

Firearm and Toolmark Opinion Evidence: Admissibility of Opinions After *Daubert* and the NAS Reports

Introduction

Toolmarks are created when a hard object comes in contact with a softer object, imparting marks (impressions) on the softer surface. Firearm and toolmark opinion evidence involves the comparison of class and individual characteristics of impression marks (often microscopic) to reach conclusions concerning the source of the marks [1]. Firearm and toolmark *identification* evidence seeks to associate a particular firearm or tool with impression marks left on an item of evidence or at a particular scene [2]. With firearm identification evidence, the examination attempts to associate a particular firearm with an evidentiary bullet or cartridge case through the comparison of the class and individual characteristics on the evidentiary bullet/cartridge case with the marks on a bullet/cartridge case test-fired from the firearm [3].

The fundamental assumptions underlying firearm and toolmark identification evidence are uniqueness and reproducibility. In the context of firearm identification evidence, the first assumption is that the manufacturing process produces imperfections in the various components of the firearm (barrel, firing pin, breech face, chamber, extractor, and ejector) [4] so that each firearm is unique. The second assumption is that these imperfections reproduce marks on every bullet or cartridge case fired from that firearm. The challenges to the admissibility of firearm identification evidence have focused on the scientific validity of these two fundamental assumptions, primarily with respect to the first assumption of uniqueness.

Daubert

In *Daubert v. Merrell Dow Pharmaceuticals* [5], the US Supreme Court rejected the “general acceptance”

test of *Frye v. United States* [6], and mandated that the trial court make “a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid and of whether that reasoning or methodology properly can be applied to the facts in issue” [5, pp. 592–593]. To perform this “gatekeeping responsibility,” the trial courts were advised to consider the following factors in ruling on the admissibility of proffered expert opinion testimony: (i) whether the type of evidence can be and has been tested by a scientific methodology; (ii) whether the underlying theory or technique has been subjected to peer review and has been published in the professional literature; (iii) how reliable the results are in terms of a potential error rate; (iv) the existence and maintenance of standards controlling the technique’s operation; and finally (v) a consideration of general acceptance [7].

In *Kumho Tire Co. v. Carmichael* [8], the Supreme Court clarified that the *Daubert* admissibility standard applied to nonscientific expert testimony: “*Daubert’s* general holding – setting forth the trial judge’s general ‘gatekeeping’ obligation – applies not only to testimony based on ‘scientific’ knowledge, but also to testimony based on ‘technical’ and ‘other specialized’ knowledge” [8, p. 141].

The *Daubert* admissibility standard is based on an interpretation of Rule 702 of the Federal Rules of Evidence and applies to proceedings (civil and criminal) in all federal courts [5, p. 587]. The same analytical framework, however, may govern admissibility decisions in state jurisdictions that have specifically adopted the *Daubert* standard through case decision or by enacting evidence rules similar to the Federal Rules of Evidence [3, p. 17]. Even in jurisdictions that have not specifically adopted the *Daubert* standard, the courts will often refer to the standard in ruling on the admissibility of expert testimony [9].

NAS Reports

2008 NAS Report. In 2004, the National Institute of Justice asked the National Research Council of the National Academy of Sciences (NAS) to address the issues raised by computerized ballistic imaging technology [10, pp. 1–2]. A committee was formed to “assess the feasibility, accuracy and reliability, and technical capability of developing and using a national ballistics database as an aid to criminal investigations” [10, p. 2]. The committee members

2 Firearm and Toolmark Opinion Evidence

were primarily from academia with a concentration of experience in statistics, computer science, and public policy. No firearm examiners were on the committee, although a former firearm and toolmark examiner served as a consultant to the committee [10, pp. v–vi, xii]. The committee published its report, *Ballistics Imaging*, in 2008 (hereinafter “2008 NAS Report”). Although the 2008 NAS Report focused on computer imaging of bullets, a section of the report examined the theory and methodology of firearm identification evidence:

