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Forensic Science in Court: Challenges in the Twenty-First Century

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Summary: *Forensic Science in Court: Challenges in the Twenty-First Century* is a book that explores the legal implications of forensic science. Starting with the history of scientific evidence in court, the book progresses into an examination of how courts treat current types of forensic evidence, specifically how modern juries receive and weigh forensic evidence, and how judges determine what evidence can be allowed. Judge Shelton makes good use of case studies in the book to illustrate the academic points in a real-world setting.[2]

About the Author: The Hon. Donald E. Shelton is an active trial judge with over twenty years of experience on the bench. In addition to his law degree, Judge Shelton has master's degrees in both criminal justice and criminology and is one of only seven American judges with a Ph.D. in judicial studies. Judge Shelton is also an adjunct professor at Eastern Michigan University, teaching classes in both criminology and political science.[3]

Introduction

The introduction lays out a roadmap for the progression of the book, but also establishes several important background ideas. Shelton makes sure the reader understands that testimony from scientific experts is a form of expert testimony, designed to allow opinion testimony to

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[2] DONALD E. SHELTON, FORENSIC SCIENCE IN COURT: CHALLENGES IN THE TWENTY-FIRST CENTURY (2011).

[3] *Id.* at 183.

reach the jury that would be precluded if offered from a lay witness.[4] The basic questions that forensic testimony is designed to address are "who", "whether", and "how."[5] Scientific testimony is allowed by trial judges based on either the *Daubert* test or *Frye* test, and not only must forensic science methods be examined under these tests for viability, advanced technology has created possible constitutional questions to admissibility of evidence as well.[6]

The History and Development of Scientific Evidence

U.S. courts have been accepting expert scientific testimony and evidence for well over a century, and established a pattern of routine acceptance of expert witnesses offered by the prosecution.[7] Case law developed into a self-perpetuating standard with the advent of the *Frye* doctrine, which required merely that testimony be "generally accepted."[8] Courts would use admissibility by other courts as evidence that the field or idea was becoming more "generally accepted" and the defense rarely challenged prosecution-generated forensic evidence empirically or for scientific reliability.[9]

Prosecution witnesses were allowed to give identification testimony, not in terms of probability, but as a "match" or even "unique match" despite the fact that the experts were often

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[4] SHELTON, *supra* note 2, at 1.

[5] *Id.*

[6] *Id.*

[7] *Id.* at 9.

[8] SHELTON, *supra* note 2, at 9.

[9] *Id.*

criminal investigators with little or no scientific training.[10] In addition, experts in other scientific areas were allowed to testify to conclusions about the origin of materials used in a crime. Social scientists were allowed, by courts, to give opinion testimony that a complainant's conduct was consistent with other persons who had been abused in a similar manner to the complainant's claim in order to "prove" that the complainant was telling the truth.[11]

Thankfully, the immergence of DNA evidence and new fingerprinting technologies has led courts to question the validity of older scientific methods that were generally accepted such as comparative bullet lead analysis, tool-mark testimony, serology testing, and hair and fiber analysis.[12] Of the first two hundred post-conviction DNA exonerations, 22 percent were based on false hair or fiber comparisons, and almost 40 percent were based on serology evidence.[13] These exonerations are "undisputable proof of the 'documented ills' of other forms of scientific evidence, including such traditionally admitted forms of evidence as fingerprints."[14]

The Problem of Junk Science: Frye and the Daubert Trilogy

The trial judge is firmly entrenched as the gatekeeper that determines which forms of scientific forensic evidence are "appropriate for consideration by the jury" in all U.S. jurisdiction.[15] While some states still use the test established in *Frye v. United States*, the

[10] SHELTON, *supra* note 2, at 9.

[11] *Id.*

[12] *Id.* at 12.

[13] *Id.*

[14] SHELTON, *supra* note 2, at 12.

