppose a group of women and a group of men are given a crossword puzzle to complete. On average, the women take ninety-four seconds to complete the puzzle, and the men take one hundred seconds. Based on this sample, the women seem to take six seconds less than the men to complete the puzzle. For those who do not understand statistics, this data might lead one to conclude that women are better at crossword puzzles than men. However, that conclusion may be incorrect. In fact, women, more generally, may be worse than men at solving a crossword puzzle, but the sample size of these two groups was not large enough to derive any conclusive result. Furthermore, even the sweeping generalizations between the two sexes’ ability to complete crossword puzzles may be inaccurate as this view assumes that a six-second discrepancy points to

\textsuperscript{76} Id. at 1298. \\
\textsuperscript{77} Id. at 1296.
black and white conclusions: either men or women are faster at crosswords.\textsuperscript{78} This interpretation of the data ignores a host of variables other than sex, such as age, familiarity with crosswords, and education, among other factors that influence speed. This example shows that numbers must be contextualized, or else they can be easily misapplied to arrive at incorrect outcomes.\textsuperscript{79}

As with all statistics, DNA matches are daunting; they present problems similar in nature to the crossword puzzle example. A likelihood of one in five million that a strand of DNA uncovered from a crime scene belongs to a person of African American descent does not mean that the defendant in this particular case—who happens to be African American and whose DNA matches with the crime scene DNA—is guilty of the crime. The statistics describe only the likelihood that the defendant may be the one who committed the crime, just as the crossword puzzle scenario pointed to some likelihood that, on average, women could be better than men at crosswords.

Some courts, however, assume that jurors can easily differentiate between probability and certainty even in cases where counsel makes arguments related to guilt or innocence from evidence of a DNA match. For example, one court suggested that jurors would not be prejudiced by the government’s argument that a DNA probability match conclusively proved the defendant’s guilt: \textsuperscript{80} “[the defendant] had left a DNA signature in his semen at each crime scene. . . . [And] [t]he jury could properly have found that this identified him as surely as if he left a card with his name and social security number with each victim.”\textsuperscript{81} By analogizing a DNA profile to a social security number, the government overemphasized the probative value of DNA statistics—arguably crossing the line from probability to certainty and thus misleading jurors to equate a DNA match with guilt. In reality, the DNA match is not as black and white as the prosecutor made it seem; rather, it provides only the probability that the defendant could be guilty of the crime. Understanding the distinction between probability and certainty would allow jurors in similar cases to render informed verdicts.

DNA evidence can be intimidating also because of the diversity of numerical probabilities that can be used to express a match. The most frequently used statistic in DNA cases is the random match probability (RMP), which provides a match frequency of how likely it is that any given person chosen at random from a population will have the same DNA as that found at the crime

\textsuperscript{78} IAN WALKER, RESEARCH METHOD AND STATISTICS 101 (2010).
\textsuperscript{79} Roth, supra note 16, at 1133 (describing the difference between “assertions of certainty rather than probability” for the source probability statistic).
\textsuperscript{80} United States v. Peters, No. 96-2286, 1998 U.S. App. LEXIS 773, at *9 (10th Cir. Jan. 20, 1998) (holding that prosecutor’s comment that a DNA match indicated that defendant was a “serial rapist” was “an isolated comment and would not have persuaded the jury to convict defendant”).
\textsuperscript{81} Brief for Appellee-Respondent at 58, United States v. Peters, No. 96-2286 (10th Cir. Jan. 20, 1998).
scene. An alternative measure that comes up in some cases is the source probability, a statistic that indicates how likely it is that a defendant in a particular case is the source of the DNA found at the crime scene. Scholars Ian Ayres and Barry Nalebuff hypothesize that source probability may in turn depend on two additional probabilities: the initial probability that the source of the DNA is included in the database and the probability that a nonsource in the database would have an alibi. These layers of probabilistic interpretation required to calculate source probabilities illustrate just how complicated the task is.

The database match probability (DMP) is yet another measure that can indicate the likelihood of getting an accidental match when a cold hit search is carried out. A cold hit search occurs when police receive a DNA match hit from a database of DNA profiles, and there is no other connection between the suspect and the crime scene. The premise behind the DMP is that in a search for a match in a database of n DNA profiles, there are n chances of finding such a match. Like most probabilities, the DMP is expressed as a number between zero and one, which means that if an event has a probability of one, then it is certain to happen.

The problem with a match probability from a database is that there is a high chance of ascertainment bias—meaning that the smaller the DNA database, the less likely that a profile match between the suspect and the database is accurate. This is because the profiles in a database are used to ascertain the frequency at which a DNA profile appears within a finite sample. In other words, the probability is not necessarily representative of how frequently the suspect’s DNA profile appears in the general population.

82. Roth, supra note 16, at 1134.
83. Id.
87. Id.
88. Ascertainment bias describes “systematic deviations from an expected theoretical result attributable to sampling processes.” Ascertainment Bias, NAT’L CTR. FOR BIOTECH. INFO., http://www.ncbi.nlm.nih.gov/books/NBK9792 [https://perma.cc/BN6M-2ZFV]. This means that a database probability that expresses how rare a DNA profile is will depend on the size of the database that was searched to render a match. See United States v. Jenkins, 887 A.2d 1013, 1017 (D.C. Cir. 2005). Because all the profiles in a database are used to estimate (or ascertain) the frequency of a DNA profile within a finite sample, there will be some kind of ascertainment bias in every batch of data submitted. See id. The larger the size of the database, the more significant the database match probability may be, thus rendering the match more inculpatory. Murphy, supra note 11, at 113. Nevertheless, the significance of a DNA match from a database (e.g., how likely it is that there are other identical DNA profiles to the defendant’s) is the subject of “raging debate” in the scientific community. Jenkins, 887 A.2d at 1017.
profile appears in the entire population, just within the sample. Thus, drawing a conclusion about a suspect’s guilt or innocence from a database match may seem convincing to the lay juror but may not be an accurate match.

The variety of statistical formulations in DNA match evidence is complicated and can be easily manipulated to prove a particular conclusion. Therefore, it comes as no surprise that DNA match statistics serve not only to confuse, but also potentially to mislead jurors who do not have any background in mathematics or statistics.

2. Interpretative Bias

Interpretive bias describes the human interpretation and hidden biases that become part of the statistics presented to jurors during a criminal trial. Even computer-generated match probabilities are laden with interpretive biases of analysts who must make subjective decisions when they input DNA profiles into a machine. Additionally, prosecutors’ biases become a part of match statistics, especially when using DNA matches to prove guilt beyond a reasonable doubt. In order to understand the significance of DNA matches, jurors need to know that match statistics are not neutral, but subject to a host of human errors and biases.

One example of computer-generated match probability software is TrueAllele. TrueAllele promises machine objectivity unparalleled by the interpretation of human counterparts. But, in reality, TrueAllele’s matches depend on a host of interpretive factors, such as the quality of the data generated by the scientific lab and the kinds of choices the machine operator makes while plugging data into the machine. The software makes DNA matches in a binary mode—match or no match. The analyst programs a threshold value for the allelic match in the system based on the quality of the DNA fingerprinting data. If the allelic match has a value higher than the threshold, it is recorded as present. If it falls below the threshold, it is recorded as absent. The threshold

89. See Jenkins, 887 A.2d at 1017; NAT’L RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE, 124 (1992) [hereinafter NRC I].


91. Moss, supra note 66, at 1047 n.84.


93. Id.

94. Id.

95. Id.
value is set high if the quality of the DNA sample is good, and set low if it is bad.96

The TrueAllele example illustrates the potential for match determination bias because forensic scientists and analysts can make judgment calls as to the subjective quality of a sample. If jurors do not know how the DNA matching software technology works, they may be tempted to believe that TrueAllele is infallible.97 Jurors must be taught to recognize the human component behind TrueAllele in order to make more informed decisions about the significance of a DNA match in relation to other evidence in the case.

Interpretive bias also extends to the arguments that prosecutors and defense attorneys make at trial. The prosecutor’s fallacy, for example, involves a scenario in which jurors are led to believe that an RMP tells them the likelihood that the defendant is the source of the DNA found at the crime scene.98 An experimental study on mitochondrial DNA matches shows how jurors believe different versions of the prosecutor’s fallacy, wrongly inferring guilt.99 In a study where 480 jurors watched a video of a robbery trial in which hair recovered from the crime scene matched the DNA of the government’s prime suspect, the government’s expert testified that 99.98 percent of the population could be excluded as suspects.100 A third of the jurors, after seeing the video and hearing expert testimony, felt that the defendant was guilty.101 Those same jurors, however, did not believe the defense expert’s simple restatement of the probability that 0.02 percent of the population could have been the source of the crime scene DNA, which would have led to the conclusion that there were a number of others who shared the same profile.102

To make informed decisions, jurors must be able to recognize the fallacies in the way that DNA matches are presented at trial. Jurors need to understand the limited meaning of DNA statistics, recognizing that “all that a DNA match does is identify—within a certain degree of confidence—an individual whose DNA profile was the same as that of a sample (or samples) found at the crime scene. By itself, it does not imply that the individual committed the crime.”103

96. Id.
100. Id.
101. Id.
102. Id.
103. Devlin, supra note 90, at 8.
3. The Truth-Myth Misconception

The truth myth, arguably a delusion of grandeur in DNA’s promised objectivity, operates as another barrier to juror comprehension of DNA evidence. The myth reflects the dominant belief that DNA is infallible, that it is unassailable as criminal evidence—a “scientific arbiter of truth.”\(^\text{104}\) Television crime dramas like CSI, NCIS, Law and Order, and Bones have also played a role in glamorizing DNA evidence, thus shaping the truth myth. Jurors need to be aware that DNA is not the gold standard that it is purported to be, but rather, a tool for determining probability of an unknown suspect’s identity.

