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Something Doesn't Add Up: Solving DNA Forensic Science Statistical Fallacies in Trial Testimony

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ABSTRACT

While the limitations of traditional forensic sciences are generally recognized, the presentation of DNA forensic science statistical testimony has widely evaded criticism. This lack of oversight has allowed four DNA forensic science statistical fallacies to plague the legal system: providing statistics without empirical support, the individualization fallacy, the prosecutor's fallacy, and the defense attorney's fallacy. These fallacies pose a significant risk to the preservation of justice, as erroneous DNA forensic science statistical testimony plays a critical role in wrongfully convicting innocent defendants.

This Note suggests administering standard jury instructions every time DNA forensic science statistical testimony is presented during trial. This solution evades common hurdles scholars have faced while trying to increase the efficacy of the presentation of forensic sciences, such as high information costs, political support, and sufficient capital. Overall, the standard jury instructions presented provide a hopeful outlook on decreasing the prevalence of wrongful convictions caused by the presentation of DNA forensic science statistical fallacies.

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On July 9, 1977, police came across sixteen-year-old Cathleen Crowell on the side of the road.[1] She claimed she had been raped.[2] Police took her to a nearby hospital where evidence, including a semen sample in her underwear, was examined.[3] The police then presented Crowell with a mugshot of Gary Dotson, who matched the description of her attacker, and she identified him as her rapist.[4] Dotson was subsequently arrested and charged with rape.[5] Unfortunately for Dotson, however, the rape in fact never occurred.[6] Crowell had created the story in case she became pregnant with her boyfriend, which did not happen.[7] Although the story was fabricated, Crowell stated at trial that she could never "forget that face."[8] This identification was used as principal evidence in Dotson's trial, and in 1979, Dotson was convicted of a crime he did not commit.[9]

In 1985, while Dotson was serving his twenty-five- to fifty-year sentence, Crowell recanted her identification; however, her recantation was deemed false by the prosecution, and Dotson was denied a pardon

1. Dolores Kennedy, *Gary Dotson*, THE NAT'L REGISTRY OF EXONERATIONS, https://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3186 [https://perma.cc/C5HB-UZ5Z] (last visited Oct. 10, 2022); Rob Warden, *The World's First DNA Exoneration, the Rape that Wasn't, and a Lesson Unlearned*, INJUSTICE WATCH (Aug. 4, 2019), https://www.injusticewatch.org/commentary/2019/the-worlds-first-dna-exoneration-the-rape-that-wasnt-and-a-lesson-unlearned/ [https://perma.cc/T94C-G9K9].

2. Kennedy, *supra* note 1.

3. *See id.*

4. *Id.*

5. *Id.*

6. *See id.*

7. *Id.*

8. *See* Warden, *supra* note 1.

9. *See* Kennedy, *supra* note 1.

by the Governor of Illinois.[10] Three years later, Dotson's luck turned around when Edward Blake, the pioneer of DNA forensic identification, tested the semen found in Crowell's underwear, and the resulting genetic profile excluded Dotson as a match.[11] With this DNA exclusion, Dotson became the first innocent person exonerated by post-conviction DNA testing in the United States.[12]

DNA evidence is just one of the many forensic sciences used to inculpate—or, as in Dotson's case, exculpate—perpetrators.[13] Other sub-fields of forensic sciences include the analysis of bitemarks, fingerprints, handwriting, arson, firearms, shoe prints, and more.[14] For many years, the forensic sciences were considered to be flawless applications of scientific principles;[15] however, this view changed when a watershed of post-conviction DNA exonerations shed light on the flawed nature of these sciences and their tendency to lead to false convictions.[16] For example, according to the Innocence Project, problems with forensic sciences have played a role in 45% of convictions later overturned using DNA.[17] These data demonstrate that the forensic sciences are far from "flawless,"[18] and serious reform is needed to transform the forensic disciplines from flawed techniques to the "gold standard" of DNA forensic technology.[19]

Since DNA forensic technology is often considered the pinnacle of "good" forensic science, it is frequently omitted from critiques of forensic methods.[20] This does not mean, however, that DNA forensic technology has reached the "flawless" standard conceived by many.[21] In fact, the fallacious presentation of DNA forensic science statistics has served as a vital piece of evidence in many wrongful convictions to

10. *See* Warden, *supra* note 1; Brandon L. Garrett & Peter J. Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 VA. L. REV. 1, 4 (2009).

11. *See* Garrett & Neufeld, *supra* note 10.

12. *Id.*

13. *See* Michael J. Saks & David L. Faigman, *Failed Forensics: How Forensic Science Lost Its Way and How It Might Yet Find It*, 4 ANN. REV. L. & SOC. SCI. 149, 150 (2008).

14. *Id.*

15. *See id.*

16. *See* JAMES R. ACKER & ALLISON D. REDLICH, WRONGFUL CONVICTION: LAW, SCIENCE, AND POLICY 380 (2d ed. 2019).

17. *Id.* This data is current through August 1, 2018.

18. *See* Saks & Faigman, *supra* note 13.

19. Jessica Gabel Cino, *Tackling Technical Debt: Managing Advances in DNA Technology That Outpace the Evolution of Law*, 54 AM. CRIM. L. REV. 373, 373, 379, 416 (2017).

20. Erin Murphy, *The Art in the Science of DNA: A Layperson's Guide to the Subjectivity Inherent in Forensic DNA Typing*, 58 EMORY L.J. 489, 490 (2008).

21. *See* Saks & Faigman, *supra* note 13, at 150, 153.

date.[22] Forensic experts make a variety of faulty arguments when presenting DNA forensic statistics that often go unnoticed, and the effects of these erroneous presentations on justice are detrimental.[23]

This Note analyzes DNA forensic science statistical fallacies with respect to wrongful convictions. Part I reviews the history of the forensic science disciplines, presents the emergence of DNA forensic technology, and details four common DNA forensic science statistical fallacies. Part II analyzes the legal standard for admitting forensic science evidence in litigation and explores case law in which DNA forensic science statistical fallacies are committed. Finally, Part III argues that promulgating standard jury instructions will most effectively counteract the detrimental effects of DNA forensic statistical fallacies on the efficacy of criminal trials.

I. BACKGROUND

A. History of Forensic Science

Forensic science is defined as evidence in legal matters that involves scientific methods.[24] The earliest subfields of forensic science included the comparison of handwriting, fingerprints, bitemarks, and footprints.[25] These subfields were based on the assumption of individualization: the idea that there existed only one unique fingerprint, bitemark, or footprint that could have made the markings.[26] Other forms of forensic science are not based on individualized identification but instead are guided by "expertise" in which "experts" analyze the forensic evidence and arrive at identificatory conclusions.[27] These subfields include arson, bullet analysis, and gunshot residue.[28] These various forms of forensic science were integrated into the police system in the early twentieth century.[29] Therefore, instead of being controlled by scientists, innovation was

22. *See, e.g.*, People v. Collins, 438 P.2d 33, 41 (Cal. 1968) ("The 'trial by mathematics' so distorted the role of the jury and so disadvantaged counsel for defense, as to constitute in itself a miscarriage of justice.").

23. *See* Garrett & Neufeld, *supra* note 10, at 9 (delineating different types of statistical fallacies including the misuse of empirical population data and presenting statistics with support).