[15] *Id.* at 17

majority of states and the Federal courts have adopted a revised admissibility standard articulated in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, and later modified by *General Electric Co. v. Joiner* and *Kumho Tire Co. v. Carmichael*.[16] While the *Frye* test was whether the method was "generally accepted" the Court ruled in *Daubert* that the criteria for determining admissibility should include whether the theory had been tested, whether it "has been subjected to peer review," its error rate, whether its operation was controlled by standards, and whether it is accepted within the relevant scientific community.[17] In *Joiner*, the Court indicated that the trial judge can disallow expert opinion, even if it is based on accepted methodology if the conclusion is not reliably based on that methodology, and in *Kumho*, the Court held that the *Daubert* test should be applied for all experts, not just scientists.[18] It is unclear if these standards are rigorously applied to prosecution witnesses however, and a congressionally authorized study concluded that "the existing legal regime – including the rules governing the admissibility . . . and judges and lawyers who often lack the scientific expertise necessary to comprehend and evaluate forensic science – is inadequate to the task of curing the documented ills of the forensic science disciplines."[19]

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[16] SHELTON, *supra* note 2, at 17.

[17] *Id.* at 17-18.

[18] *Id.* at 18.

[19] *Id.* at 19.

DNA: The New Gold Standard

DNA evidence is the "gold standard" of forensic evidence because it is very durable, can be extracted from small remains long after a crime, is "polymorphic,"[20] and is precise enough to "often demonstrate that only one person in billions could have been the source of the specimen evidence."[21] The first successful use of DNA in a U.S. criminal prosecution was in *Andrews v. State*, a rape case, and since that time DNA evidence has become admissible in virtually every jurisdiction.[22] DNA evidence has almost totally replaced blood typing for identification and is "the most important forensic science development of the twentieth century."[23]

The three common methods to generate DNA profiles are restriction fragment length polymorphism, polymerase chain reaction (PCR), and short tandem repeats tests.[24] PCR-based DNA evidence has been specifically admitted in more than thirty-five states and is the last common form of DNA profile to have any questions to its validity.[25] Absent fraud or error in handling, the probability of a false positive result is miniscule.[26]

DNA evidence has value beyond proving identity. Prosecutors are urged to use DNA evidence "just as any other form of evidence – to corroborate, validate and/or impeach evidence

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[20] SHELTON, *supra* note 2, at 27 (meaning that DNA is unique among humans and, with the proper method for extraction, can identify the donor of the specimen with overwhelming accuracy).

[21] *Id.*

[22] *Id.*

[23] *Id.*

[24] SHELTON, *supra* note 2, at 28.

[25] *Id.*

[26] *Id.*

or testimony."[27] Despite DNA profiling being scientifically superior, , it is not infallible. Human error can always cause invalid results and DNA evidence has been recently challenged on many factors including: poor laboratory proficiency in testing, lack of proper lab protocols, lack of quality control, and broken custody chains. In addition, DNA is very sensitive to environmental conditions and can "start to degrade depending on the sample's exposure to extreme temperatures, oxygen, water, sweat, and breath."[28] However, the biggest threat to the use of DNA in criminal trials may come from the immense demand by police and prosecutors. This overwhelming demand may be resulting in poor laboratory practices and the hiring of inexperienced or overworked technicians, which can cause the confidence in DNA results to be affected.[29] The role of judges in determining when human error is a significant risk factor in DNA results is important because a 2005 Gallup poll shows that 85% of "Americans think DNA evidence is either completely or very reliable."[30]

DNA testing is also important in the post-conviction arena. It is now up to the courts to determine when DNA testing should be used in a search for important exculpatory evidence. While courts are trying to adapt common law standards and statutes regarding post-conviction relief to DNA testing requests, the Department of Justice completed a study in 1999, concluding that out of five possible categories of DNA testing requests, the court should consider it in only two. Where "biological evidence was collected . . . still exists, [and if] subjected to DNA testing or retesting, exclusionary results will exonerate the petitioner" or "would support the petitioner's

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[27] SHELTON, *supra* note 2, at 28.

[28] *Id.* at 29.

[29] *Id.*

[30] *Id.* at 30.

claim of innocence, but reasonable persons might disagree as to whether the results are exonerative."[31]

The "Who" Question

Fingerprint analysis is the first means of forensic identification discussed by Shelton in this section. After a lengthy discussion of the different methods used to lift and compare fingerprints, the main focus is on the analysis required to determine an identifying match.[32] Particularly telling is that fingerprint examiners consider their expertise to be a matter of qualitative, not quantitative analysis. "[T]he ability to see details in prints and the ability to compare features in prints is an 'acquired skill' gained through experience and a lengthy apprenticeship."[33] Examiners believe it is impossible to establish a numerical score or threshold based on corresponding features because examiners do not determine the relevance of those features until an initial "analysis and comparison"[34] is made.