The truth myth is a myth for good reason—it does not reflect reality. History is replete with examples of criminal convictions based on false positive DNA matches. For example, forensic scientist William Thompson discusses multiple instances where suspects were wrongly accused of serious crimes based on false positive matches due to cross contamination of DNA samples in the lab.\(^\text{105}\)

Despite unbelievable stories of error, DNA is still “heralded as a new gold standard for truth telling”\(^\text{106}\) in forensic science. A student piece published in USC’s undergraduate engineering magazine confirms the glamour that surrounds DNA testing technology:

[i]t can exonerate a falsely accused person, while undeniably implicating a guilty party. It allows scientists to identify the remains of victims of highly disfiguring accidents or soldiers lost in battle. It can even settle child custody cases by identifying the child’s true biological parents. This amazing technology is DNA fingerprinting, and it is arguably the most powerful and accurate form of human identification currently used.\(^\text{107}\)

This excerpt illustrates the recurring myth that DNA continues to be touted as the gold standard of truth, and placed on a pedestal.

104. LYNCH ET AL., supra note 7, at 340.
105. The Ruelas case is by far one of the most shocking. In 2002, Michigan State Police Crime Laboratory, investigating the 1969 murder of University of Michigan law student Jane Mixer, found DNA of two men on her clothing. When forensic scientists searched through a database, the profiles matched two men, Gary Leiterman and John Ruelas. When Mixer was murdered in 1968, John Ruelas was four years old. Leiterman was charged with murder, and at trial, the prosecutor created a hypothetical scenario to explain Ruelas’s presence at the crime scene. According to the prosecutor, Ruelas was at the scene of the murder and happened to be a chronic nose-bleeder whose blood had dropped on Jane Mixer. Thompson explained this confounding situation by conjecturing that a more likely scenario is that the “cold hit” match to Ruelas was a product of sample cross contamination in the lab. Later laboratory records revealed that known samples of DNA from both Leiterman and Ruelas were being processed in the Michigan State lab on the same day as the old samples from the Mixer murder. The lab had tested Ruelas’s DNA in another case unrelated to the Jane Mixer’s murder, and the most plausible explanation was that his DNA inadvertently ended up on Jane Mixer’s clothing. See THOMPSON, supra note 27, at 27–28.
106. LYNCH ET AL., supra note 7, at 256.
107. DNA Fingerprinting, ILLUMIN (Nov. 1, 2001), http://illumin.usc.edu/28/dna-fingerprinting/1 [https://perma.cc/TTL7-HHYQ].
The three barriers that prevent jurors from comprehending DNA evidence are the formidable nature of statistics, the bias that creeps in from machine technologies, and the truth myth. Comprehension-related issues make it difficult for the bionic juror to come into being organically, without any outside guidance. The next Section discusses jury instructions as one instrument of guidance that can be used to transform an ordinary person into a bionic juror in DNA evidence cases.

B. How Jury Instructions Create the Bionic Juror

The bionic juror fits into Roth’s biotechnic framework as the “back-end adversarial safeguard” against mechanization’s glamorous promise of objectivity.\(^{108}\) Evolving legal architectures that help to create the bionic juror represent the first step towards creating these requisite “courtroom safeguards.”\(^{109}\)

But, without widespread recognition by the legal community for the need to develop buffers that correct for “automation pathologies,” the bionic juror cannot become a reality.\(^{110}\) Where centuries-old canons of legal construction have been built around the reasonable person in the law, those same canons have yet to be modified to adapt to the bionic person living in a mechanized world. The lethargy in moving towards a bionic standard may be explained by courts and legislatures being slow to grasp how integral a role machines play in human decision making. It may be because we feel uncomfortable asking the difficult ethical and psychological questions at the expense of compromising the convenience and efficiency that mechanization has gifted us. Or, it may be that in our legal system of stare decisis, change is welcomed only when it is incremental.

In criminal trials involving DNA evidence, DNA-specific instructions can remove some of the comprehension-related issues that prevent ordinary jurors from acquiring a basic vocabulary, framework, and healthy cynicism with which to evaluate the evidence. The overall effect of the instructions would be to educate and de-bias jurors of the three misguided beliefs: that automated software interpreting DNA evidence produces objective and true results; that numbers are markers of truth; and that DNA is infallible.

While one obstacle to creating the bionic juror is overcoming the comprehension-related issues, another set of hurdles emerges from the strong aversion towards instructions themselves. American trial judges are overwhelmingly disinclined to give DNA instructions, based on the stance that instructions constitute comments on fact, and in turn, require judges to overstep

\(^{108}\) Roth, supra note 17, at 1300.
\(^{109}\) Id.
\(^{110}\) Id. at 3.
their societally prescribed role as neutral decision makers. The deep-rooted fear goes to the heart of the value-laden beliefs underlying the roles we assign to judges (neutral adjudicators), lawyers (biased advocates), and juries (impartial fact-finders).

Despite negative sentiments associated with judges guiding juries through instructional methods, some courts have recognized the need to evolve DNA-specific instructions. The British Court of Appeal has developed a set of instructional guidelines to provide jurors with a framework for comprehending DNA statistics:

Suppose the match probability is 1 in 20 million. If you believe that number, then on average there will be two or three people in Britain whose DNA it could be, and probably no more than 6 or 7... Now your job, as a member of the jury, is to decide, on the basis of the other evidence, whether or not you are satisfied that it is the person on trial who was the assailant, rather than one of the few other possible people who match. We don't know anything about the other people who match, although they are probably spread all over the UK, may have been nowhere near the scene of the crime, and some or all may also be ruled out by other factors, for example gender or age.

The instructions above are from Regina v. Adams, a Great Britain rape case, in which DNA match evidence and unconvincing eyewitness testimony of the victim were the only evidence against the suspect. Without the instruction, jurors might have inferred the defendant’s guilt based on the argument that the chance that one person picked at random would share the defendant’s profile was so low—one in twenty million—that the defendant was most likely the source of the crime scene DNA. But by drawing the jury’s attention to the fact that between two to seven people in the United Kingdom may share the same DNA profile as the defendant, the instruction cautioned jurors on the weight to be given to the DNA match.

While the Regina v. Adams instructions direct jurors to consider the difference between the source probability and the RMP, another, broader set of instructions from the Minnesota Supreme Court addresses other aspects of DNA

111. See State v. Arroyo, 931 A.2d 975, 983 (Conn. App. Ct. 2007) (trial judge's refusal to give the proposed DNA-specific instruction by defense was proper, and a general instruction was "sufficient to guide the jury in its deliberation"); State v. Hannon, 703 N.W.2d 498, 509 (Minn. 2005) (trial court's giving a more generic cautionary instruction that differed from the DNA-specific instruction requested by the defense was not prejudicial); State v. Thoms, No. C0-01-1373, 2002 WL 1420724, at *5 (Minn. Ct. App. July 2, 2002) (in absence of "authority for requiring a special instruction for DNA evidence," trial court was not required to issue a cautionary instruction); State v. Lloyd, No. 15927, 1999 WL 173017, at *11 (Ohio Ct. App. Mar. 31, 1999) (trial court did not err in refusing defendant's proposed DNA-specific instruction which was "more appropriately a matter of proof and argument, rather than a matter of an instruction of law"); United States v. Peters, No. 96-2286, 1998 U.S. App. LEXIS 773, at *6 (10th Cir. Jan. 20, 1998) (trial judge used proper discretion in refusing defendant's request for DNA-specific instructions).


probabilities. In the case of State v. Bloom, a rape prosecution, Justice Page wrote a concurring opinion, in which he proposed a set of DNA instructions because he believed that jurors must understand the “very precise and limited meaning of DNA statistics,” especially “which conclusions represent inferences that go beyond the statistics themselves.”

115 (1) A given DNA profile may be shared by two or more people;
(2) The random match probability statistic is not the equivalent of a statistic that tells the jury the likelihood of whether the defendant committed the crime;
(3) The random match probability statistic is the likelihood that a random person in the population would match the characteristics that were found in the crime scene evidence and also in defendant’s DNA;
(4) Where the known DNA sample from the defendant matches the unknown sample obtained from the crime scene, it does not necessarily mean the defendant is the source of the sample found at the crime scene; and
(5) That jurors alone have the final responsibility to decide the weight to be given to DNA random match probability statistics.

These proposed instructions by judges indicate that some in the judicial community recognize the role that jury instructions can fulfill—to “ensure, as best as humanly possible, that the jury uses the evidence presented in the correct manner.” Theories on the way that juries process information help elucidate the key question: How exactly will the proposed instructions by Justice Page and the British Court of Appeals help overcome the three comprehension barriers?