24. BRANDON L. GARRETT, AUTOPSY OF A CRIME LAB: EXPOSING THE FLAWS IN FORENSICS 4 (2021).

25. *See* Saks & Faigman, *supra* note 13.

26. *See id.*

27. *See id.*

28. *Id.*

29. *See id.* at 152.

heavily regulated by bureaucrats within the police apparatus.[30] This control heavily influenced the manner in which forensic science evolved, which was largely separated from the scientific community and devoid of empirical testing.[31] Despite this lack of scientific involvement, many viewed the forensic sciences as clear, rational, objective, and without biases—characteristics which are central to scientific enterprises.[32] This faulty assumption influenced the widespread belief that forensic sciences were "flawless," resulting in courts becoming complicit with the validity of their application.[33]

Forensic science was strongly impacted by the discovery of DNA in 1953 by doctors James Watson and Francis Crick.[34] DNA, short for deoxyribonucleic acid, is the building block for all organisms.[35] DNA is made up of two strands containing four types of nucleotides—adenine, cytosine, guanine, and thymine—paired in a double helix formation.[36] Discrete differences in these strands of pairs differentiate each person's genetic makeup.[37]

In 1984, Dr. Alec Jeffreys paved the way for DNA testing when he discovered genetic fingerprinting, the process of identifying an individual through his or her unique fingerprint.[38] After this discovery, the application of DNA identification in criminal cases came to fruition.[39] The overall process is as follows: once DNA is detected at a crime scene—for example, in a semen sample—the DNA is extracted.[40] The DNA is then amplified using the polymerase chain reaction (PCR), a process which cuts the DNA strand at certain designated locations and creates identical copies of the relevant sections.[41] The relevant DNA sections are typically locations in the DNA strand where there are short tandem repeats: repeated nucleotides within a sequence that are indicative of a person's traits.[42] The strands from the PCR are then

30. *See id.*

31. *See id.*

32. *See* Simon A. Cole, *Forensic Science and Wrongful Convictions: From Exposer to Contributor to Corrector*, 46 NEW ENG. L. REV. 711, 712–13 (2012).

33. *See* Saks & Faigman, *supra* note 13.

34. *See id.* at 153; Cino, *supra* note 19, at 373, 378.

35. *See* Cino, *supra* note 19, at 377.

36. *See id.* at 380.

37. *See id.*

38. *See id.* at 378.

39. *See id.*; GARRETT, *supra* note 24, at 27.

40. *See* Murphy, *supra* note 20, at 497.

41. *See id.* at 497–98.

42. *See id.* at 494–95.

processed through electrophoresis, and the results are interpreted through a computer software.[43]

Next, the computer software, an all-in-one software for electrophoresis analysis, assesses the amount of short tandem repeats at thirteen different locations called loci.[44] At each locus, there are two possibilities for the number of repeats because each person has two sets of chromosomes, one paternal set and one maternal set.[45] Overall, a forensic DNA genetic profile is expressed as twenty-six numbers, two numbers for each of the thirteen loci.[46] The genetic profile from the crime scene is then compared to the genetic profiles of possible suspects.[47] This comparison is a highly effective way to exclude suspects that have a different number of repeats at a particular locus compared to the crime scene sample.[48] On the other hand, if a suspect's DNA profile matches each of the twenty-six short tandem repeat numbers in the evidence sample, the lab would declare that the suspect could not be excluded as the contributor of the sample.[49]

DNA forensic science evidence is presented through expressions of statistical probabilities rather than arbitrary statements of identification.[50] DNA analysts present the random match probability—the probability that a person selected at random from the population would match the DNA profile obtained at the crime scene—to frame the analysis.[51] The random match probability is essential to DNA forensic science because, without knowing how unusual a match is, the jury would have no basis for assessing the relevance of a match between DNA profiles.[52] To calculate the frequency of the crime scene profile in the population, the DNA analyst consults a statistical table created by the Federal Bureau of Investigation based on sample groups from four racial categories.[53] These tables help the analyst estimate the probability of finding each particular short tandem repeat number at each particular locus across the different racial

43. *Id.* at 498.

44. *See id.* at 495, 498, 504.

45. *See id.* at 495.

46. *See id.*

47. *See* Cino, *supra* note 19, at 382.

48. *See id.* at 381–82.

49. *See* Andrea Roth, *Safety in Numbers? Deciding When DNA Alone is Enough to Convict*, 85 N.Y.U. L. REV. 1130, 1136 (2010).

50. *See* Murphy, *supra* note 20, at 490.

51. *See* Dawn McQuiston-Surrett & Michael J. Saks, *The Testimony of Forensic Identification Science: What Expert Witnesses Say and What Factfinders Hear*, 33 LAW & HUM. BEHAV. 436, 437 (2009).

52. *See* Roth, *supra* note 49.

53. *See id.*

groups.[54] The analyst then multiplies the twenty-six probabilities together to determine the random match probability.[55] Another statistic that DNA analysts present is the source probability, or the probability that the defendant is the source of the sample DNA given the evidence.[56] The source probability can be calculated by inputting the random match probability and the size of the suspect population into Bayes' theorem, a well-established mathematical formula.[57] These objective datapoints pose a stark contrast to the often subjective measures presented by non-DNA forensic disciplines, which further supports the notion that DNA forensics is the epitome of "good" forensic science.[58]

When DNA testing became more common, people started to ask what research supported traditional non-DNA forensics.[59] In 2009, the National Academy of Sciences issued a comprehensive report analyzing the forensic sciences and the use of forensic science evidence in court.[60] The report noted the lack of empirical testing and reliability of the non-DNA forensic sciences, stating, "With the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source."[61] This landmark report constituted the first critical look into the science behind the forensic disciplines, and within months, Justice Scalia cited the report in *Commonwealth v. Melendez-Diaz*, stating that "forensic evidence is not uniquely immune from the risk of manipulation."[62] From these findings, the term "junk science" became known to describe non-DNA forensic sciences to indicate their lack of efficacy and reliability.[63] While the report criticized the efficacy of

54. *See id.*

55. *See id.*

56. *See id.* at 1148.

57. *See id.* Bayes' theorem is described by this formula: $P(A|B) = (P(B|A)*P(A))/P(B)$. This formula incorporates three variables: the prior odds of a proposition, the posterior odds of a proposition, and the likelihood ratio. CFI Team, *Bayes' Theorem*, CORPORATE FINANCE INSTITUTE (May 6, 2022), https://corporatefinanceinstitute.com/resources/knowledge/other/bayes-theorem/ [https://perma.cc/NZV8-6GA5].

58. *See* Murphy, *supra* note 20, at 501.

59. *See* GARRETT, *supra* note 24, at 6.

60. *See* NAT'L RSCH. COUNCIL, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD (2009).

61. *Id.* at 7.

62. Paul C. Giannelli, *Daubert and Forensic Science: The Pitfalls of Law Enforcement Control of Scientific Research*, 2011 U. ILL. L. REV. 53, 53 (2011).

63. *See* Jim Hilbert, *The Disappointing History of Science in the Courtroom: Frye, Daubert, and the Ongoing Crisis of "Junk Science" in Criminal Trials*, 71 OKLA. L. REV. 759, 759–60 (2019).

non-DNA forensic sciences, it bolstered the idea that DNA forensic science was the "gold standard"[64] of forensic evidence, further promulgating blind trust in testimony discussing DNA forensic science statistics without evaluating its reliability.[65] As testimony regarding DNA forensic science statistics has found its way into courtrooms without much scrutiny, four statistical fallacies have evolved in the presentation of DNA forensic statistics.