Although the determination that two different persons could not have produced the print is a subjective assessment, examiners generally refuse to use statistics to assign match probabilities and instead testify with "absolute certainty" that the prints could not possibly have come from two different individuals.[35]

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[31] SHELTON, *supra* note 2, at 30-31.

[32] *Id.* at 44.

[33] *Id.* at 46.

[34] *Id.*

[35] SHELTON, *supra* note 2, at 46.

This practice leads to serious question about the scientific value of fingerprint analysis in criminal proceedings under *Daubert*. Although the claims made by fingerprint examiners enjoy unquestioning belief among the lay public, including the bench and bar, there is little conventional science to support these generally accepted claims.[36] There is no scientific or court-recognized minimum standard for the number of points of similarity necessary to declare a fingerprint match. Summary assessments of fingerprint analysis from the National Academy of Sciences, Haber and Haber, and Professor Jennifer Mnookin all identify serious flaws in the science behind fingerprint analysis, as well as the accuracy and validity of the claims by analysts.[37] Although this information should not affect jurisdictions using a *Frye* analysis, because fingerprint analysis has been "generally accepted" for a long time, jurisdictions using a *Daubert* analysis should be radically affected. This has not been the case however; as no court has ruled to date that fingerprint analysis expert testimony cannot at least be given to the jury as a question, despite the mounting evidence that fingerprint analysis is more art than science.[38]

Handwriting analysis is tackled next by Shelton, and his analysis is quite similar the analysis of fingerprint testimony. Despite being based on the basic principle that "although individuals have variations in their own writing, no two persons write the same way", there is no identified or accepted system for analyzing handwriting and all conclusions are subjective evaluations made by the examiners.[39] Scientists have expressed concern that the basic principle above, while plausible based on intuition, has never been established through scientific evidence.

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[36] SHELTON, *supra* note 2, at 46.

[37] *Id.* at 47-48.

[38] *Id.* at 50.

[39] *Id.* at 54.

A study sponsored by the FBI succeeded in showing that a group of trained examiners was significantly better than a group of untrained college students at identifying handwriting samples, but the professionals still declared erroneous identification in 6.5% of the cases.[40] To date, courts seem reluctant to apply a *Daubert* analysis to handwriting testimony; much like fingerprint testimony, but Shelton speculates that a highly publicized conviction overturned by DNA evidence could be all it takes to change this trend.[41]

Shelton also examines hair analysis and bite-mark analysis as identifying evidence and comes to the same basic conclusions as in the previous sections. Both of these disciplines have been called into question under scientific analysis and even if they have "general acceptance" would not survive a true *Daubert* test.[42] Hair analysis has already been rejected by many courts, and bite-mark testimony, while not rejected in as many jurisdictions, has been excluded all together by some.[43]

The "How" Question

Forensic evidence is also used by prosecutors to prove the origins and mechanism of events at a crime scene. Tool mark evidence is one of the oldest of these, and consists of the impressions left when a hard tool contacts a softer object.[44] Examples include the marks left by a screwdriver or crowbar used to break into a door or window, as well as marks generated during a

[40] SHELTON, *supra* note 2, at 56.

[41] *Id.* at 57-58.

[42] *Id.* at 67-77.

[43] *Id.*

[44] SHELTON, *supra* note 2, at 81.

manufacturing process such as the groove in a barrel of a gun.[45] Firearms testimony is one of the more common forms of tool mark evidence and American courts have routinely admitted this form of expert testimony for over 130 years.[46] By comparing the markings on the bullet the groove in the barrel of a gun and the markings on the cartridge to the firing pin with a comparison microscope, experts testify that the bullet in question could only have been fired from one specific firearm.[47]

Like fingerprint and other impression testimony however, the testimony of tool mark experts is, in the final analysis, subjective. The 2009 National Academy of Sciences ("NAS") report is critical of the scientific basis for the type of tool mark and ballistic evidence that has been routinely accepted by courts because "not enough is known about the variabilities among individual tools and guns" and because "sufficient studies have no been done to understand the reliability and repeatability of the methods."[48] The report also noted the "heavy reliance on the subjective findings of examiners rather than on the rigorous quantification and analysis of sources of variability" and the lack of a "precisely defined scientific process."[49]

Despite these findings, there have been no reported cases that reject the fundamental assumption of firearm or other tool mark testimony based on a *Daubert* analysis.[50] Two recent Massachusetts cases included lengthy *Daubert* hearings regarding the admissibility of firearms

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[45] SHELTON, *supra* note 2, at 81-83.