Underlying the specific tasks with which the committee was charged is the underlying question of whether firearm-related toolmarks are unique: that is, whether a particular set of toolmarks can be shown to come from one weapon to the exclusion of all others. [10, p. 3]

The Committee cited its review of the research studies on the fundamental assumptions of uniqueness and reproducibility of the individual characteristics that provide the foundation for firearm identification evidence and commented that “[m]ost of these studies are limited in scale and have been conducted by firearms examiners (and examiners in training) in state and local law enforcement laboratories as adjuncts to their regular casework” [10, p. 70]. The 2008 NAS Report concluded that “[t]he validity of the fundamental assumptions of uniqueness and reproducibility of firearm-related toolmarks has not yet been fully demonstrated,” but cautioned that “[o]ur review . . . is not – and is not meant to be – a full weighing of evidence for or against the assumptions, but is ample enough to suggest that they are not fully settled, mechanically or empirically” [10, pp. 81–82]. The report went on to address the scientific validity of expressions of absolute certainty by firearm examiners:

Conclusions drawn in firearm identification should not be made to imply the presence of a firm statistical basis when none has been demonstrated. Specifically, [as described *supra*], examiners tend to cast their assessments in bold absolutes, commonly asserting that a match can be made ‘to the exclusion of all other firearms in the world.’ Such comments cloak an inherently subjective assessment of a match with an extreme probability statement that has no firm grounding and unrealistically implies an error rate of zero. (emphasis in original) [10, p. 82]

2009 NAS Report. In 2006, the NAS was commissioned by the United States Congress to review the provision of forensic science services in the United States. A duly-appointed committee (the Committee on Identifying the Needs of the Forensic Science Community) of professionals from the legal, forensic science, and academic communities met throughout 2007 and 2008. The report (hereinafter “2009 NAS Report”) was published in February 2009 [11]. In addition to the noncontroversial recommendations of increased funding and training, the 2009 NAS Report included statements about various forensic science disciplines suggesting that some current techniques and common expert opinions were inadequately grounded in science. In particular, the 2009 NAS Report found little support in science for identification testimony offered in some forensic science disciplines, including firearm and toolmark examination:

With the exception of nuclear DNA analysis . . . 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. [11, p. 7]

While recognizing that some well-established forensic science techniques used in crime laboratories are based on solid scientific principles and supporting research, other techniques:

have been developed heuristically. That is, they are based on observation, experience, and reasoning without an underlying scientific theory, experiments designed to test the uncertainties and reliability of method, or sufficient data that are collected and analyzed scientifically. [11, p. 7]

Quoting the finding of the 2008 NAS Report concerning the validity of the fundamental assumptions of firearm identification, the 2009 NAS Report also found that “[s]ufficient studies have not been done to understand the reliability and repeatability of the methods” used in firearm identification [11, p. 154]. The report criticized the lack of specific protocols and insufficient research concerning the uniqueness and reproducibility assumptions for the limitations of firearm and toolmark examination [11, p. 155].

After this less than enthusiastic endorsement of the reliability of firearm and toolmark analytical

methods and conclusions, the forensic science and legal communities waited for the judicial response.

Response from the Courts

Post-Daubert (1993–2009)

Questions of the admissibility of firearm and toolmark opinion evidence did not develop immediately after the *Daubert* decision but the defense in criminal cases began to challenge the evidence in the early 2000s. These early challenges to the reliability of the methodology were largely unsuccessful [12]. By 2005, however, the challenges also focused on the expressions of “absolute certainty” and some courts began to restrict the scope of the expert testimony to bar identifications “to the exclusion of every other firearm in the world” [13]. Although firearm and toolmark opinion evidence continued to be admitted, several of the court decisions also included critical assessments of the scientific validity of the methods used in firearm identification:

[W]hen liberty hangs in the balance – and, in the case of the defendants facing the death penalty, life itself – the standards should be higher than were met in this case, and than have been imposed across the country. The more courts admit this type of toolmark evidence without requiring more documentation, proficiency testing, or evidence of reliability, the more sloppy practices will endure; we should require more. [14]

Post-NAS Reports (2008–2013)

Following the publication of the two NAS Reports, the challenges to the admission of firearm and toolmark opinion evidence had additional supporting material but the challenges continued to meet the same fate: firearm and toolmark opinion evidence remained admissible. Some courts did continue, however, to impose limitations on the scope of the examiners’ testimony [15].