B. DNA Forensic Science Statistics Fallacies

1. Providing Statistics Without Empirical Support

The first DNA forensic science statistical fallacy occurs when experts provide DNA statistics absent any supporting empirical evidence or research.[66] Essentially, this fallacy occurs when the DNA forensic statistics are manufactured by the analyst.[67] This is a fallacious presentation of evidence because, according to the American Statistical Association, in order to make statements regarding a probability, there must be data to support the statement from a relevant population.[68] In one study, trial transcripts of 137 exonerees were examined.[69] In eighty-two of these cases, forensic analysts provided invalid testimony by either misusing empirical population data or making statistical conclusions that were not supported by empirical evidence.[70] This study shows that the fallacy of providing statistics without empirical support is quite prevalent, which is alarming since jurors place special trust in expert witnesses to present and explain reliable scientific evidence and principals.[71] Courts do regulate the scientific disciplines upon which experts may testify; however, once the scientific discipline is deemed satisfactory, courts do not thoroughly assess the reliability of statistics presented by DNA analysts during testimony, often relying on cross-examination to demonstrate potential unreliability to the jury.[72] Therefore, it is possible that experts may present fallacious statistics

64. *See* Cino, *supra* note 19, at 376.
65. *See* NAT'L RSCH. COUNCIL, *supra* note 60, at 7.
66. *See* Garrett & Neufeld, *supra* note 10, at 9.
67. *See id.*
68. *See* GARRETT, *supra* note 24, at 92.
69. *See* Garrett & Neufeld, *supra* note 10, at 9.
70. *See id.*
71. *See id.*
72. *See id.* at 32–33.

without catching the attention of the court, which poses a threat to justice.[73]

2. The Individualization Fallacy

The individualization fallacy occurs when the DNA expert concludes with "100 percent certainty" that the defendant is the only possible donor of the DNA found at the crime scene.[74] Individualization is synonymous with uniqueness and refers to the absolute specificity of identification, meaning there is one, and only one, person whose DNA could match the sample from the crime scene.[75] While individualization is the goal of DNA forensic science, it can only be achieved in a probabilistic sense, such as reducing uncertainty to the smallest possible amount.[76] Since random match probabilities are configured by multiplying the nonzero probabilities of the number of repeats at each loci together via the product rule, there will always be a nonzero probability that a source other than the defendant exists who matches the DNA profile from the crime scene.[77] Therefore, individualization has no scientific validity.[78]

The individualization fallacy also occurs when expert witnesses assume uniqueness because the random match probability occurs once in over seven billion people, roughly the world's population.[79] For example, if the probability of a genetic profile matching the genetic string is one in ten billion, it is fallacious to conclude uniqueness from this calculation.[80] No law of mathematics prevents two or more people from matching this profile; the probability of the two DNA matches would be calculated using the product rule and would result in a one in one hundred billion probability.[81] Although this is an extremely small probability, it is still nonzero; therefore, individualization cannot be inferred.[82]

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73. *See id.* at 33.

74. *See* Michael J. Saks & Jonathan J. Koehler, *The Individualization Fallacy in Forensic Science Evidence*, 61 VAND. L. REV. 199, 205 (2008).

75. *See id.*

76. *See* McQuiston-Surrett & Saks, *supra* note 51, at 436.

77. *See* Saks & Koehler, *supra* note 74, at 209.

78. *See id.* at 206–07 ("The product rule [is] a fundamental tool of probability theory that yields the joint probability of independent events by multiplying their separate probabilities.").

79. *See id.* at 203.

80. *See id.*

81. *See id.*

82. *See id.* at 204.

3. Prosecutor's Fallacy

The prosecutor's fallacy, otherwise known as the transposition fallacy, occurs when the prosecutor or an expert witness conflates the random match probability with the source probability.[83] Recall that the random match probability is the probability that a random, innocent person matches the DNA profile from the crime scene, while the source probability is the probability that the defendant is the true source of the sample given a DNA match.[84]

Consider a situation in which the defendant's DNA matches the DNA found at the crime scene.[85] Then, let's say the expert testifies that if a random, innocent person's DNA is taken from the population, there is a one in ten thousand chance that his or her DNA matches the profile of the DNA found at the crime scene.[86] After, the expert concludes that since the defendant's DNA profile matches the DNA found at the crime scene, there is a one in ten thousand chance the defendant is innocent, or a 9,999/10,000 chance the defendant is guilty.[87]

This argument is fallacious because the expert witness is assuming that the probability of A given B equals the probability of B given A, which is statistically incorrect.[88] In other words, the probability that there is a DNA match given that the person is innocent does not equal the probability that the defendant is innocent given that there is a DNA match.[89] Returning to the example above, if a random person is innocent (A), there is a one in ten thousand probability that the random person matches the DNA sample from the crime scene (B).[90] This is the probability of B given A.[91] The expert then argues that if the defendant matches the DNA sample from the crime scene (B), there is a one in ten thousand probability that the defendant is innocent (A).[92] This is the probability of A given B.[93] By conflating these two probabilities, the expert commits the prosecutor's fallacy.[94] This fallacious reasoning is named the prosecutor's fallacy because when this argument is made,

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83. *See* Roth, *supra* note 49, at 1150–51.

84. *See id.* at 1151.

85. *See* Kingsley R. Browne, *Pernicious P-Values: Statistical Proof of Not Very Much*, 42 U. DAYTON. L. REV. 113, 116 (2017).

86. *See id.*

87. *See id.*

88. *See id.*

89. *See id.*

90. *See id.*

91. *See id.*

92. *See id.*

93. *See id.*

94. *See id.*

the jury is led to conclude that there is a very small probability that the defendant is innocent given that his or her DNA matches the crime scene DNA, which disproportionately favors the prosecutor's position.[95]

The prosecutor's fallacy can also be committed outside of the courtroom.[96] Consider two statements: (1) given that the animal is a chimpanzee, there is a 99.9% probability that the animal has two arms and two legs; and (2) given that the animal has two arms and two legs, there is a 99.9% probability that the animal is a chimpanzee.[97] The second statement clearly does not follow from the first, as it is a classic example of conflating the probability of A given B with the probability of B given A.[98]

4. Defense Attorney's Fallacy

The defense attorney's fallacy is committed when an expert witness assumes the DNA match is irrelevant unless it isolates the defendant or a very small class of people.[99] To demonstrate this, let's say an expert witness testifies that one out of every twenty-five people has DNA that matches the crime scene.[100] The expert then concludes that the match is immaterial because in a large population, hundreds, if not thousands, of people would match the crime scene DNA; therefore, the defendant is placed in a large pool of people that could potentially be the alleged perpetrator.[101] This line of reasoning is fallacious because it disregards all other evidence except the DNA match that might link the defendant with the crime scene, such as gender, race, eye color, height, weight, and age.[102] In other words, the expert is fallaciously asking the jury to disregard all other evidence except the DNA match, which erroneously excludes other identificatory evidence.[103] These additional identifying factors, if present, place the defendant in a narrower class of potential perpetrators and heighten the relevance of the DNA match.[104] This fallacious reasoning is coined the defense

95. *See id.* at 116–17.