The social-psychological province of jury decision making has fascinated scholars, and the story model, one of the most influential models of causal reasoning, helps to illustrate what function tailored DNA instructions would play. The story model rests on the hypothesis that jurors impose a narrative story organization on trial information, which facilitates evidence comprehension and enables them to reach a pre-deliberation verdict decision. The model includes the following three components: (a) evidence evaluation through story construction; (b) representation of the decision alternatives by learning verdict category attributes; and (c) reaching a decision through the

115. Id. at 171.
116. Id.
117. Id.
118. William S. Bailey, Foreword to W. Lance Bennett & Martha S. Feldman RECONSTRUCTING REALITY IN THE COURTROOM (2d ed. 1984) (describing Bennett and Feldman’s book as “using a mix of actual trial observation, transcripts from dozens of other trials, and classic cases” to present a model of how stories work).
119. Pennington & Hastie, supra note 19, at 190.
classification of the story into the best fitting verdict category.\textsuperscript{120} See Figure 1, below.\textsuperscript{121}

Figure 1: Trapezoidal representation of the Pennington and Hastie’s Story Model\textsuperscript{122}

Figure 1 illustrates, in depth, the causal reasoning pattern that describes how jurors get from hearing the evidence to reaching a verdict. First, jurors construct a story based on the evidence they hear at trial, their prior conceptions of the world, and their generic expectations of what a story structure should look like.\textsuperscript{123} This phase represents the story construction process. Next, jurors learn verdict categories, including the elements of the crime, the verdict alternatives, and the burden of proof.\textsuperscript{124} This process is facilitated by the instructions that the judge gives to jurors and colored by preconceived ideas jurors already have about crime categories.\textsuperscript{125} The last stage of the learning process involves classification of the story into a verdict category. At this stage, members of the jury deliberate and decide on how well the story fits into one verdict category or another.\textsuperscript{126} Based on how well the story fits, the jury renders a verdict of guilty or innocent.\textsuperscript{127} Jurors’ satisfaction with the “goodness of fit,” or what Roth has

\begin{itemize}
  \item Prior ideas about crime categories (e.g., burglary, manslaughter, rape)
  \item Jury instructions
  \item Learn verdict alternatives
  \item Case specific information
  \item Prior knowledge about similar events
  \item Generic expectations about story structure
  \item Goodness of fit between story and verdict category
  \item Verdict classification
\end{itemize}

\textsuperscript{120} \textit{Id.} at 190.
\textsuperscript{121} \textit{Figure 1} is my own visual adaptation of the story model as described by Pennington and Hastie.
\textsuperscript{122} I felt that the trapezoidal shape visually represented the story model as described by Pennington and Hastie best.
\textsuperscript{123} Pennington & Hastie, \textit{supra} note 19, at 190.
\textsuperscript{124} \textit{Id.} at 191.
\textsuperscript{125} \textit{Id.}
\textsuperscript{126} \textit{Id.} at 191–92.
\textsuperscript{127} \textit{Id.}
called “moral certainty of guilt” is a product of how sincere their belief is in the truth of their story.\footnote{128}{Roth, \textit{supra} note 16, at 1168.}

In the context of DNA match cases, Roth has argued that “naked statistical evidence of guilt is incapable of inspiring a juror’s actual belief in guilt” because a juror has difficulty constructing a story based on numbers alone.\footnote{129}{\textit{Id.} at 1158.} The weight jurors give to a DNA match alone is therefore heavily inspired by the arguments of counsel, inevitably colored by the persuasive force of complex statistical evidence as illustrated by the prosecutor’s fallacy. As Roth has observed, “even the most seemingly innocuous proxies systematically overpunish if they are \ldots triggered and executed in an automated way, without a safety valve.”\footnote{130}{Roth, \textit{supra} note 17, at 1288.} Jury instructions aimed at equipping the ordinary juror to critically evaluate evidence generated solely by machines or a combination of machines and human interpretation function as a safety valve to help jurors engage in a more thoughtful reasoning process. Juror rationality, in turn, checks the power of mechanical proxies like TrueAllele that overpunish criminal defendants.

With respect to the way that jurors form conclusions, evidence scholar David Sklansky has suggested that story construction is not linear, and instead, occurs on a continuum.\footnote{131}{David A. Sklansky, \textit{Evidentiary Instructions and the Jury as Other}, 65 \textit{STAN. L. REV.} 407, 413 (2013).} This rendition of juror decision making is different from Pennington and Hastie’s linear model. Sklansky shows how learning verdict categories through instructions (specifically, limiting instructions that caution jurors to disregard a piece of evidence they have already heard) influences jurors to change their narrative, and in so doing, change their pre-deliberation verdict.\footnote{132}{\textit{Id.}} As such, the new causal reasoning process that Sklansky describes would require the story trapezoid (Figure 1) based on Pennington and Hastie’s model to be modified in the following way (Figure 2).
In this new model, linear pathways are replaced by a circular information flow in which the jury verdict is closely tied to the intellectual process that continuously evaluates story construction and verdict representations. The story model is a better way of representing juror decision making because it captures the circular flow of human thought.

Based on this circular information flow of narrative construction and reconstruction, DNA jury instructions would play an important role in determining how story formation occurs. First, instructions provide a framework that allows jurors to assemble information to produce a verdict. For example, the fourth and fifth instructions proposed by Justice Page tell jurors that there may be more DNA profiles that match the crime scene DNA. In so doing, they help to prevent jurors from drawing an adverse inference of guilt based on a single match. Second, the instructions encourage jurors to view their pre-deliberation verdict critically and change it based on a clearer understanding of statistical evidence. Finally, the instructions ensure that the reasoning process is rational and not based on flawed information or biases.

133. I felt that Sklanky’s description of the information flow leading to the story construction process could best be represented in the form of a circle because story construction occurs on a continuum with jurors reevaluating their understanding of the story as they hear more information during the course of the trial.

134. State v. Bloom, 516 N.W.2d 159, 171 (Minn. 1994) (Page, J., concurring) (Justice Page’s fourth and fifth instructions were: “(4) Where the known DNA sample from the defendant matches the unknown sample obtained from the crime scene, it does not necessarily mean the defendant is the source of the sample found at the crime scene; and (5) That jurors alone have the final responsibility to decide the weight to be given to DNA random match probability statistics”).
Many have argued that instructions are unnecessary given that experts are sufficient to educate the jury on complex statistical evidence. However, leaving this explanation to experts often brings chaos, because experts are hired to persuade the jury toward a certain legal conclusion. Because most jurors enter the courtroom with only a rudimentary understanding of DNA evidence and mathematics, they need someone who is neutral to provide them with clarification. The judge, whose impartiality carries great weight in the courtroom, occupies that position. The next Part addresses the counterarguments against judges giving DNA-specific instructions—spanning from judicial overreach, to the sufficiency of expert instructions, to scientific exceptionalism of DNA.

III. COUNTERARGUMENTS

Four primary concerns drive the debate against requiring DNA-specific jury instructions at trial. First, courts claim that DNA jury instructions would require a judge to comment impermissibly on factual scientific evidence. Second, judges fear that special instructions would contribute to scientific exceptionalism of DNA over other types of complex forensic evidence. Third, some judges maintain that DNA instructions are unnecessary when the general expert jury instruction for all forensic evidence serves to caution jurors on any ambiguities in DNA evidence. Finally, scholars assert that the Frye and Daubert standards as well as state statutes provide adequate safeguards for DNA evidence presented at trial, rendering the need for DNA instructions superfluous. While a trial judge may reject DNA instructions based on one or a combination of the rationalizations discussed above, it is probably the fear of reversal on appeal that most animates such a decision. This Part aims to allay those expected fears so that judges feel more comfortable granting the request to provide instructions.

A. Judge’s Comment: A No-No

One critique against DNA instructions is that it would require a judge to overstep judicial neutrality and comment on the evidence. However, judicial comment in the form of jury instructions is important in the context of DNA match evidence, because jurors are prone to misapplying match statistics and arriving at inaccurate verdicts for reasons discussed in Part II.A.

In the American system of jurisprudence, judicial comment on evidence is often improper because of the notion that it places too much authority in one person. According to one judge, prohibitions against comment “arose from the

135. See State v. Roman Nose, 667 N.W.2d 386, 398 (Minn. 2003). In a rape case, the trial court rightly “believed an instruction on expert testimony sufficiently covered the topic” and did not abuse “its discretion in failing to provide [defense’s proposed] cautionary jury instructions . . . .” Id.

136. Frank Hoyt, The Judge’s Power to Comment on Testimony in His Charge to the Jury, 11 Marq. L. Rev. 67, 68 (1927) (observing that the cause behind the American position on judicial
pioneer spirit which enjoyed the excitement of the trial of the lawsuit. The "pioneer spirit" manifests itself in a system that has narrowly carved out the roles of judge, jury, and counsel as a way to provide checks and balances on judicial overreach. At common law, judges were allowed to comment on the evidence presented at trial to the jury. In most states, this privilege has been removed through statute or judicial decision. While federal courts still retain the power to comment on evidence, that power is rarely invoked in criminal trials because, as Judge Jack Weinstein put it, "[J]udges know that use of dry, generic form charges copied from chargebooks reduces the risk that they will be reversed." This deep-rooted fear that judicial comment will add to the evidence and bias the jury in favor of the judge's opinion extends to DNA jury instructions as well. In a Virginia case, Keen v. Commonwealth, the trial judge rejected the defendant's request to provide six cautionary DNA-specific instructions. The defendant then raised the issue on appeal arguing that without the instructions, jurors could not be expected to perform their duty fully or fairly when they did not understand the intricacies of DNA evidence. On appeal, the court sided with the trial judge, reasoning that the proposed instructions were "scientific knowledge, not legal principle," and would require the impartial trial judge to "impermissibly [comment] upon the evidence."

Comment "really lies deeper: namely, these constitutional prohibitions were the result of the revolutionary spirit of our ancestors, which opposed placing what they considered too much authority to be exercised by one man, and considered that it was more democratic and safer to leave the determination of their rights to the members of the jury, free from the influence which the comments of the judge would exercise upon their minds.").