In *United States v. Otero* [16], the court directly addressed “the reliability of forensic toolmark examination employed to identify the firearm from which discharged ammunition originated” [16, p. 427]. The defense challenged the individualized identification of the firearm as based on a theory that has not been proven scientifically, citing both NAS Reports [16, p.

430]. The court held that the evidence met all of the *Daubert* factors for admission while heavily criticizing the qualifications and testimony of the defense expert as “an advocate for a particular position rather than as a dispassionate analyst” [16, pp. 436–437]. Similarly, in *United States v. McCluskey* [17], the court held that the firearm identification evidence was reliable under the principles of *Daubert* and *Kumho Tire*, specifically finding that the validity of the underlying theory “is testable and has been tested,” has been published in peer-reviewed journals, has sufficient standards governing the methodology, and is generally accepted [18]. The court permitted the examiner to express her conclusion as a “practical certainty” but not as an “absolute certainty” [17, p. 21].

In *Commonwealth v. Heang* [19], although the court upheld the decision to admit the firearm identification evidence, the court established the following guidelines for the admission of such evidence in future cases:

First, before trial, the examiner must adequately document the findings or observations that support the examiner’s ultimate opinion, and . . . this documentary evidence . . . shall be provided in discovery Second, before an opinion is offered at trial, [the examiner] should explain to the jury the theories and methodologies underlying the field Third, in absence of special circumstances casting doubt on the reliability of an opinion . . . [the examiner] may present an expert’s opinion . . . to a ‘reasonable degree of ballistic certainty.’ [19, pp. 944–945]

The court specifically noted that “[p]hrases that could give the jury an impression of greater certainty, such as ‘practical impossibility’ and ‘absolute certainty,’ should be avoided” [19, p. 946].

Some court decisions also continued to contain criticism of the underlying methodology and the lack of research on the fundamental assumptions of firearms and toolmark identification evidence. In *United States v. Glynn* [20], the court concluded that firearms identification “lacks the rigor of science [and] suffers from greater uncertainty than many other kinds of forensic evidence.” The court barred the examiner from testifying as to absolute certainty as to the identification and permitted the conclusion to be expressed only as “more likely than not” that the firearm had fired the evidentiary bullet [21].

4 Firearm and Toolmark Opinion Evidence

Conclusion

The *Daubert* decision and the NAS Reports were seminal events within the legal and forensic science communities. In response to these events, admissibility challenges were raised to firearm and toolmark opinion evidence. While the adequacy of the empirical support for the underlying assumptions of firearm and toolmark identification evidence remains a subject of controversy, the admissibility of firearm and toolmark opinion evidence as a field of forensic science has not changed with the milestones of *Daubert* and the NAS Reports. However, as admissibility challenges have focused more attention on the methodology, standards, and inherent subjectivity of the expert conclusions, there have been limitations imposed – both by professional organizations [22] and by the courts – on the expressions of certainty as to the conclusions of the examiners.

In *Daubert*, the Court noted that “it would be unreasonable to conclude that the subject of scientific testimony must be ‘known’ to a certainty; arguably, there are no certainties in science” [5, p. 590]. This recognition of uncertainty in science is inconsistent with the expressions of absolute certainty used in the past by some firearm and toolmark examiners and may have shaped the admissibility challenges to firearm and toolmark opinion evidence following the *Daubert* decision and the publication of the NAS Reports. Some courts were critical of the “lack of scientific rigor” in firearm identifications, admonishing the forensic science and legal communities to demand “better” but recognizing the probative value and reliability of the evidence in admitting the evidence. In response, professional organizations have continued to improve standards and protocols and have invested significant resources in empirical research to support the fundamental assumptions of uniqueness and reproducibility.