96. *See id.* at 115.

97. *See id.*

98. *See id.* at 115–16.

99. *See* Dale A. Nance & Scott B. Morris, *An Empirical Assessment of Presentation Formats for Trace Evidence with a Relatively Large and Quantifiable Random Match Probability*, 42 JURIMETRICS J. 403, 427 (2002).

100. *See id.*

101. *See id.*

102. *See id.*

103. *See* Michael Conklin, *The Effectiveness of Bayesian Jury Instructions in Mitigating the Defense Attorney's Fallacy*, 9 HOUS. L. REV. 73, 74–75 (2019).

104. *See id.* at 74.

attorney's fallacy because it leads the jury to place less importance on the DNA match than is appropriate, which bolsters the defense attorney's strategy.[105]

II. ANALYSIS

A. The Legal Standard for Admitting Forensic Science Testimony

Considering the existence of DNA forensic science statistical fallacies in expert testimony, it is necessary to examine how expert testimony is originally admitted into evidence, which allows these fallacies to occur. Generally, expert testimony is admissible when the expert testifies to matters that are outside the common knowledge of laypeople.[106] Furthermore, expert testimony is admissible if the proffered expert is qualified by skill, education, training, experience, or knowledge.[107] The first major case establishing standards for admission of expert testimony about scientific evidence was *Frye v. United States*, decided in 1923.[108]

In *Frye*, the defendant was convicted of second-degree murder.[109] During the trial, counsel for the defendant offered an expert witness to testify regarding the result of the defendant's systolic blood pressure deception test; however, counsel for the government objected to this offer, and the objection was sustained.[110] The defendant proceeded to appeal this judgment.[111] The US Court of Appeals for the District of Columbia cited the following rule in its opinion: "While courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs."[112] Since the court found that the systolic blood pressure test had not gained general acceptance in the scientific community, the judgment was affirmed.[113] This "general acceptance" test was the standard for the admission of expert witness testimony regarding scientific evidence for nearly

105. *See* Nance & Morris, *supra* note 99.
106. *See* People v. Gilliam, 670 N.E.2d 606, 619 (Ill. 1996).
107. *See* Snelson v. Kamm, 787 N.E.2d 796, 809 (Ill. 2003).
108. *See* Frye v. United States, 293 F. 1013, 1014 (D.C. 1923).
109. *See id.* at 1013.
110. *See id.* at 1013–14.
111. *See id.*
112. *Id.* at 1014.
113. *Id.*

seventy years.[114] However, as the years progressed, courts began noticing the significant downfalls of the *Frye* general acceptance test, which ultimately led to its demise in most states.[115]

One of the major drawbacks of the *Frye* general acceptance test is the burden it imposes on courts due to its two-step analysis.[116] First, the court must identify the specific scientific community that encompasses the underlying scientific principle.[117] Then, the court must determine whether or not the underlying scientific principle is generally accepted in that scientific community.[118] Not only do these questions pose an undue burden on courts to define these standard parameters, the application of the *Frye* general acceptance test is furthermore restricted to "novel" scientific evidence.[119] This then poses the difficult question of when scientific evidence is "novel."[120] A "novel" scientific technique is "not always easy to identify," as stated by the Illinois Supreme Court, due to the rapid pace of our scientific and technological advances.[121] Finally, the *Frye* general acceptance test was issued without explanation or previous cited authority, which led courts to question the efficacy of the test overall.[122] These limitations of the *Frye* general acceptance test ultimately led the US Supreme Court to issue the landmark *Daubert v. Merrell Dow Pharmaceuticals, Inc.* opinion in 1993, which significantly displaced the *Frye* test.[123]

In *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, the petitioners alleged that they suffered serious birth defects after their mothers ingested Bendectin, a prescription drug marketed by the respondent for nausea treatment, during their pregnancies.[124] The District Court for the Southern District of California granted the respondent's motion for summary judgment after the respondent proffered an expert witness affidavit concluding that prenatal ingestion of Bendectin had not been shown to be a risk factor for human birth defects based on the examination of epidemiological evidence.[125] Although petitioners

114. *See* Andrew Stolfi, *Why Illinois Should Abandon Frye's General Acceptance Standard for the Admission of Novel Scientific Evidence*, 78 CHI.-KENT L. REV. 861, 862 (2003).

115. *See id.*

116. *See id.* at 865.

117. *Id.*

118. *See id.*

119. *See id.* at 887.

120. *See id.*

121. *See* Donaldson v. Central Illinois Pub. Serv. Co., 767 N.E.2d 314, 325 (Ill. 2002).

122. *See* Stolfi, *supra* note 114, at 864–66.

123. *See id.* at 866.

124. *See* Daubert v. Merrell Dow Pharm. Inc., 509 U.S. 579, 579 (1993).

125. *See id.*

responded with eight other experts' conclusions that Bendectin can cause birth defects according to animal studies, chemical structure analyses, and "reanalysis" of human statistical studies, the district court determined that this type of evidence was inadmissible as it did not meet the *Frye* general acceptance test.[126] The Ninth Circuit Court of Appeals affirmed.[127]

The US Supreme Court faced the growing concerns with the *Frye* general acceptance test head on.[128] The Court concluded that this test was superseded by the adoption of the Federal Rules of Evidence, specifically Rule 702, which states, "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise."[129] The Court emphasized that nowhere in this Rule is there any indication that "general acceptance" is a prerequisite to admissibility, and application of the *Frye* standard would therefore be in opposition to Rule 702.[130]

The Supreme Court, however, noted that the Rules do place limits on the admissibility of scientific evidence: in order for scientific testimony to be admitted, it must not only be relevant, but it also must be reliable.[131] To assess the relevancy and reliability of expert testimony based on scientific theory, the Court laid out a variety of factors to consider: (1) whether the theory or technique can be and has been tested, (2) whether the theory or technique has been subjected to peer review and publication, (3) the known or potential rate of error, (4) the existence of standards controlling the technique's operation, and (5) the scientific technique's degree of acceptance within the relevant scientific community.[132] Overall, the Court emphasized that the inquiry under Rule 702 using these factors is a "flexible one."[133]

In the almost thirty years since the *Daubert* standard nearly replaced the *Frye* general acceptance test in federal and most state courts, the legal community has had to confront the reality that almost every method of forensic science is either of "questionable validity" or "entirely unreliable."[134] However, "junk science" continues to be

126. *See id.*
127. *See id.*
128. *See id.* at 585.
129. *See id.* at 588.
130. *See id.*
131. *See id.* at 589.
132. *See id.* at 593–94.
133. *See id.* at 594.
134. *See* Hilbert, *supra* note 63 at 762.

admitted into courtrooms by judges under the *Daubert* standard—such as hair comparison analysis, fingerprints, and bite mark analysis—due to judges' reliance on stare decisis and prior case law.[135] If "junk science" continues to be admitted into evidence under *Daubert*, it is clear that DNA evidence, the "gold standard" of forensic science, would easily be admitted into evidence under the *Daubert* analysis.[136] Having determined that the underlying discipline, DNA forensic science, is satisfactory and the evidence is admissible under the *Daubert* standard, courts do not typically examine the statistical conclusions experts reach on the stand.[137] This finding leads to a rather neglected question: once DNA evidence is admitted under the *Daubert* standard, how do we ensure that the data will be interpreted, reported, and testified about in a way that comports with reliable scientific parameters?[138]