[46] *Id.* at 84.

[47] *Id.* at 82.

[48] *Id.* at 85.

[49] SHELTON, *supra* note 2, at 85.

[50] *Id.*

testimony, but found that while the expert in the current case was not qualified, firearms testimony in general was admissible.[51]

Bullet lead comparison[52], widely used earlier in U.S. judicial history, has been almost completely rejected by every jurisdiction. The FBI has even discontinued the use of bullet lead comparison in its investigations following a 2004 NAS study that found the practice was based on faulty science.[53]

Bloodstain pattern evidence is another very common form of forensic evidence, especially conclusions drawn from the patterns of blood spattering at a crime scene.[54] Even though the practice claims to be based in "biology, physics, and mathematics" there are no formal education requirements for qualifying experts in blood pattern analysis.[55] Professional organizations, such as the International Association for Identification, which requires as little as 240 hours of workshop training for certification, and the Scientific Working Group on Bloodstain Pattern Analysis which has recognized an analyst who had "a high school diploma or equivalent and four years of job-related experience" do little to support the claimed basis.[56] A NAS report was highly critical of bloodstain pattern analysis, noting that exit wounds are highly variable due to the damage bullets cause in soft tissue and the complex patterns that fluids make.

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[51] SHELTON, *supra* note 2, at 85.

[52] *Id.* at 85 (the practice of measuring the combinations of arsenic, antimony, tin, copper, bismuth, silver, and cadmium in bullets on the theory that the batches of bullet lead have unique combinations of these elements and that two bullets with the same ratios must have come from the same source).

[53] *Id.* at 86.

[54] *Id.* at 98-100.

[55] SHELTON, *supra* note 2, at 101.

[56] *Id.*

The report stated, "[E]xtra care must be given to the way in which [bloodstain pattern analyses] are presented in court. The uncertainties associated with bloodstain pattern analysis are enormous."[57]

However, like the other historically accepted forms of forensic testimony discussed earlier, courts are reluctant to fully apply the *Daubert* test to bloodstain pattern analysis.[58] This reluctance is coupled with a general propensity to qualify experts on very minimal credentials.[59] In fact, an appellate court in Texas has even approved the qualification of a local police officer with "45-50 hours" of instruction at a conference as an expert in blood pattern analysis.

Jurors and Forensic Science Evidence

Judges' decisions about the admissibility of forensic evidence are extremely important due to the extent that jurors consider such evidence especially critical to their ultimate decision about guilt.[60] It is widely perceived that modern juries give a great deal of weight to scientific evidence.[61] Prosecutors have often complained that jurors today demand more scientific evidence and will wrongfully acquit defendants if scientific evidence is not presented. Most of the blame for this is based on popular television, and is even colloquially known as the "*CSI* effect."[62] Empirical studies of jurors conducted in 2006 and 2009 were conducted to determine

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[57] SHELTON, *supra* note 2, at 102.

[58] *Id.*

[59] *Id.*

[60] *Id.*

[61] SHELTON, *supra* note 2, at 115.

[62] *Id.*

if juries indeed expect and demand more scientific evidence, and if so, was this demand related to television watching habits. The results confirmed that jurors do expect prosecutors to present scientific evidence; particularly in cases where the majority of evidence is circumstantial, but they also found that there was no measurable correlation between the demand for evidence and watching *CSI* or similar programming.[63]

Instead, Shelton postulates that it is not television that is shaping the jurors' desire for scientific evidence, due to the fact that television is not as influential a media source as it was in the past.[64] Shelton considers the "cultivation theory" put forward by George Gerbner over thirty years ago, but argues that due to the greater programming offerings available and the additional forms of entertainment media available, the effects of television as a shaper of reality has been diminished in force and scope.[65]

Judge Shelton identifies that the 2006 study on jurors indicated a correlation between the sophistication of technology used in the juror's everyday life and the amount of scientific evidence that they expected.[66] He proposes that instead of a "*CSI* effect," this evidence points to a general "tech effect" instead.[67] Because jurors are able to access individual GPS devices and mail-in DNA test kits for determining parentage and know that these technologies can be used in trials, expect that a complete investigation would include these elements.[68] While prosecutors

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[63] SHELTON, *supra* note 2, at 116.