Despite some limitations on expressions of absolute certainty, firearm and toolmark opinion evidence remains an applied science routinely used by law enforcement and generally accepted by the courts.

References

- [1] Class characteristics of a firearm result from design factors and include land and groove diameters, rifling direction, the number of lands and grooves, the width of lands and grooves, and the degree of rifling twist. Individual characteristics arise from imperfections that are created through the manufacturing process and subsequent use of the firearm that impart striations and other microscopic markings on bullets and cartridge casings fired from the firearm. Federal Judicial Center (2011). *Reference Manual on Scientific Evidence*, 3rd Edition, The National Academies Press, Washington, DC, pp. 91–96.
- [2] The first published decision upholding the admission of firearm opinion evidence was from the Virginia Supreme Court in 1879 and concerned the comparison of the weight of an evidentiary bullet and a bullet in the defendant’s possession. *Dean v. Commonwealth*, 73 Va. (32 Gratt.) 912 (1879). The case also involved the examination of impression marks from the defendant’s firearm on a fence railing. In 1902, the Massachusetts Supreme Court approved the admission of testimony concerning the similarities of markings on the evidentiary fired bullet and a test bullet pushed through the defendant’s rifle. *Commonwealth v. Best*, 180 Mass. 492, 62 N.E. 748 (1902). The comparison of markings on two fired bullets was finally addressed as scientific evidence by the Kentucky Supreme Court in 1929. *Evans v. Commonwealth*, 230 Ky. 411, 19 S.W.2d 1091 (1929). See also *People v. Fisher*, 172 N.E. 743, 754 (Ill. 1930) (upholding the admission of firearm opinion evidence and discussing the necessary expert qualifications). The admission of opinion testimony concerning the comparison of markings on an evidentiary cartridge case and a test-fired cartridge case was upheld in *State v. Clark*, 99 Or. 629, 196 P. 360 (1921).
- [3] For a thorough discussion of firearm and toolmark identification, including a detailed glossary and bibliography of additional resources, see Moenssens, A.A., DesPortes, B.L. & Edwards, C.N. (2013). *Scientific Evidence in Civil and Criminal Cases*, 6th Edition, Thomson Reuters/Foundation Press, New York, pp. 313–392.
- [4] Federal Judicial Center (2011). *Reference Manual on Scientific Evidence*, 3rd Edition, The National Academies Press, Washington, DC, pp. 93–94.
- [5] 509 U.S. 579 (1993).
- [6] 293 F. 1013 (D.C. Cir. 1923).
- [7] The Court noted that the test did not have a controlling factor and other factors could be considered. 509 U.S., pp. 592–594.
- [8] 526 U.S. 137 (1999).
- [9] See *Turner v. State*, 953 N.E.2d 1039, 1048 (Ind. 2011) (“Though noting that federal jurisprudence on the issue is not binding on Indiana courts, the trial court applied the Supreme Court’s factors from *Daubert*”).
- [10] Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database, National Research Council of the National Academies (2008). *Ballistic Imaging*, The National Academies Press, Washington, DC.
- [11] Committee on Identifying the Needs of the Forensic Science Community, National Research Council of the National Academies (2009). *Strengthening Forensic*