B. Case Studies of DNA Forensic Science Statistical Fallacies

1. Providing Statistics Without Empirical Support

DNA forensic science statistical fallacies arise throughout case law, lending support to the conclusion that *Daubert* is not effectively screening out these errors. The first example of the DNA forensic science statistical fallacy of providing statistics without empirical support is seen in *State v. Phillips*.[139] In this case, a well-known drug dealer, Darius Woods, was found dead in his house with two gunshot wounds to his neck and head.[140] The murder weapon, a pistol, was found on Woods' stomach, and the pockets of his jeans had been pulled out as though the murderer had stolen Woods' money.[141] Several witnesses testified that they had seen defendant Billy Phillips around Woods' house about an hour before Woods' body was found.[142] Later, a forensic analyst, Lilly Gallman, compared Phillips' DNA with several "touch DNA" samples collected from the crime scene and excluded him as a contributor to all of the samples except two: the first sample taken from Woods' jeans pocket and the second taken from the grip of the gun.[143]

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135. *See id.* at 804–12.
136. *See* Cino, *supra* note 19.
137. *See* Garrett & Neufeld, *supra* note 10, at 6.
138. *See id.*
139. *See* State v. Phillips, 844 S.E.2d 651, 660 (S.C. 2020).
140. *See id.* at 652.
141. *See id.*
142. *See id.* at 653.
143. *See id.*

During Gallman's testimony, she stated that the statistical probability that someone other than the defendant could have been the contributor of the DNA found on the gun, the random match probability, was one in two hundred, and the random match probability of the DNA found on the victim's pants was one in two.[144] However, the Supreme Court of South Carolina noted that Gallman never explained how she calculated these probabilities.[145] There must have been a method used to obtain these probabilities, and "the method by which a DNA analyst calculates random match probability must be explained."[146] Because of this DNA forensic science statistical fallacy, the defendant's convictions were reversed.[147]

Importantly, the court stated that just because a trial judge is within his or her discretion in finding that DNA evidence is admissible, this does not mean that *every time* a party offers DNA evidence it is admissible.[148] Rather, if an objection is made, the proponent of the evidence must present the factual and scientific basis necessary to satisfy the *Daubert* standard and Federal Rule of Evidence 702.[149] Additionally, the court noted that DNA evidence is not infallible, although when presented it often takes on an "aura of invincibility."[150] Overall, DNA evidence must have an adequate evidentiary basis and be appropriately explained in order to avoid any adverse effects on the outcome of the trial, such as the risk of wrongful convictions.[151]

Yet another example of the providing statistics without empirical support fallacy, although not directly related to DNA forensic statistics, is seen in *People v. Collins*.[152] In this case, Juanita Brooks was pushed down and robbed, and while she was on the ground, Brooks managed to look up and see a Caucasian woman with "dark blond" hair running from the scene.[153] John Bass, a bystander, saw a woman running from the crime scene and entering a yellow car driven by a Black man with a "mustache and a beard."[154] The defendants were later

144. *See id.* at 654.
145. *See id.* at 655.
146. *See id.* at 660.
147. *See id.* at 663.
148. *See id.*
149. *See id.*
150. *See id.* at 656.
151. *See id.*
152. *See* People v. Collins, 438 P.2d 33, 36 (Cal. 1968).
153. *See id.* at 34.
154. *See id.*

identified using these descriptions and charged with second-degree robbery.[155]

At trial, the prosecution experienced some difficulty with identifying the defendants.[156] In order to bolster the identifications, the prosecution called a mathematics professor at a local college as an expert witness.[157] The prosecution sought to establish that there was an overwhelming probability that the crime was committed by the defendant couple matching the following characteristics: a White woman with blond hair and a Black man with a beard and mustache driving a yellow car.[158] Without providing any statistical evidence in support of the probabilities presented, the expert witness used the product rule to determine the probability of a couple matching all of the aforementioned traits was one in twelve million.[159] Despite the lack of evidentiary foundation, the trial court still admitted this expert testimony into evidence.[160]

The Supreme Court of California recognized the fallacy in the expert witness' testimony.[161] The court began by noting the record was "devoid of any evidence" regarding how the expert arrived at any of the six probabilities.[162] In other words, there was an "inadequate evidentiary foundation" for the probabilities presented.[163] Additionally, the court highlighted that there was "inadequate proof of statistical independence."[164] In order to apply the product rule to probabilities, the probabilities must be mutually independent, meaning the probability of a person having one of the traits does not overlap with the probability of a person having one of the other traits.[165] In this scenario, the expert witness provided no evidence that any of the probabilities were mutually independent, such as a man being Black and a man having a beard; thus, the application of the product rule was entirely erroneous, resulting in an inaccurate conclusion.[166] Consequently, the court held

155. *See id.* at 34–35.
156. *See id.* at 36.
157. *See id.* at 36–37.
158. *See id.*
159. *See id.*
160. *See id.* at 37.
161. *See id.* at 38.
162. *See id.*
163. *See id.*
164. *See id.*
165. *See id.* at 39.
166. *See id.*

that admission of the expert's testimony resulted in prejudicial error, and the judgment against the defendants was reversed.[167]

2. Individualization Fallacy

The individualization fallacy—asserting with 100 percent certainty that the defendant is the one and only contributor of the DNA sample[168]—is also seen throughout case law and specifically seen in *State v. Alejandro*.[169] In this case, expert Fred Zain testified that he had conducted DNA testing, and the DNA collected from the crime scene was "identical" to the DNA sample obtained from the defendant, Gilbert Alejandro.[170] Zain went on to say that the DNA "could only have originated from him."[171] Furthermore, Zain stated that "DNA typing is a hundred percent identity as to whether a blood or bodily fluid may have originated from a particular donor or not."[172] All of these statements culminate to an egregious example of the individualization fallacy because Zain is asserting with absolute certainty that Alejandro is the only possible person to have contributed the DNA sample, which is fallacious because individualization can only be achieved in a probabilistic sense.[173]

Yet another example of the individualization fallacy is seen in the O.J. Simpson murder trial.[174] In that case, the prosecutor made the following argument:

> [L]adies and gentlemen, his blood on the rear gate with that match, that makes him one in 57 billion people that could have left that blood, I mean there is [sic] what, five million [sic] people on the planet, that means you would have to go through 57 billion people to find the DNA profile that matches Mr. Simpson's. There is [sic] only five billion people on the planet. Ladies and gentlemen, that is an identification, okay, that proves it is his blood. Nobody else's on the planet; no one.[175]

This argument is fallacious because it infers uniqueness based off of the fact that the random match probability is one in fifty-seven billion, which has a denominator greater than the earth's population.[176] Although the prosecutor asserts there are only five billion people on the

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167. *See id.* at 42–43 (explaining the prosecutor's misuse of probability statistics as not admissible under the rules of evidence).

168. *See* Saks & Koehler, supra note 74.

169. *See* Garrett & Neufeld, *supra* note 10, at 64.

170. *See id.*

171. *See id.*

172. *See id.*

173. *See* McQuiston-Surrett & Saks, *supra* note 51, at 436.

174. *See* Saks & Koehler, supra note 74, at 203.