137. Id. at 67 (paraphrasing observations of Judge Newcomer).
138. Id. at 67–68.
139. Lawrence Wolff Gidwitz, The Right of a Federal Judge to Comment on the Evidence, 1 U. CHI. L. REV. 335, 335 (1933). This was a practice thought to give to jurors "great light and assistance." Id. (quoting Sir Matthew Hale, HISTORY OF THE COMMON LAW 291–92 (1793)).
140. Hoyt, supra note 136, at 67.
142. In Quercia v. United States, 289 U.S. 466, 468, 470 (1933), the Supreme Court reversed a conviction in a case where the trial judge called the jury's attention to the fact that the defendant had wiped his hands during the testimony: "[I]t is rather a curious thing, but that is almost always an indication of lying. Why it should be so we don't know, but that is the fact. I think that every single word that man said, except when he agreed with the Government's testimony, was a lie." The Court held that trial judge had assumed the role of witness in giving improper assistance to the jury. The Court reasoned that the trial judge had impermissibly commented on evidence by stating an opinion so strong that it influenced members of the jury and prejudiced the defendant. Id. at 468, 470.
144. Id.
145. Id.
The Keen case—and similar cases in other states—shows not only the fear of judicial comment but also the age-old dichotomy between fact and law. Similarly, the Supreme Court of Ohio rejected a defendant’s request to provide jury instructions citing this fact-law distinction: “[t]he position sought to be advanced by the defendant through the use of this proposed jury instruction is more appropriately a matter of proof and argument, rather than a matter of an instruction of law.”

While the general thrust of American jurisprudence prohibits a judge from commenting on fact, in most criminal trials, judges routinely make threshold factual decisions related to reliability or sufficiency. James Thayer aptly pointed out that “much fact which is part of the issue is for the judge . . . and, as regards all, the jury is subject to the supervision of the judges in order to keep it within the limits of reason.” Although DNA statistics involve factual matters, the key question is whether DNA instructions constitute impermissible judicial comment, or whether they provide necessary guidance to keep jurors within the limits of reason to justify an exception to the rule.

DNA evidence warrants an exception to the judicial comment rule for two reasons. First, instructions would increase a juror’s ability to follow technically oriented proceedings and thus increase the accuracy of verdicts. Second, instructions would clarify “what may have been distorted by the bias of counsel’s arguments.” In so doing, the instructions would provide jurors with the requisite vocabulary and framework for evaluating complex DNA evidence.

In the past, courts have extended the comment exception to situations where jurors were at high risk of misunderstanding the evidence and erroneously inferring guilt. Under the common law, California and most other states required the judge to give sua sponte jury instructions in rape cases where the victim’s testimony was uncorroborated by any other evidence because conventional wisdom held that a word of a rape victim was not reliable. A boilerplate rape corroboration instruction would have stated that “a charge such as that made against the defendant in this case is one which is easily made and, once made,

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149. Id. at 169.

150. See Weinstein, supra note 141, at 163.

151. See id.

difficult to defend against, even if the person accused is innocent. Therefore, the law requires that you examine the testimony of the female person named in the information with caution.” The first portion contained a general observation about the character of the crime charged—“rape is easy to charge, but difficult to defend against.” The second portion of the instruction prescribed caution by commenting on the credibility of a witness.

In California, the suggestion of requiring a cautionary instruction was first adopted in People v. Putnam, where a trial court held a minor’s accusation of lewd and lascivious acts to be unreliable and untrustworthy. Because California had no corroboration requirement for the conviction of sex crimes, the Putnam court reasoned that the trial court’s failure to give “a cautionary instruction was prejudicial and that a different verdict would not have been improbable had the error not occurred.”

However, after a series of rape reform initiatives, most jurisdictions, including California, abolished the corroboration requirement either through legislation or court rulings. In People v. Rincon-Pineda, the California Supreme Court first disavowed the corroboration instruction because it had outlived its usefulness. The court disapproved of the discretionary use of the instruction as “inappropriate in any context,” finding that it served “no just function,” and that defendants accused of sex offenses no longer suffered any “special prejudice.”

Although the corroboration instruction is outdated and sexist in the context of sex offenses, it is surprisingly useful in the DNA context. The corroboration instruction shows the need for jury instructions in situations where evidence carries a certain power. While feminists and rape reform activists succeeded in uncovering the lack of empirical support for believing that a victim’s word was unreliable, scholars have conversely illustrated how DNA is exalted as the “truth machine,” the “gold standard,” and “unassailable.” Although the rape instruction likely served no function other than to fuel sexist assumptions about women, here DNA jury instructions would act as a counterweight to protect the

153. Judicial Council of Cal. Criminal Jury Instructions (CALCRIM) No. 10.22 (3d ed. 1970). The instruction was based on British Jurist Matthew Hale’s statement, “It is true rape is a most detestable crime, and therefore ought severely and impartially to be punished with death; but it must be remembered, that it is an accusation easily to be made and hard to be proved, and harder to be defended by the party accused, tho [sic] never so innocent.” See SIR MATTHEW HALE, THE HISTORY OF THE PLEAS OF THE CROWN 635 (Sollum Emlyn ed., Robert H. Small 1847) (1680).
154. CALCRIM No. 10.22.
155. 20 Cal. 2d 885, 892 (Cal. 1942).
156. Id.
158. 14 Cal. 3d 864, 877 (Cal. 1975).
159. Id. at 882.
160. See LYNCH ET AL., supra note 7, at 256, 340.
accused. Thus, unlike the corroboration instruction, there exists a much stronger basis to believe that DNA is so powerful that it warrants instructions to caution jurors of its hidden biases and subjectivities. A judge’s cautionary instruction that a DNA profile may be shared by more than one person, or that RMP does not necessarily indicate that the defendant is the source of the crime scene DNA, aims to prevent the jury from drawing an improper inference of guilt.

B. Scientific Exceptionalism

Another objection to DNA jury instructions is that they single out DNA evidence over other types of evidence, and in turn, give more weight to DNA matches. This argument is an example of scientific exceptionalism, which describes the phenomenon where judges object to DNA jury instructions because they do not want to promote the notion that DNA is special. For example, one court rejected a defendant’s request for cautionary DNA instructions similar to those suggested by Justice Page in State v. Bloom,161 because it felt that such instructions would “highlight the importance of DNA opinion evidence over other scientific opinion evidence such as the medical examiner’s analysis of the condition of the victim’s body and the BCA’s fingerprint analysis.”162

This objection is misguided because DNA is already exceptional, as it is often placed on a pedestal and heralded as the gold standard. In rejecting the defendant’s request for DNA instructions, the court overlooked the reality that DNA is already glorified by the media and experts. This leads jurors to “place undue weight on, or make inappropriate inferences from statistical probability testimony.”163

As discussed in Part II, DNA is often viewed as exceptional because it is used for different, legitimate purposes, such as predicting disease predisposition, informing disease management, identifying family ancestry, clarifying paternity disputes, and exposing individual identity.164 Awareness of these uses has elevated DNA, the blueprint of life, to a pedestal that inspires awe and reverence in popular culture, among scholars, law enforcement communities, and groups like the Innocence Project, which use DNA to exonerate wrongfully convicted individuals.165

Additionally, DNA match evidence has the potential to provide more nuanced probabilities and, in turn, accurate information about a suspect’s identity. This sets it apart from other types of forensic evidence that do not involve probabilities to the same extent. For example, fingerprint matches are

162. State v. Roman Nose, 667 N.W.2d 386, 398 (Minn. 2003).
not particularly difficult to comprehend because they can be visibly compared and contrasted to render a match or no match. Blood type testing requires even fewer interpretive leaps than fingerprinting. The data from blood typing is one-dimensional because it results in a determination of one blood type—A, B, AB, or O. Since 25 percent of the population shares the same blood type, it is not probative of identity in the same way DNA is.

DNA is also exceptional because of the way it is used. Unlike other forensic techniques used to determine identity, DNA alone can obtain convictions and exonerations. Part of DNA’s stand-alone power is the molecule’s potential for accurately predicting identity. This accuracy remains unparalleled in contrast to fingerprints, blood type, and facial recognition, which are far less reliable and, in many cases, have been limited to investigative purposes. There are very few cases in which cold hit convictions were obtained from fingerprints or blood typing alone because courts, scholars, and ordinary individuals recognize that these technologies are unreliable. While facial recognition software analysis is probably the closest to DNA typing in terms of complexity, its utility is limited to investigative purposes. As the California Court of Appeal noted, “[w]hether facial recognition software is discerning and accurate enough to select the

166. Fingerprint matches are based on a fingerprint’s friction ridge, the presence or absence of features along the individual friction ridge paths and their sequence, and the intricate detail of a single ridge. See Gang Fang et al., Use of Ridge Points in Partial Fingerprint Matching 24–25 (Research Paper 2007), http://research.mssn.edu/fanglab/papers/Fang2007RRP-full.pdf [https://perma.cc/K59K-5QJ]. Different examiners and jurisdictions have set their own standards to determine what constitutes a match. And courts in the United States have left the definition of a match up to the experts themselves. In some jurisdictions, an expert may testify that four points of similarity constitute a match. See Jennifer L. Mnookin, The Achilles’ Heel of Fingerprints, WASH. POST (May 29, 2004), http://www.washingtonpost.com/wp-dyn/articles/A64711-2004May28.html [https://perma.cc/SKN7-B386].