[64] *Id.*

[65] *Id.* at 116-17.

[66] *Id.* at 117.

[67] SHELTON, *supra* note 2, at 117.

[68] *Id.* at 118.

argue that this trend has improperly increased their burden of proof, Shelton counters, "constitutional commitment to a jury system is a judgment that justice in individual cases *should* reflect the values of the popular culture."[69] "Jurors think that DNA and other modern scientific techniques are extremely accurate," and they are correct.[70] With the ability to declare a random-match probability of one in 7.87 trillion, jurors will find that evidence "highly probative, if not dispositive."[71] The trend of jurors demanding more scientific evidence will continue, and the government and judicial system must respond and adapt to those trends.[72]

One method being used by prosecutors to address a jury's desire for scientific evidence is to introduce evidence of tests that were not done, or tests that did not incriminate the defendant.[73] Over objection that this evidence was irrelevant, in *State v. Cooke*, Delaware Judge Herlihy ruled that juror's expectations for scientific evidence are influencing trials enough to justify the prosecutor's presentation of "negative evidence."[74] In *United States v. Fields*, the United States Court of Appeals for the Fifth Circuit upheld a ruling allowing the prosecutor to display nineteen photographs of the murder victim at the crime scene, despite the gruesome nature of the decomposing body, because they were, "highly probative based on the defense's position that there was no reliable DNA evidence and little crime scene evidence regarding the body itself." The court recognized the increased demand for scientific evidence by modern jurors and allowed

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[69] SHELTON, *supra* note 2, at 118.

[70] *Id.*

[71] *Id.*

[72] *Id.*

[73] SHELTON, *supra* note 2, at 118.

[74] *Id.* at 119.

otherwise prejudicial evidence to be admitted to explain why some scientific evidence could not be presented.[75]

Courts have also allowed attorneys to address the "tech effect" and juror expectations directly at trial during voir dire, and prosecutors have tried to expand into opening statements, and closings.[76] Shelton gives many examples of allowable voir dire questions that both directly and indirectly reverence *CSI* and scientific evidence.[77] Multiple courts have also upheld peremptory challenges in the context of a *Batson* challenge, holding that concerns over responses to "*CSI*" questions were not just pretextual and race-neutral.[78]

While judicial response to attorney's attempts to address these same issues in opening or closing arguments has been mixed, it appears to at least, be a context-based decision. Courts have held that arguments revolving around "television expectations" will not be allowed if they disparage or trivialize the actual constitutional standard of the burden of proof.[79] Jury instructions are another area where the "tech effect" may sometimes be addressed. While standards are still being determined, Shelton states, "If the trial judge gives an instruction regarding the lack of scientific evidence, . . . it should be cast in terms of reasonable doubt to make sure that the jury understands that while a lack of scientific evidence alone does not mean

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[75] SHELTON, *supra* note 2, at 119.

[76] *Id.*

[77] *Id.* at 120.

[78] *Id.* at 121.

[79] SHELTON, *supra* note 2, at 121.

there is reasonable doubt, they must . . . determine whether the government has proven, without such scientific evidence, the defendant's guilt beyond a reasonable doubt."[80]

Conclusion

The questioning of routine admission of forensic science evidence in criminal prosecutions began during an era when science and technology was experiencing a surge of development.[81] Because of the miniaturization of computers and application of computer technology to every aspect of human life, society's awareness of technology is at an all time high.[82] This technological backdrop, and the changing legal, scientific, and cultural landscape, has cast significant doubts as to the continued use of many types of previously unquestioned forensic science evidence.[83] Three events have spearheaded this movement: the Supreme Court decision in *Daubert*, the advent of DNA as a model for forensic identification, and the use of DNA to exonerate innocent individuals convicted based on erroneous forensic evidence.[84] The technological proficiency of jurors and the increased expectation for prosecutors to produce scientific evidence at trial are at odds with a move away from the legal sufficiency of forensic techniques that have been long expected. New technologies will undoubtedly fill the void created as these technologically savvy jurors recognize the scientific flaws in traditional forensic

[80] SHELTON, *supra* note 2, at 124.

[81] *Id.* at 125.

[82] *Id.* at 126.

[83] *Id.*

[84] SHELTON, *supra* note 2, at 126.

techniques, and prosecutors will be forced to move away from them until they can be scientifically proven.[85]

[85] SHELTON, *supra* note 2, at 140.