175. *See id.*

176. *See id.* at 204.

planet, there is no law of mathematics that prevents two people from matching the DNA sample taken from the rear gate due to the fact the denominator of the random match probability is greater than the number of available humans.[177]

3. Prosecutor's Fallacy

Another DNA forensic science statistical fallacy committed when the explanation of DNA evidence is left unmonitored is the prosecutor's fallacy. To recall, the prosecutor's fallacy occurs when the random match probability is conflated with the source probability.[178] In other words, if the probability that an innocent person matches the DNA sample from the crime scene is one in ten thousand, the prosecutor concludes that the probability that the defendant is innocent given his or her DNA matches is one in ten thousand.[179] This fallaciously inflates the probability of the defendant's guilt.[180]

McDaniel v. Brown provides an illustration of the prosecutor's fallacy.[181] In this case, a nine-year-old child was sexually assaulted.[182] Police collected a semen sample from the child's underwear, and expert Renee Romero tested the sample and determined that the DNA matched respondent Troy Brown.[183] At trial, Romero testified that the random match probability, the probability that a random person in the population would match the DNA sample found in the underwear, was one in three million.[184] Later on in Romero's testimony, however, she indicated that based off of this random match probability, due to the fact that Brown's DNA matched the sample, there was a one in three million chance that he was innocent.[185] Further solidifying this fallacious argument, when the prosecutor asked whether "it would be fair to say . . . that the chances that the DNA found in the panties—the semen in the panties—and the blood sample, the likelihood that it is not Troy Brown would be .000033," Romero agreed.[186] Noting that "it is important that [DNA evidence] be presented in a fair and reliable

177. *See id.*
178. *See* Roth, *supra* note 49, at 1150–51.
179. *See* Browne, *supra* note 85.
180. *See id.*
181. *See* McDaniel v. Brown, 558 U.S. 120, 127–28 (2010).
182. *See id.* at 122.
183. *See id.* at 123–24.
184. *See id.* at 124.
185. *See id.* at 128.
186. *See id.* at 128–29.

manner," the US Supreme Court concluded that Romero committed the prosecutor's fallacy.[187]

Though not a case involving DNA forensic statistics, *People v. Collins* also provides a clear depiction of the prosecutor's fallacy.[188] As discussed above,[189] in this case involving the robbery of Juanita Brooks, the expert witness arbitrarily assigned probabilities to each of the six attributes described by the witnesses and fallaciously used the product rule to multiply each of the probabilities.[190] While it was clear to the court that the expert committed the fallacy of providing statistics without empirical support, the expert also committed the prosecutor's fallacy.[191] After the expert fallaciously applied the product rule, he determined the random match probability that an innocent couple possessed all of the characteristics was one in twelve million.[192] He then went on to conclude that given the defendant couple matched all of the characteristics, there was a one in twelve million chance that the couple was innocent.[193] This is a clear conflation of the random match probability with the source probability; therefore, the expert witness erroneously committed the prosecutor's fallacy in his testimony.[194]

4. Defense Attorney's Fallacy

The final group of case studies illustrating DNA forensic science statistical fallacies involves the act of committing the defense attorney's fallacy in legal arguments. The defense attorney's fallacy occurs when it is argued that a DNA match is immaterial unless it completely isolates the defendant or a small class of people.[195] An example of the defense attorney's fallacy in practice occurred in the O.J. Simpson murder trial.[196] In this trial, the DNA obtained from the crime scene matched O.J. Simpson's with a random match probability of one in four hundred people.[197] The defense attorney consequently argued that a football stadium could therefore be filled with Los Angeles residents

187. *See* McDaniel v. Brown, 558 U.S. 120, 136 (2010).

188. *See* People v. Collins, 438 P.2d, 33, 36–37 (Cal. 1968).

189. *See supra* Section III.B.1.

190. *See Collins*, 438 P.2d at 36-38.

191. *See id.* at 36–37.

192. *See id.* at 37.

193. *See id.*

194. *See id.* at 36–37.

195. *See* Nance & Morris, *supra* note 99.

196. *See* BERNARD ROBERTSON, G.A. VIGNAUX & CHARLES E.H. BERGER, INTERPRETING EVIDENCE: EVALUATING FORENSIC SCIENCE IN THE COURTROOM 133 (2nd ed. 2016).

197. *See id.*

matching the DNA sample; thus, the DNA match was irrelevant.[198] This is an example of the defense attorney's fallacy because the argument completely disregards all of the other characteristics that linked O.J. Simpson to the crime scene, which would greatly narrow the number of Los Angeles residents that would be in the "football stadium."[199]

An additional example of the defense attorney's fallacy is illustrated in *People v. Robinson*.[200] Unlike the O.J. Simpson murder trial, the appellate judge, rather than the defense attorney, committed the defense attorney's fallacy by stating in the opinion,

> Proof that defendant had type 'A' blood and that the semen found in and on the body of decedent was derived from a man with type 'A' blood was of no probative value in the case against defendant in view of the large proportion of the general population having blood of this type and, therefore, should not have been admitted.[201]

This is yet another instance of the defense attorney's fallacy because the appellate judge disregarded the importance of the blood type match between the crime scene and the defendant.[202] Although there are many people in the general population that match this blood type, the judge discounted the other characteristics of the defendant that linked him to the crime scene and limited the pool of people who could be the perpetrator.[203]

As demonstrated throughout these four groups of case studies, it is clear that there is a general lack of oversight over testimony describing DNA forensic statistics once the expert testimony is admitted under *Daubert* and Federal Rule of Evidence 702, unless evidence is otherwise governed by *Frye* and state rules of evidence. DNA forensic science statistical fallacies, such as providing statistics without empirical support, the individualization fallacy, the prosecutor's fallacy, and the defense attorney's fallacy, have plagued expert testimony for far too long, resulting in defendants being wrongfully incarcerated for crimes they did not commit. Therefore, judicial action must be taken in order to halt the deleterious effects these fallacies have on the administration of justice.

198. *See id.*

199. *See* Conklin, *supra* note 103.

200. *See* People v. Robinson, 265 N.E.2d 543, 543 (N.Y. 1970).

201. *See id.*

202. *See id.*

203. *See id.*; Conklin, *supra* note 103.

III. SOLUTION

A. Potential Reforms Posed by Other Sources

In order to prevent DNA forensic science statistical fallacies from continuing to appear throughout legal arguments, scholars Garrett and Neufeld recommend enforcing national standards that govern the interpretation of forensic data, whether in written reports or sworn testimony.[204] While this type of reform would assuredly increase consistency across written forensic reports and expert forensic testimony,[205] the issue with enforcing national standards is twofold. On one hand, there would need to be adequate capital to fund the research necessary to establish these standards.[206] Accumulating the right amount of capital would be incredibly difficult to accomplish, as funding for the forensic sciences is already minimal.[207] On the other, assuming the appropriate amount of capital is raised, administering the standards and monitoring adherence to these standards would impose large information costs on the judicial or administrative body tasked with this assignment.[208] As forensic laboratories themselves have not created effective mechanisms to monitor analysts' work, it would be nearly impossible for a judicial or administrative body to review every forensic expert's testimony and adherence to the national standards.[209]