168. For example, the Innocence Project reports that there have been 339 post-conviction DNA exonerations since 1989. See DNA EXONERATIONS NATIONWIDE, INNOCENCE PROJECT (Mar. 7, 2016), http://www.innocenceproject.org/free-innocent/improve-the-law/fact-sheets/dna-exonerations-nationwide [https://perma.cc/F8TT-QD4X].

169. Roth, supra note 17, at 1261 (discussing that “DNA has a relatively impressive scientific foundation compared to forensic disciplines like toolmark and fingerprint analysis that were developed mostly within the law enforcement context”).

170. The famous case of Brandon Mayfield, a lawyer and convert to Islam, who was arrested and detained when the FBI alleged that his fingerprint had matched with terrorists responsible for the Madrid bombings, is an exceptional case of fingerprints being used as sole evidence to arrest and detain someone who later turned out to be innocent. Mayfield’s case shows how unreliable fingerprinting can be. See Gretchen Gavett, Can Unconscious Bias Undermine Fingerprint Analysis?, KPBS FRONTLINE (Apr. 16, 2012), http://www.pbs.org/wgbh/frontline/article/can-unconscious-bias-undermine-fingerprint-analysis [https://perma.cc/GM35-YEE6].

perpetrator, or whether it declared a match involving many different people who resembled ‘Joey,’ or how many driver’s license photographs were searched by the software, is immaterial: what matters is the subsequent confirmatory investigation.\textsuperscript{172}

To the contrary, scholars agree that DNA match evidence is “generally quite reliable.”\textsuperscript{173} Mathematician Keith Devlin has written that the RMP “provides a reliable estimate of the likelihood that the two profiles came from different individuals.”\textsuperscript{174} The National Research Council has declared the “reliability and validity of a properly collected sample” of DNA. Even Professor Roth has acknowledged that DNA has a “relatively impressive scientific foundation,” compared to forensic disciplines like toolmark and fingerprint analysis.\textsuperscript{175}

Furthermore, most state legislatures have decided that DNA evidence is reliable enough to be admitted at trial. All fifty states admit DNA evidence unless there is a specific reason to believe that it is not relevant to the case.\textsuperscript{176} Indiana, for example, has gone as far as to declare by statute that in any criminal trial, “the results of forensic DNA analysis are admissible in evidence without antecedent expert testimony that forensic DNA analysis provides a trustworthy and reliable method of identifying characteristics in an individual’s genetic material.”\textsuperscript{177} The general consensus around DNA testing as a reliable method for identifying unknown perpetrators shows that DNA is special and begs the question of how DNA matches can better be explained to jurors so they can arrive at informed verdicts.

While the concern about scientific exceptionalism is well-founded, it does not apply to DNA evidence, which is already exceptional. The double-edged sword of DNA being both statistically daunting and so hyper-reliable that it alone can propel a verdict compels the need for jury instructions that elucidate its complexity. DNA-specific instructions are necessary because they would dissipate this existing exceptionalism and dispel the “truth myth” through cautionary effect.

C. General Expert Instructions and “Neutral” Experts

A third argument against DNA instructions is that DNA evidence is already “properly imparted to the jury through the testimony of expert witnesses.”\textsuperscript{178} Experts, however, are frequently used as “hired guns” to buttress counsel’s

\textsuperscript{173} THOMPSON, supra note 27, at 3.
\textsuperscript{174} Devlin, supra note 90, at 8.
\textsuperscript{175} Roth, supra note 17, at 1261.
\textsuperscript{176} See supra text accompanying note 40.
\textsuperscript{177} IND. CODE § 35-37-4-13 (1991).
Experts have a strong incentive to manipulate statistics, and in some cases, omit statistics that would be more favorable to the other party. The cold hit database case of John Puckett is telling in this respect. In that case, the government’s expert only introduced one statistic, an RMP of 1.1 million that bolstered its argument that seventy-two-year-old Puckett had murdered the victim more than thirty years earlier. The judge refused the defense attorney’s request to admit the source probability, which would have been more favorable to Puckett. If jurors had heard the source probability—that there was a greater than 50 percent chance that another individual in the Bay Area shared the same profile—they might not have found Puckett guilty.

Countless examples abound of trial judges refusing to give DNA-specific instructions because they feel that generic expert instructions serve the same educational purpose. Rather than providing DNA-specific instructions, most judges provide a generic instruction that tells jurors to take the expert’s testimony with a grain of salt. The following is from California’s model criminal jury instructions:

(A witness was/Witnesses were) allowed to testify as [an] expert[s] and to give [an] opinion[s]. You must consider the opinion[s], but you are not required to accept (it/them) as true or correct. The meaning and importance of any opinion are for you to decide. In evaluating the believability of an expert witness, follow the instructions about the believability of witnesses generally. In addition, consider the expert’s knowledge, skill, experience, training, and education, the reasons the expert gave for any opinion, and the facts or information on which the expert relied in reaching that opinion. You must decide whether information on which the expert relied was true and accurate. You may disregard any opinion that you find unbelievable, unreasonable, or unsupported by the evidence.

These instructions focus exclusively on ensuring that jurors do not afford the expert testimony more weight than lay testimony, rather than elucidating the testimony itself. The problem with such boilerplate instructions in DNA cases is that they fail to guide jurors on the complexities specific to DNA evidence.

181. *Id.* at 1131–32.
182. *Id.* at 1132.
183. State v. Arroyo, 931 A.2d 975, 983 (Conn. App. Ct. 2007) (trial judge’s refusal to give the proposed DNA-specific instruction by defense was proper, and a general instruction was “sufficient to guide the jury in its deliberation”); State v. Hannon, 703 N.W.2d 498, 509 (Minn. 2005) (trial judge’s more generic cautionary instruction that differed from the DNA-specific instruction requested by the defense was not prejudicial); State v. Roman Nose, 667 N.W.2d 386, 398 (Minn. 2003) (An “instruction on expert testimony sufficiently covered the topic.” The court concluded that “while courts may disagree whether cautionary jury instructions are required when DNA evidence is presented, we cannot say the district court abused its discretion in failing to provide cautionary jury instructions in this case”).
184. CALCRIM No. 332 (2016).
Furthermore, they fail to provide any basis for jurors to engage in fully informed reasoning that prompts them to reevaluate their story and pre-deliberation verdict before reaching a final verdict.

One alternative that, on the surface, may seem appealing is the use of court-appointed experts under Federal Rule of Evidence 706, or the Rule’s state equivalents. While the Rule does not by its own terms refer to “neutral” experts, the underlying goal is to find an expert—outside of the stances of the litigating parties—who is neutral as to the scientific and technical questions presented. Advocates for the use of Rule 706 generally point to the ability of court-appointed experts to educate judges who have no scientific expertise and the ability of such experts to “break the deadlocks” created by the “battle of the experts.”

But, no matter how neutral we wish experts to be, science itself is not value-free. Thus scientific experts can never be neutral in the sense required by Rule 706. A judge, on the other hand, considered to be a neutral adjudicator, has the power to assure neutrality through jury instructions. In technical DNA trials, a generic jury instruction to caution jurors that expert opinions are not infallible is inadequate. Expert jury instructions are too general to help jurors comprehend the unique issues specific to DNA evidence. Judges need to provide jurors with DNA-specific instructions that help jurors engage in a thought process to understand the significance of a DNA match and render a well-informed verdict.

D. Conditional Instructions

The fourth objection to DNA instructions is that they are not appropriate unless the defendant is able to produce evidence of error in the match results. The effect of this practice places the burden on defendants to either produce independent proof that the prosecution’s DNA matches contain error, or elicit (through cross examination) evidence that there was error in the DNA testing process. The objection is misguided because, first, it places an insurmountable burden on defendants to prove existence of error when, in many instances, defendants do not even have access to their test results or to independent testing of samples and, second, placing such a high burden on defendants overlooks the purpose of instructions, which is to help jurors understand DNA probabilities.

This issue came up in State v. Lloyd, a case where the defendant, Lloyd, was convicted of burglary after the State showed at trial “that blood collected from the crime scene matched blood subsequently drawn from the defendant.” The case was appealed to the Ohio Supreme Court. One of the principle issues Lloyd raised on appeal was that the trial court had committed reversible error in

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185. FED. R. EVID. 706 (regarding court appointed expert witness).
186. Id.
187. See Crowley, supra note 30, at 948.
189. Id. at *1–2.
failing to give the following instruction pertaining to DNA evidence: “[n]o scientific procedure always produces correct results. Given the human element involved in their design and process, all scientific procedures and analyses have incidents of error.”

The Supreme Court of Ohio ruled against Lloyd on this issue. First, the court made the familiar judicial comment argument, reasoning that the instructions required the judge to step outside the bounds of judicial neutrality by commenting on a matter of fact, not law. Second, the court reasoned that DNA instructions were inappropriate because Lloyd had not elicited specific evidence on the “propensity of scientific procedures to produce correct results or the effect that the ‘human element’ may have on the incidents of error . . . ” in his particular case. While the court acknowledged that Lloyd had “challenged the accuracy of particular DNA test results on cross-examination,” it deemed Lloyd’s challenge as far too general to merit any DNA-specific instructions.