- Science in the United States: A Path Forward*, The National Academies Press, Washington, DC.
- [12] See, e.g., *United States v. Cooper*, 91 F. Supp.2d 79 (D. DC 2000); *United States v. Santiago*, 199 F. Supp.2d 101 (S.D. NY 2002); *United States v. Foster*, 300 F. Supp.2d 375 (D. Md. 2004); *United States v. Hicks*, 389 F.3d 514 (5th Cir. 2004); *Commonwealth v. Whitacre*, 878 A.2d 96 (PA Super. Ct. 2005); *State v. Anderson*, 624 S.E.2d 393 (NC Ct. App. 2006); *United States v. Diaz*, No. 05-0167, 2007 U.S. Dist. LEXIS 13152, 2007 WL 485967 (ND Cal. February 12, 2007).
- Although the reliability of conventional firearm identification evidence was upheld by the courts, some attempts to extend the scope of the field were curtailed. In *Sexton v. State*, 93 S.W.3d 96, 101 (Tex. Crim. App. 2002), the appellate court found that the expert testimony concerning the “match” between magazine marks on unfired cartridge cases in the defendant’s possession and a fired cartridge case was not admissible because the magazine was not recovered (preventing any testing) and the expert possessed no knowledge of the magazine manufacturing process to establish the uniqueness of magazine marks.
- [13] See *United States v. Green*, 405 F. Supp. 2d 104, 109 (D. Mass. 2005); *United States v. Diaz*, CR05-00167 WHA, 2007 WL 485967 (ND Cal. 2007). But see *United States v. Natson*, 469 F. Supp. 2d 1253, 1261 (MD Ga. 2007) (opinion “to 100% degree of certainty” admitted).
- [14] *United States v. Green*, 405 F. Supp. 2d 104, 109 (D. Mass. 2005). See also *United States v. Monteiro*, 407 F. Supp. 2d 351, 355 (D. Mass. 2006) (finding that “there is no reliable . . . scientific methodology which will currently permit the expert to testify . . . [as to] a ‘match’ to an absolute certainty, or to an arbitrary degree of statistical certainty,” but permitting admission with limited conclusions).
- [15] See *United States v. Taylor*, 663 F. Supp. 2d 1170 (D. NM 2009) (firearm identification evidence admissible, but examiner not allowed to testify that “there is a match to the exclusion, either practical or absolute, of all other guns”); *United States v. Willock*, 696 F. Supp. 2d 536 (D. Md. 2010) (adopting comprehensive magistrate’s report and recommendation that firearm identification evidence admitted with limitations on expressions of “absolute certainty”). See also *Turner v. State*, 953 N.E.2d 1039 (Ind. 2011) (firearms identification evidence admitted without limitation); *Jones v. United States*, 27 A.3d 1130 (DC Ct. App. 2011) (firearm identification evidence admissible, any error in the expression of “absolute certainty” was harmless).
- Many of these cases note that guidelines of professional organizations such as the Association of Firearm and Tool Mark Examiners (AFTE) and the Scientific Working Group for Firearms and Toolmarks (SWGUN) do not endorse expressions of “absolute certainty.” See SWGGUN, *The Foundations of Firearm and Toolmark Identification* (May 1, 2013), http://www.swggun.org/swg/index.php?option=com_content&view=article&id=66:the-foundations-of-firearm-and-toolmark-identification&catid=13:other&Itemid=43 (accessed Sep 2013).
- [16] 849 F. Supp. 2d 425 (D. NJ 2012)
- [17] Case No. 1:10CR02734 (D. NM February 7, 2013), http://www.swggun.org/swg/index.php?option=com_content&view=article&id=42:case-citations&catid=9:ark&Itemid=19 (accessed Sep 2013).
- [18] The court, however, found that “insufficient data exists to calculate a definitive error rate.” *Id.*, p. 16.
- [19] 942 N.E.2d 927 (2011).
- [20] 578 F. Supp.2d 567, 574-575 (SD NY 2008).
- [21] *Id.* Relying on the *Glynn* decision, a recent decision from the US District Court in the Southern District of New York held that the government had failed to establish that firearm identification “is a ‘science’” and prohibited the witness from “referring to his methodology or the principles he relies upon as ‘science’ or ‘scientific.’” The court permitted the examiner to testify as to his opinion that the cartridge cases came from the same firearm, but prohibited the use of “language that implies a specific degree of certainty as to his conclusion . . . that it is a ‘practical impossibility’ that the [cases] came from different firearms, that he is ‘absolutely certain,’ or anything of that sort.” *United States v. Dore et al.*, Case 1:12CR00045-RJS (SD NY March 11, 2013), pp. 1–3, http://www.swggun.org/swg/index.php?option=com_content&view=article&id=42:case-citations&catid=9:ark&Itemid=19 (accessed Sep 2013).
- [22] See Ref. 15 for references to the guidelines of SWGGUN and AFTE.

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