Another potential reform designed to prevent DNA forensic science statistical fallacies is the establishment of an independent federal agency designed specifically to monitor and review the use and explanation of forensic science methodology.[210] This reform idea was spearheaded by the report published by the National Academy of Sciences, *Strengthening Forensic Science in the United States: A Path Forward*.[211] In this report, the National Academy of Sciences confirmed what many of the academic critics had been discussing regarding forensic science: many of the claims made by forensic scientists were inadequately researched and supported.[212] Therefore, in order to bolster the efficacy of the forensic sciences, the report recommended creating a

204. *See* Garrett & Neufeld, *supra* note 10, at 95.
205. *See id.* at 96.
206. *See id.* at 95.
207. *See id.*
208. *See id.*
209. *See id.*
210. *See id.* at 95–96; NAT'L RSCH. COUNCIL, *supra* note 60, at 18.
211. *See* NAT'L RSCH. COUNCIL, *supra* note 60, at 18.
212. *See id.* at 7–8.

new federal agency entitled the National Institute of Forensic Science (NIFS).[213]

While the prospect of a new federal agency explicitly dedicated to the forensic science discipline certainly raised the hopes of many, the NIFS failed to materialize due to a lack of political support and funding.[214] Later, the more modest National Commission on Forensic Science (NCFS) was created in 2013; however, it too lacked support and funding and was ultimately terminated in 2017.[215] Overall, the idea of creating a federal agency exclusively devoted to forensic science would certainly reduce the emergence of DNA forensic science statistical fallacies in expert testimony, as the agency would be tasked with educating experts on the risks of these testimonial errors. Unfortunately, however, as seen through the failed attempts at creating the NIFS and NCFS, any hope of another federal agency of this type materializing in the future is slim.

Finally, a third potential reform that some scholars have proposed is requiring forensic experts to disclose error rate information in their written reports and testimony in court.[216] This is an attractive reform because it highlights the limitations of the statistical and probabilistic DNA analysis that expert forensic scientists are presenting.[217] However, this reform has the same downfall as enforcing national standards—monitoring the adherence to this reform poses significantly high information costs.[218] The ideal reform to halt the emergence and adverse effects of DNA forensic science statistical fallacies in expert testimony is one that avoids the downfalls that these potential reforms possess: high information costs and the necessity of political support and capital.

B. Solution: Standard Jury Instructions

1. Explanation of the Solution

In order to thwart the destructive effects of DNA forensic science statistical fallacies in legal testimony, standard jury instructions should be created and administered every time DNA forensics are presented during trial. These standard jury instructions hold promise

213. *See id.* at 19.

214. *See* ACKER & REDLICH, *supra* note 16, at 384.

215. *See id.*

216. *See* Saks & Koehler, supra note 74, at 218–19; GARRETT, *supra* note 24, at 198.

217. *See* Saks & Koehler, supra note 74, at 218–19; GARRETT, *supra* note 24, at 198.

218. *See* Garrett & Neufeld, *supra* note 10, at 95.

to explain and correct all four types of DNA forensic science statistical fallacies.

To begin, an example of the first jury instruction aimed at correcting the fallacy of providing statistics without empirical support is as follows:

> *DNA forensic science statistics presented must be supported by evidence or research. If the evidence or research is not presented to support the statistics explained to you, then these statistics are not reliable.*

This jury instruction will likely correct the providing statistics without empirical support fallacy because it explains that unsupported statistics should not be taken as fact.[219] As seen in the case studies of *People v. Collins*[220] and *State v. Phillips,*[221] unsupported DNA forensic science statistics can grossly mislead the jury and have detrimental effects on the preservation of justice. Therefore, it is necessary to administer this jury instruction every time DNA forensic science statistics are presented to encourage the jury to closely analyze whether the statistics presented were adequately supported by research.

The next jury instruction focuses on correcting the individualization fallacy:

> *Although individualization, identifying the perpetrator with 100 percent certainty, is the goal in DNA forensic science, DNA forensic science can only estimate the probability that the defendant is a match to the DNA from the crime scene. Therefore, there will always be a certain percentage of uncertainty when applying DNA forensic science. Additionally, even if the frequency of a DNA sequence is less than the population, it is erroneous to conclude that it is impossible for two people to share that DNA sequence. For example, if the frequency of a DNA sequence is one in ten billion, it is possible that two people share that sequence although there are less than ten billion people on this Earth.*

This instruction aims to correct the individualization fallacy in two ways. First, it informs the jury that individualization is not currently attainable in DNA forensic science.[222] Specifically, this instruction will advise the jury to discount any statements made by the attorneys or experts indicating that the defendant is the only possible match to the DNA from the crime scene, like the statements made in *State v. Alejandro.*[223] Next, this jury instruction tries to correct the fallacy that if the denominator of the random match probability is greater than the number of people on the planet, it is still a mathematical possibility for more than one person to match the DNA

219. *See* GARRETT, *supra* note 24, at 92.

220. *See* People v. Collins, 438 P.2d 33, 36–37 (Cal. 1968).

221. *See* State v. Phillips, 844 S.E.2d 651, 660 (S.C. 2020).

222. *See* McQuiston-Surrett & Saks, *supra* note 51, at 436.

223. *See* Garrett & Neufeld, *supra* note 10, at 64.

sample.[224] This instruction likely would have corrected the fallacy committed by the prosecutor in the O.J. Simpson trial.[225]

Continuing, the following jury instruction focuses on correcting the prosecutor fallacy:

> *The probability that a random person from the population matches the DNA from the crime scene is called the random match probability. The random match probability does not equal the probability that the defendant is innocent, however. Therefore, if you are presented with a statistic such as there is a 1/300,000 chance that a random person would match the DNA sample, it is erroneous to conclude that there is a 1/300,000 chance that the defendant is innocent given the defendant matches the DNA sample.*

This jury instruction informs the jurors that the random match probability does not equal the source probability.[226] Had the jurors been aware of this in *McDaniel v. Brown*[227] and *People v. Collins*,[228] the probability of the defendants' guilt would not have been exaggerated.

Finally, the last jury instruction contained in this reform is aimed at correcting the defense attorney's fallacy:

> *If, for example, one in twenty-five people share the DNA sequence of the perpetrator, and the defendant matches that DNA sequence, it is erroneous to conclude that this information is irrelevant in a large population, as this would place the defendant within a large pool of potential matches. Evidence can be relevant even if it does not isolate the defendant.*

This instruction highlights the fact that failure to isolate the defendant does not mean that DNA forensic science evidence is immaterial;[229] it is important to analyze this data in relation to the other characteristics that place the defendant at the scene of the crime.[230] Jurors would have benefitted from this jury instruction in order to sift through the fallacious arguments made by the defense attorney during the O.J. Simpson murder trial and the appellate judge in *People v. Robinson*.[231]

Overall, by administering these jury instructions to jurors prior to their deliberation, the detrimental effects of these four DNA forensic science statistics fallacies may be avoided.

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224. *See* Saks & Koehler, supra note 74, at 203.

225. *See id*.

226. *See* Roth, *supra* note 49, at 1150–51.

227. *See* McDaniel v. Brown, 558 U.S. 120, 127–28 (2010).

228. *See* People v. Collins, 438 P.2d 33, 36–37 (Cal. 1968).

229. *See* Nance & Morris, *supra* note 99, at 427.

230. *See* Conklin, *supra* note 103, at 74–75.

231. *See* ROBERTSON ET AL., *supra* note 196, at 133; People v. Robinson, 265 N.E.2d 543, 543 (N.Y. 1970).