The Lloyd court cited to State v. Pierce, another Ohio Supreme Court case related to DNA match evidence in which the majority suggested that cautionary jury instructions may be appropriate in the case, even though the defendant had not asked for them. The Pierce court stated that “[w]ith adequate cautionary instructions from the trial judge, vigorous cross-examination of the government’s experts, and challenging testimony from defense experts, the jury should be allowed to make its own factual determination as to whether the evidence is reliable.” The Lloyd court interpreted the holding in Pierce to mean that instructions were not necessary because the defendant, Pierce, had only shown that the laboratory that conducted his DNA tests had a less than 100 percent proficiency score, without raising affirmative evidence that the DNA analysis of his blood samples was “done incorrectly, or that the test results were misinterpreted or tainted in any way.” Lloyd shows how the Ohio Supreme Court created a new burden on defendants to elicit affirmative evidence of error in DNA testing in order to merit jury instructions.

Several problems exist with placing the burden on the defendant to prove that a DNA match contains errors or exonerates the defendant. In many cases, defendants do not have access to their test results. Without access to their results beforehand, defendants are at a high risk of being wrongly convicted or coerced by law enforcement to confess and take guilty pleas when they did not commit the crime. This situation arose in the 2001 prosecution of Joseph Buffey, which made headlines and resulted in a ruling from the West Virginia Supreme

190.  Id. at *10.
191.  Id. at *11.
192.  Id. (reasoning that the jury instruction “would potentially skew the jury’s determination of the weight to be given to the DNA evidence actually presented in the case”).
194.  Id.
In 2001, Joseph Buffey, a nineteen-year-old man was arrested in West Virginia for three separate commercial burglaries. During his interrogation, the police asked Buffey about another recent robbery and sexual assault of an eighty-three-year-old woman that had occurred less than a mile away from one of the burglaries. After nine hours of questioning at the police station without food or water, Buffey confessed to the robbery and rape of the woman. Over the next few months and until May 2002, his lawyer asked the prosecution for the DNA match results from the rape kits that had been collected at the crime scene. Buffey’s lawyer was told that the West Virginia State Police Forensic Laboratory had not generated any reports. In May, the prosecution offered Buffey a plea deal, which Buffey’s lawyer advised him to take because the lawyer believed that “he [Buffey] had a good chance of only serving [fifteen] years in prison.” Instead of the fifteen years as predicted, Buffey received a sentence of seventy to one-hundred-and-ten years.

In November 2002, Buffey filed a petition from prison asking for the DNA results, alleging that he was coerced into making a false confession. The report he received from the state forensics lab revealed that he was not the source of the male DNA taken from the semen sample in the victim. While the report “found trace amounts of DNA from another male, [] they were later determined to be too minute to have come from the rape.” The prosecution never turned over the results to Buffey or his lawyer, even though the forensic lab had produced the DNA report weeks before the trial court accepted Buffey’s guilty plea.

Buffey’s case raised serious questions of a defendant’s access to DNA match results. It confirmed that DNA samples and testing processes remain exclusively in the hands of law enforcement. On appeal in the case, the West Virginia Supreme Court ruled in favor of defendants’ access to DNA test results. The court held that prosecutors had an obligation to turn over exonerating DNA match evidence to defendants. The court’s ruling, however,

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198. Buffey, 782 S.E.2d at 206–08.
199. Id. at 207.
200. Id.
201. Bazelon, supra note 197.
202. Id.
203. Id.
204. Id.
205. Id.
206. Id.
207. Id.
208. Id.
210. Id. at 220–21.
was narrow; it only mandated that prosecution turn over DNA matches that exonerate the defendant. The rule did not provide a uniform procedure for giving defendants access to their results before trial and in a timely manner. This affects not only criminal defendants, but the lawyering profession in general. For example, the West Virginia Trial Lawyers’ Handbook notes how narrowly the state’s courts have interpreted DNA access laws.\(^{211}\)

Just as the West Virginia courts have taken a cautionary approach to giving defendants access to their DNA results, its legislature has gone even further in limiting the rights of defendants to DNA testing. The law states that defendants have the absolute right to ask for DNA testing results, but it does not give defendants the right to have DNA testing conducted.\(^{212}\) Thus, even with the ruling in *Buffey*, the access problem persists in other contexts of DNA match testing, with the state having almost no procedures that guarantee defendants’ access to test results.\(^{213}\)

Even the Federal Rules of Evidence prescribe procedures for providing defendants with access to certain types of evidence that have the tendency to be prejudicial. For example, Rule 404(b) requires the prosecution, upon request by the defendant, to provide reasonable notice of any character evidence the prosecutor intends to offer at trial to prove motive, opportunity, intent, plan, or identity.\(^{214}\) The Rule provides that prosecutors must give notice before trial unless the court “for good cause, excuses lack of pretrial notice.”\(^{215}\)

No such safeguard exists in the federal evidence rules for giving defendants pretrial notice related to DNA evidence. Rule 16 of the Federal Rules of Criminal Procedure gives defendants some right to discovery of DNA evidence, but is still inadequate in providing access to data that would uncover laboratory error. Specifically, Rule 16(a)(1)(G) requires the government to disclose information regarding its expert witnesses, which, in a DNA case, would include the qualifications and testimony of the prosecution’s forensic expert.\(^{216}\) But, the rule

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\(^{211}\) See *Stephen P. Meyer*, TriAL HanDBOOK FoR West Virginia LAWYers § 4:45 (2017) (discussing that the West Virginia Supreme Court “held that its ruling, *In re Renewed Investigation of State Police Crime Laboratory, Serology Div.*, [633 S.E.2d 762 (W. Va. 2006),] did not afford every petitioner with alleged serology issues the right to additional DNA testing.” The Handbook further states that according to another ruling, *State ex rel. Burdette v. Zakaib*, 685 S.E.2d 903 (W. Va. 2009), “[i]n order to have the right to additional DNA testing, the evidence sought to be tested must likely produce an opposite result if a new trial were to occur, and the evidence cannot be such that its purpose is merely to impeach or discredit a State’s witness”).


\(^{213}\) *Buffey* v. Ballard, 782 S.E.2d 204, 220–21 (W. Va. 2015).

\(^{214}\) FED. R. EVID. 404(b).

\(^{215}\) *Id.*

\(^{216}\) FED. R. CRIM. P. 16(a)(1)(G). According to the National Research Council on DNA Forensic Science, Rule 16 was amended in 1993 to “require that the government disclose to a defendant a summary of the expert testimony that the prosecution intends to offer on direct examination and the bases. It is still unclear whether this provision will cause experts to provide more detailed written documentation than they previously furnished. Many states do not have a counterpart to this subdivision. Other jurisdictions make all discovery related to scientific tests discretionary, and still others explicitly
is not applied uniformly in all jurisdictions because some courts only require discovery disclosure of written statements. This means that the defendant “cannot obtain discovery of laboratory records if the DNA examiner fails to submit a written report or to incorporate a matter into a report, even if the examiner makes an oral report.” Some state courts have adopted liberal DNA discovery rules, yet other states are more restrictive, denying discovery of DNA databanks and experts’ forensic notes. The lack of uniform discovery procedures across jurisdictions and some states’ restrictive rules prevent defendants from acquiring the range of information needed to challenge the accuracy of DNA matches.

Access questions have gained traction in the scholarly legal community as well. For example, the American Bar Association (ABA) has suggested ways to ensure that defendants receive their DNA match results. Similar to Federal Rule 404(b), the ABA outlines pretrial procedures for disclosure: “[t]he prosecutor should be required, within a specified and reasonable time prior to trial, to make available to the defense the following information and material relating to DNA evidence . . . .” This includes laboratory reports, laboratory case files, chain of custody documents, raw electronic data produced during testing, reports of lab contamination or other problems affecting testing, lists of lost or destroyed items from the crime scene that were believed to contain DNA evidence, and any

provide for the discovery of oral reports of examinations or tests.” See Nat’l Research Council, The Evaluation of Forensic DNA Evidence 166, 168, n.7 (1996).

217. See United States v. Shue, 766 F.2d 1122, 1135 (7th Cir. 1985), cert. denied 484 U.S. 956 (1987) (finding that FBI photographic expert’s oral report was not discoverable under Federal Rule 16 because it was not written).


219. State v. Schwartz, 447 N.W.2d 422, 427–28 (Minn. 1989) (DNA testing laboratory, Cellmark’s refusal to supply, at the defendant’s request, “more specific information regarding its methodology and population data base” violated the defendant’s constitutional right to due process. The court excluded the evidence reasoning that “access to the data, methodology, and actual results is crucial so a defendant has at least an opportunity for independent expert review”); People v. Davis, 196 A.D.2d 597, 598 (N.Y. App. Div. 1993) (finding that in a rape case, Lifecodes, a forensic laboratory, violated the defendant’s due process rights when it refused to provide the defendant, upon his request, with information on match probability estimates at trial, but nevertheless, testified that the statistical “probability of someone other than the perpetrator providing the alleged ‘match’ was ‘one in ten million.’” The court held that the failure to disclose this “crucial” information necessitated a new trial). In contrast, some states interpret discovery of DNA evidence more restrictively. See State v. Dykes, 847 P.2d 1214, 1217–18 (Kan. 1993) (denying a defendant who had Native American ancestry his request to obtain discovery of a DNA data base which would have allowed him to discover whether the data base contained other Cherokee Indian genealogies and overestimated his match frequency); Spencer v. Commonwealth, 384 S.E.2d 785, 791 (Va. 1989), cert. denied, 110 U.S. 1171 (1990) (a forensic expert’s failure to provide defendant with a written report of probability statistics which had been updated the day before trial did not violate defendant’s due process rights).

matches that would tend to negate defendant’s guilt. These ABA guidelines address the unique DNA evidence issues and recognize how important it is for defendants to have as much information as possible before trial.

Yet, even if federal and state rules were changed with procedures that ensured that defendants had access to match results, states like West Virginia provide defendants with a limited right to independent testing of DNA samples. The problem with such a narrow right to independent testing is that defendants have no means of cross-checking match results until after they have been convicted. Because errors frequently occur at the testing stage or due to lab error, cross-checking for error before conviction is extremely important to ensuring the accuracy of a match.

Even the ABA has recognized the need for cross-checking; it recommends that “[w]hen possible, a portion of the DNA evidence tested and, when possible, a portion of any extract from the DNA evidence should be preserved for further testing.” This standard enumerates that a “laboratory should not undertake testing that entirely consumes DNA evidence or [] extract from it without the prior approval of the prosecutor if a law enforcement officer is requesting the testing, or of defense counsel if the testing is requested by defense counsel or defense counsel’s agent.” These suggested guidelines illustrate the need and importance for preserving DNA extracts in case one party requests further testing.

As discussed above, there exist insurmountable burdens related to defendants’ access to match results and their samples. While the ABA has set out guidelines to ameliorate access issues, most federal and state courts do not have procedures to ensure that defendants have all the information related to their DNA tests. Given this lack of access to their DNA match results, it is impractical to expect defendants to raise evidence of error or false matches. Thus, conditioning the availability of DNA-specific jury instructions on whether the defendant has affirmatively elicited evidence of error ignores access issues.

The second problem with courts denying jury instructions based on a defendant’s failure to prove a specific instance of error is that it overlooks the educational role that instructions play in helping jurors understand complex match evidence. Without instructions, jurors will continue to remain confused. The O.J. Simpson trial, one of the most publicized DNA criminal adjudications in history, exemplifies the problem of juror miscomprehension, which led to a

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221. *Id.*
222. *W. Va. Code § 15-2B-14* (2004) (providing defendants with a limited right to independent DNA testing, but only after conviction. The law enumerates, “[a] person convicted of a felony currently serving a term of imprisonment may make a written motion before the trial court that entered the judgment of conviction for performance (DNA) testing”).
223. *Standards for Criminal Justice, supra* note 220.
224. *Id.*
misinformed acquittal. In that case, O.J. Simpson, a popular sports celebrity, was charged with a brutal murder of his ex-wife Nicole and her friend. The Los Angeles Police department found “over 100 pieces of biological evidence” from the crime scene “consisting of primarily blood droplets and stains.” Three independent laboratories tested sixty-one items of evidence, which included 108 samples “extracted in 22 sets and tested alongside 21 quality control samples.” According to forensic scientist and expert John Butler, “from a scientific point of view, the results from the three testing laboratories agreed and more than a score of DNA markers were examined with no exclusions between the crime scene samples and Mr. Simpson.” Despite numerous DNA matches, the jury acquitted O.J. Simpson. Butler uses this example of acquittal to show that “DNA evidence is not always understood and can be quite complex to explain to the general public.”

At the time of the incident in 1994, DNA-typing technology was a “relatively new science” to the courtroom. Now, as awareness and use of DNA has grown, it suffers from the opposite problem—DNA is over-glorified. As such, jurors are at a risk of placing too much weight on match evidence. Jury instructions provide a framework to jurors for understanding complex DNA matches. Courts that require defendants to make an affirmative case of error in laboratory testing as a prerequisite to DNA-specific instructions are misguided because in many instances defendants do not have access to their match results, and jurors remain at risk of rendering misinformed verdicts, as the jury did in the O.J. Simpson case.

IV. A RIGHT TO RATIONAL JURIES

In Part II.A, this Note made a case for why DNA jury instructions function as back-end adversarial safeguards to help jurors overcome the barriers that prevent them from comprehending DNA match evidence. Part II.B framed jury instructions as a tool for creating the ideal bionic juror, aware of and enhanced by the information generated from electronic devices used in DNA typing. Part III addressed counterarguments against DNA instructions and showed why each

226. Id.
228. Id.
229. Id.
230. Butler goes on to argue that “expert witnesses have the challenge of presenting the difficult subjects of DNA biology, technology and genetics and jury members must make sense of concepts such as contamination and mixture analysis that can be fairly complex.” Id.
231. Meier, supra note 225.
232. See discussion infra Part II.B.
argument was flawed in light of the purpose of the instructions to remove juror biases about DNA. This next Section frames an intellectual due process argument around rational juries who understand DNA match probabilities and proposes model instructions that help secure this right.

A. Why Criminal Defendants Deserve a Rational Jury

This Section of the Note addresses the following questions: Why is rationality so important in DNA trials, and why do criminal defendants deserve rational juries? There is no constitutionally recognized right to rational juries. The Sixth Amendment grants criminal defendants the right to trial by a “tribunal both impartial and mentally competent.” The standard for what constitutes a competent and impartial jury is permissive. For example, the Supreme Court of the United States has ruled that evidence from some members of a jury that their peer jurors had consumed alcohol, marijuana, and cocaine at trial and during deliberations did not warrant overturning the verdict and did not violate the defendant’s right to an impartial and mentally competent jury. In terms of juror bias, the Court has created a high burden on defendants to prove juror impartiality—if an allegation of bias is made, a court “must determine the circumstances, the impact thereof upon the juror, and whether or not [they were] prejudicial, in a hearing with all interested parties permitted to participate.” In Smith v. Phillips, the Court held that a juror who submitted, during trial, an application to be an investigator with the prosecutor’s office bringing the case was not biased absent a violation of guaranteed right under the Fourteenth Amendment. In another case, Remmer v. United States, the Court declined to find that a juror was prejudiced by an FBI agent’s effort to obtain a favorable verdict via attempted bribe. These cases illustrate the Court’s low bar for juror competence and partiality. Despite the Court’s permissive standard, this Note takes the position that the Court’s rulings, with respect to what constitutes an impartial jury, do not present an impediment towards arguing for a right to rational juries.

Rationality and impartiality are different concepts. The Court has interpreted impartiality as the ability of a juror to render a fair verdict based on the evidence presented before it, without extraneous influences. Thus, in Irvin v. Dowd, the Court held that a jury verdict finding the defendant guilty of six murders did not meet constitutional standards of impartiality because the defendant was “tried in an atmosphere undisturbed by so huge a wave of public
passion and by a jury other than one in which two-thirds of the members admit, before hearing any testimony, to possessing a belief in his guilt.\(^2\)

Rationality and mental competence are also different concepts. The Court has reasoned that mental competence refers to a juror’s capacity to render a verdict. For example, in *Tanner v. United States*, the Court found that the jurors, who consumed alcohol during deliberations, were not so intoxicated as to be incompetent.\(^2\) The Court held that one juror’s ability to consider the evidence because he was “falling asleep all the time during the trial,” was insufficient to prove that the juror was incompetent.\(^2\) The Court’s holdings illustrate that impartiality and incompetence involve instances of extreme extraneous influence prevent jurors from rendering a fair verdict.\(^2\) Even alcohol or drug use during trial has not swayed the Court to find that jurors were incompetent, absent evidence that the jurors were impaired from considering the evidence before them.\(^2\)

In contrast, rationality explains the internal processes within a juror’s mind related to deliberation and decision making. The Supreme Court has addressed the necessity of “shielding jury deliberations from public scrutiny,” directing courts not to probe into the jury’s mind or use the “internal processes of the jury” to impeach a verdict.\(^2\) Rationality is thus related to how a person thinks. Rationality is an important standard to aspire to in the context of DNA evidence. This is because a more sophisticated rationality is at stake, one that requires jurors to meld the thought processes of two very different disciplines: science

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238. 366 U.S. 717, 725 (1961). The court stated:
[T]he build-up of prejudice is clear and convincing. An examination of the then current community pattern of thought as indicated by the popular news media is singularly revealing. For example, petitioner’s first motion for a change of venue from Gibson County alleged that the awaited trial of petitioner had become the cause célèbre of this small community—so much so that curbstone opinions, not only as to petitioner’s guilt but even as to what punishment he should receive, were solicited and recorded on the public streets by a roving reporter, and later were broadcast over the local stations. A reading of the 46 exhibits which petitioner attached to his motion indicates that a barrage of newspaper headlines, articles, cartoons and pictures was unleashed against him during the six or seven months preceding his trial. The motion further alleged that the newspapers in which the stories appeared were delivered regularly to approximately 95% of the dwellings in Gibson County and that, in addition, the Evansville radio and TV stations, which likewise blanketed that county, also carried extensive newscasts covering the same incidents. These stories revealed the details of his background, including a reference to crimes committed when a juvenile, his convictions for arson almost 20 years previously, for burglary and by a court-martial on AWOL charges during the war. He was accused of being a parole violator. The headlines announced his police line-up identification, that he faced a lie detector test, had been placed at the scene of the crime and that the six murders were solved but petitioner refused to confess. Finally, they announced his confession to the six murders and the fact of his indictment for four of them in Indiana. Id.


240. *Irvin*, 366 U.S. at 725.


243. *Id.* at 119–20.
and law. Melding the two disciplines is a difficult task for anyone because the distinctions between science and law arise from the fundamental differences in the way that the two disciplines view the world. Law is a normative pursuit to define how the world ought to be—the system “embraces the adversary process to achieve ‘truth,’ for the ultimate purpose of attaining an authoritative, final, just, and socially acceptable resolution of disputes.” While science is also a quest for truth, it embraces empirical analysis, “not to define how the universe should be, but how it actually is.” These two diverging disciplinary perspectives use different reasoning processes.