2. Comparison to Other Reforms

This solution is superior to the reforms posed by other scholars for many reasons. First, in comparison to establishing national standards that govern the interpretation of forensic data, administering standard jury instructions imposes much lower information costs.[232] The administrative body tasked with monitoring the adherence to national standards would be forced to review every expert's testimony and written reports and ensure that the standards are being met.[233] Not only is this an onerous task, but this would also take a significant amount of time, thereby stalling the judicial process and administration of justice.[234] On the other hand, monitoring adherence to standard jury instructions would solely require an administrative or judicial body to make certain the standard jury instructions were issued to jury members after testimony explaining DNA forensic science statistics was heard.

Additionally, creating the standard jury instructions to explain DNA forensic science statistics does not require the research and capital necessary to create national standards governing the interpretation of forensic data.[235] All that is required is consensus regarding the language contained in the standard jury instructions. From this comparison, it is evident that the standard jury instructions are not limited by the downfalls of administering national standards governing the interpretation of forensic data.

Furthermore, standard jury instructions do not require the capital and political support that impeded the successful creation of administrative agencies dedicated to forensic science.[236] Both the NIFS and NCFS had the prospect of decreasing the prevalence of DNA forensic science statistical fallacies and their deleterious effects; however, inadequate funding and political support posed significant barriers to these agencies' success.[237] Contrarily, standard jury instructions require little to no capital or political support, thereby surmounting the hurdles that impeded the success of both the NIFS and NCFS.

The standard jury instructions are most similar to the reform posed by some scholars requiring experts to disclose error rate

232. *See* Garrett & Neufeld, *supra* note 10, at 95.

233. *See id.*

234. *See* NAT'L RSCH. COUNCIL, *supra* note 60, at 20.

235. *See* Garrett & Neufeld, *supra* note 10, at 95.

236. *See* ACKER & REDLICH, *supra* note 16, at 384.

237. *See id.*

information in their written reports and testimony in court.[238] However, while both of these reforms require some sort of disclosure, monitoring adherence to issuing the standard jury instructions results in fewer information costs. Instead of scouring written reports or expert testimony for the correct error rate disclosure, all that would be required for monitoring adherence to issuing the standard jury instructions would be to make sure they were disclosed in the jury instruction packet and that the judge read the instructions accordingly. This would significantly reduce the time and effort required of monitoring error rate disclosure.

Moreover, standard jury instructions are more explicative to the common juror compared to the disclosure of error rates. Expert testimony regarding DNA forensic science statistics can be extremely complex to the lay juror.[239] Solely stating error rates can get lost in the explanation of the statistical analysis, whereas issuing standard jury instructions allows jurors to revisit the testimony they heard and gain a better understanding of the theory. Additionally, the standard jury instructions will allow jurors to correct the fallacies they may have heard, which will overall be more explanatory compared to a simple error rate disclosure.

Critics of standard jury instructions argue that their implementation impedes the individualization of such instructions to the specific facts of the case.[240] However, the standard jury instructions posed do not foreclose the ability of the court to review and add additional information necessary for the instructions to fit the individualistic aspects of each case.[241] These instructions are not exhaustive, and more detail can be implemented as the court deems necessary.[242] Other critics of standard jury instructions raise the issue that jurors may be confused by the terminology used in the instructions, and judges often give inadequate responses to jurors' requests to simplify.[243] For instance, judges may simply refer the jurors back to the original instructions rather than clarifying terms or substance.[244] This is a colorable argument; however, courts have developed a presumption

238. *See* Saks & Koehler, *supra* note 74, at 218–19; GARRETT, *supra* note 24, at 198.

239. *See* Garrett & Neufeld, *supra* note 10, at 95.

240. *See* Don Musser, *Instructing the Jury–Pattern Instructions*, 6 AM. JUR. *Trials* 923 § 5 (1967).

241. *See id.*

242. *See id.*

243. *See* Peter Tiersma, *The Rocky Road to Legal Reform: Improving the Language of Jury Instructions*, 66 BROOKLYN L. REV. 1081, 1087 (2001).

244. *See id.* at 1086.

that jurors understand their instructions as a "rule of law."[245] This presumption is nearly infallible because, if it were not, it would undermine the efficacy of a jury's role in the legal system at its core.[246]

The aforementioned standard jury instructions avoid the obstacles plaguing the potential reforms posed by other scholars.[247] Not only do the standard jury instructions have low information costs, but they also lack the necessity for political support and capital. Additionally, these instructions can be tailored to become more case-specific and are presumptively understood by jury members.[248] By averting these hurdles, the standard jury instructions pose a sound solution to correcting the detrimental effects of the four DNA forensic science statistical fallacies.

IV. CONCLUSION

The presentation of DNA forensic technology is far from the "gold standard" that commentators have deemed it to be.[249] Since the first application of DNA testing in 1984, setting apart the efficacy of DNA forensic science from the rest of the forensic disciplines, the legal and scientific professions have promulgated a blind trust in DNA forensic science testimony.[250] As a result, DNA forensic science testimony has been admitted into evidence under *Daubert*, Federal Rule of Evidence 702, and state equivalents uncontested.[251]

DNA forensic science is presented through statistical and probabilistic evidence.[252] The presentation of these analyses yields several DNA forensic science statistical fallacies that plague legal arguments and have detrimental effects on the preservation and administration of justice.[253] With fallacies such as providing statistics without empirical support, the individualization fallacy, the prosecutor fallacy, and the defense attorney's fallacy appearing in legal testimony, the probability of wrongful convictions escalates as these fallacies grossly affect the presentation of evidence to the jury.[254]

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245. Gacy v. Welborn, 994 F.2d 305, 313 (7th Cir. 1993).
246. *See* Tiersma, *supra* note 243, at 1088.
247. *See supra* Section III.B.1.
248. *See Gacy*, 994 F.2d at 313; Musser, *supra* note 240.
249. *See* Cino, *supra* note 19, at 416.
250. *See supra* Section I.A.
251. *See supra* Section II.A.
252. *See supra* Section I.A.
253. *See supra* Section I.B.
254. *See supra* Sections I.B, II.B.

While scholars have posed a variety of reforms aimed at deflecting the negative effects of DNA forensic science statistical fallacies—such as issuing national standards for DNA forensic science reports and testimony, establishing an independent federal agency, and reporting error rates—all fall victim to insurmountable hurdles, such as high information costs and lack of necessary capital and political support.[255] This Note suggests, instead, to administer standard jury instructions every time DNA forensic statistics are presented.[256] These standard jury instructions have low information costs and do not require capital or political support, escaping the downfalls of other reforms proposed.[257] If these standard jury instructions are effectuated, the risk of wrongful conviction due to jurors' misunderstanding of DNA forensic science would be reduced.[258]

Although the exoneration of Gary Dotson, the first innocent person acquitted by post-conviction DNA testing in the United States, catalyzed a closer look at the forensic science disciplines, it bolstered the idea that DNA forensic technology is immune from fallacious representation. If the judicial system hopes to erase the adverse effects of this erroneous belief, the standard jury instructions presented in this Note should be enforced, or else the judicial system runs the risk of repeating history.[259]

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255. *See supra* Section III.A.

256. *See supra* Section III.B.

257. *See supra* Section III.B.2.

258. *See supra* Section III.B.

259. *See supra* Section III.B.

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