Uncertainty, for example, is a hallmark of scientific evidence: there is always room for new empirical observations to change what was previously considered the norm. It is commonly known that Galileo’s infamous telescopic observations of a heliocentric elliptical orbit displaced the widely accepted geocentric model of the universe. Although uncertainty has become a part of scientific disciplines, it remains at odds with legal methodologies, which rely on a black and white conception of the universe. This is especially true in criminal adjudications, which have zero tolerance for convictions borne of uncertainty. The verdict options are binary: guilty or not guilty.

With scientific DNA evidence “increasingly invading courts,” there remains a need for mechanisms that allow for a blending of the disciplines, such that jurors evaluate match probabilities in a more rational way. One such mechanism to help jurors achieve the rational standard before jury deliberations in DNA trials is to provide a combination of cautionary and pedagogical jury instructions explaining match probabilities. Legal scholar Professor Cass Sunstein makes an “affirmative case for paternalism” in the law because much of the time, “people’s choices are based on incorrect judgments, at the time of choice, about what their experience will be after the choice, there is reason to question whether respect for choices rooted in these incorrect judgments is a good way to promote utility or welfare.” Sunstein uses the example of juries awarding exorbitant punitive damages in tort cases to illustrate the arbitrary and unpredictable outcomes that result when jurors translate their normative assessment of a defendant’s bad conduct “onto an unbounded dollar scale.” Based on unpredictability of punitive damages, Sunstein recommends reform, suggesting that “perhaps the ‘mapping’ can occur by a legislative or regulatory

244. *Developments in the Law*, supra note 179, at 1484.
245. *Id.*
246. *Id.*
251. *Id.* at 1193.
body that decides, in advance, on how a normative judgment made on a bounded numerical scale or by comparison to preselected scenarios can be translated into dollars.’

Similarly, jury instructions are one way to reform and help map rationality onto jurors’ thought processes. Rationality is important in DNA trials because understanding probability is a large part of being able to comprehend DNA matches. Sunstein points out that people mistakenly do not “weight probabilities in a linear fashion,” meaning that people would “much rather see a risk of .001 reduced to zero than a risk of .002 reduced to .001,” even though the value of the two reductions are the same. As discussed in Part II.A, DNA matches reveal a host of risks related to misinterpreting the significance of probabilities, including the common misconception that likelihood is a certainty.

Every defendant in a DNA trial deserves a rational jury because it increases the likelihood that a given verdict will be fair. Legal theorist and evidence scholar, Professor Scott Brewer, has forwarded a theory of intellectual due process that sheds light on how to blend the disciplines of science and law. The concept of intellectual due process is rooted in the “epistemic constraints” placed on the reasoning processes by which legal decision makers apply law to individual litigants. This means that in order to avoid making an “epistemically arbitrary choice,” a person must understand the “cognitive aims and methods of science.” Brewer observes that “even the act of soliciting and deferring to expert scientific judgment requires nonexperts to use a reasoning process . . . .” In the case of DNA match probabilities, when jurors are unaware of the uncertainties underlying statistical computations, their decision making is uninformed and irrational—contrary to the tenets of scientific reasoning.

By instituting a process of “structured reasoning,” DNA-specific instructions increase juror comprehension and help create the bionic juror. First, structured reasoning makes the “probabilistic nature of an evaluation task explicit,” which is especially important given that DNA evidence is meaningless without probabilities. Second, it decreases the risk of poor decisions that are a result of “unconscious method of processing information.” As discussed earlier, jurors are led to make unconscious assumptions of guilt based on the presumption that DNA is infallible, or through misleading arguments by counsel in the form of the prosecutor’s fallacy. Instructions aim to create a bionic juror

252. Id.
253. Id. at 1191.
255. Id. (emphasis omitted).
256. Id. at 1538.
257. See ERICA BEECHER-MONAS, EVALUATING SCIENTIFIC EVIDENCE: AN INTERDISCIPLINARY FRAMEWORK FOR EVALUATING INTELLECTUAL DUE PROCESS 7 (2007).
258. Id. at 22.
259. Id. at 20.
who is conscious of these barriers and equipped to make informed decisions based on a genuine understanding of DNA matches. Third, a structured reasoning process speaks to the underlying goals of “coherence and correspondence,” both prerequisites to a “framework for justice.” Instructions facilitate justice because they convey the limited meaning of DNA and prevent jurors from making inferences that go beyond the statistics themselves. By accounting for scientific risks of uncertainty, instructions blend science and law. In so doing, DNA instructions become a precondition to a fair trial, and in turn, secure criminal defendants’ rights to having more rational juries.

B. Model Jury Instructions

Below, I propose a set of model jury instructions that counsel and judges can use in DNA cases. The first set is for DNA cases, in which other corroborating evidence is present. The second set is for cold hit cases, or cases where the defendant was identified solely from a database search. Because cold hits require searching a database for a match, the instructions aspire to caution jurors on the specific biases that are unique to database searches.

1. Instructions for General DNA Evidence

(1) A given DNA profile may be shared by two or more people.

(2) You have heard one probability in this trial, RMP, or the random match probability. The random match probability is a statistic that will tell you what the likelihood is that any given person picked at random from the population will match the crime scene DNA. In other words, the RMP measures the frequency with which a profile will appear in a given population. Say that the RMP is one in twenty million, for example. This means that every person picked at random from the population will have a one in twenty million chance of matching the DNA profile. In a population of twenty million, it is likely that one person picked at random will have the same DNA profile as the crime scene DNA. The population may be larger than twenty million, in which case, there may be more than one person who will share the same DNA profile as the crime scene DNA.

(3) If you believe an RMP of one in twenty million is accurate, this means that there may be two or three individuals who may be the source of the DNA at the crime scene depending on how large the population sample is.

(4) It is important that you understand that the RMP is not the equivalent of a statistic that tells the jury the likelihood of whether the defendant committed the crime.
(5) The RMP is also not the same as the probability that the defendant is the source of the crime scene DNA, nor is it a probability that tells you whether the defendant is guilty or innocent.

(6) Keep in mind, where the known DNA sample from the defendant matches the unknown sample obtained from the crime scene, it does not necessarily mean the defendant is the source of the sample found at the crime scene.

(7) In deciding whether you believe the defendant is the source of the crime scene DNA, you must consider a range of factors. You must take into account that there may be more people who share the crime scene DNA profile in the population, the likelihood of laboratory error, the possibility of malfeasance, and other non-DNA evidence.

(8) Jurors, you alone have the final responsibility to decide the weight to be given to DNA random match probability statistics and any other statistics you may have heard in this trial.

2. Instructions for Cold Hit DNA Cases

(1) A given DNA profile may be shared by two or more people.

(2) You have heard one probability in this trial, RMP, or the random match probability. The random match probability is a statistic that will tell you what the likelihood is that any given person picked at random from the population will match the crime scene DNA. Say that the RMP is one in twenty million, for example. This means that every person picked at random from the population will have a one in twenty million chance of matching the DNA profile. In a population of twenty million, it is likely that one person picked at random will have the same DNA profile as the crime scene DNA. In other words, the RMP measures the frequency with which a profile will appear in a given population. The population may be larger than twenty million, in which case, there may be more than one person who will share the same DNA profile as the crime scene DNA.

(3) If you believe random match probability (RMP) of one in twenty million is accurate, this means that there may be two or three individuals who could be the source of the DNA at the crime scene depending on how large the population sample is.

(4) You may have heard the database match probability (DMP) in this case. The database match probability is a statistic that will tell you what the likelihood is that any given person picked at random from a finite database population will match the crime scene DNA. Thus, the DMP is a measure that is limited to the number of profiles appearing in any given database.

(5) As you may have heard an expert testify, the DMP is calculated
by multiplying the random match probability and the number of profiles in any given database or databases. The accuracy of a match found between the defendant’s DNA profile and a database will depend on the characteristics of the database, such as its size, the quality of the DNA profiles, or how representative the database is of the general population.

(6) Where the unknown DNA sample obtained from the crime scene matches a person’s profile stored in a database, it does not necessarily mean the person whose profile matched with the crime scene DNA is the source of the sample found at the crime scene.

(7) Also, a match obtained from a database is subject to ascertainment bias, a term that stands for the systematic distortion in measuring the true frequency of a DNA profile reoccurring in the population due to the way that the database was created. In DNA database match cases, ascertainment bias is represented as a statistic that shows how rare the existence of a specific profile is in a database.

(8) In considering the significance of a database match, you must take into account several factors, such as the size of the database, the rarity of the DNA profile, and the number and position of the loci that were tested to yield the match.

These general and cold hit jury instructions seek to educate and caution jurors on the biases inherent in DNA probabilities. More specifically, because cold hits are conducted through matches obtained from DNA databases, the cold hit instructions warn jurors of the potential errors that may arise from calculating database probabilities.

CONCLUSION

The complex and ever-evolving field of DNA forensics sheds light on the gaps in juror comprehension of DNA evidence. Lay jurors do not have the expertise to understand technical DNA probabilities and, as such, are prone to misapplying DNA match evidence. Cautionary DNA jury instructions help jurors comprehend DNA evidence and shy away from drawing adverse inferences of guilt and, as a result, render accurate verdicts. In merging the legal and scientific disciplines, DNA-specific instructions preserve the integrity of the criminal trial. Most importantly, instructions secure criminal defendants’ rights to a fair trial by bionic, rational juries that have the ability to evaluate DNA matches in an informed manner.