

IN THE CIRCUIT COURT FOR PRINCE GEORGE'S COUNTY, MARYLAND
(Criminal Division)

STATE OF MARYLAND

v.

KOBINA EBO ABRUQUAH

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Criminal No. CT121375X

BRIEF OF THE INNOCENCE PROJECT AND THE MARYLAND OFFICE OF THE
PUBLIC DEFENDER AS AMICI CURIAE IN SUPPORT OF DEFENDANT

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*Statement of Interest*¹

The Innocence Project is an organization dedicated to providing pro bono legal and related investigative services to indigent prisoners for whom evidence discovered post-conviction can provide proof of innocence. Drawing on the lessons from cases in which innocent persons were convicted, the Innocence Project also promotes study and reform designed to enhance the truth-seeking function of the criminal justice system and to prevent further injustice.

The Innocence Project pioneered the DNA model that has exonerated 351 innocent people, and has served as counsel in many of these cases. Today, DNA test results are widely accepted as powerful evidence at trial, in large part because DNA testing was originally developed through rigorous scientific research at leading institutions. But not all purportedly scientific evidence admitted at trial has undergone sufficiently rigorous scientific evaluation, including the underlying data and methodology utilized by many expert forensic witnesses. Indeed, in nearly half of the 351 exonerations secured through post-conviction DNA evidence through 2017, the admission of unreliable expert “scientific” forensic evidence played a role in convicting the innocent.²

The Maryland Office of the Public Defender (“OPD”) was created in 1971 to “provide for the realization of the constitutional guarantees of counsel in the representation of indigent individuals, including related necessary services and facilities, in criminal and juvenile

¹ The parties have consented to the filing of this brief. No counsel for a party authored this brief in whole or in part, and no party or its counsel made a monetary contribution intended to fund the preparation or submission of this brief. No persons other than amici, their members, or their counsel made a monetary contribution to this brief’s preparation or submission.

² See generally The Innocence Project, *Misapplication of Forensic Science*, available at <https://www.innocenceproject.org/causes/misapplication-forensic-science/> (last visited on Dec. 1, 2017); Brandon L. Garrett & Peter J. Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 Va. L. Rev. 1, 14 (2009); Brandon L. Garrett, *Judging Innocence*, 108 Colum. L. Rev. 55, 83–84 (2008).

proceedings in the State” and to “assure the effective assistance and continuity of counsel to indigent accused individuals taken into custody and indigent individuals in criminal and juvenile proceedings before the courts of the State.” Md. Crim. Proc. Code Ann., § 16-201 (2013). In 2016, the OPD opened files for 171,886 primarily criminal and juvenile delinquency cases in the circuit and district courts. Maryland Office of the Public Defender, FY 2017 Annual Report (September 2017). The OPD’s mission is to “provide[] superior legal representation to indigent defendants in the State of Maryland.” *Id.*

The OPD represents many individuals charged with offenses that involve forensic evidence, including cases, like Mr. Abruquah’s, where the testimony of State firearms examiners is central to the State’s case and where the methods employed are almost exclusively in the hands of police and prosecutors. In the OPD’s experience, State firearms examiners, like other forensic witnesses, frequently overstate the alleged scientific character of their methods and the degree of alleged scientific certainty in their conclusions, prejudicing the defendant’s right to a fair trial.

Summary of Position

The Innocence Project and the OPD file this amicus brief to call the Court’s attention to the mounting recognition by the scientific community that many forensic techniques, although widely used in criminal cases and assumed to be valid and reliable scientific tools are, in fact, unvalidated and unreliable evidence. The recognition of the weak or nonexistent scientific underpinnings of these techniques encompasses many fields, including arson, comparative bullet

lead analysis, bite mark and hair comparisons, gunshot residue analysis, and—in this case—firearms identification.³

For decades, the government has presented the testimony of firearms examiners as “scientific” proof that the bullets or shell casings recovered from a crime scene were fired from a particular gun to the exclusion of all other guns. With unqualified certainty, these examiners have testified in case after case that the bullets found at the crime scene came from the defendant’s gun, or that bullets found at different crimes were fired from the same weapon, implicating the same shooter. In Mr. Abruquah’s own 2013 trial, the State’s firearms examiner, Mr. McVeigh, concluded that “to a reasonable degree of scientific certainty,”⁴ the bullet and jacket fragments recovered from the victim or the crime scene had been fired from Mr. Abruquah’s Taurus revolver. Tr. 136:11–Tr. 137:22, Dec. 12, 2013. He then testified that another way to characterize “a reasonable degree of scientific certainty” is to say that “the level of matching or agreement in another firearm is so remote as to consider it a practical impossibility.” *Id.* 139:5–11. He explained that he examined only Mr. Abruquah’s gun because, based on his observations and the “abundant sufficient agreement” he decided that “look[ing] at other guns would have been fruitless.” *Id.* 143:3–6. And he insisted that this process was

³ Although we use the familiar term “identification,” the more precise term is “individualization”—the alleged ability to scientifically conclude that an individual bullet or shell casing came from a specific firearm to the exclusion of all other firearms based on a comparison of various markings from the bullet or shell in question with others from the weapon that is suspected as a match. This is a highly subjective process. Experts can and do disagree and mistaken identifications have occurred. Paul C. Giannelli, *Daubert Challenges to Firearms (“Ballistics”) Identifications*, http://scholarlycommons.law.case.edu/faculty_publications/153 (2007). No two projectiles fired by the same weapon will exactly match each other.

⁴ Despite its common usage in the courtroom, the term “reasonable degree of scientific certainty” is undefined and inherently ambiguous. See, e.g., Paul C. Giannelli, *The NRC Report and Its Implications for Criminal Litigation*, 50 *Jurimetrics J.* 53, 60 (2009) (“The phrase, which combines two suspect words—*scientific* and *certainly*—has no scientific meaning.”).

“scientifically correct.” *Id.* 142:6.⁵ Equally as significant is what he did not say. In particular, he did not indicate how many common marks he identified and, conversely, how many marks he eliminated or deemed inconclusive. Nor did he tell the jury that firearms identification is highly subjective and lacks scientific protocols to reduce errors and biases.

The scientific community has rejected such claims of scientific certitude as unupportable. In particular, three authoritative reports issued in 2008, 2009, and 2016, two by the research arm of the National Academy of Sciences and one by the President’s Council of Advisors on Science and Technology, found that the techniques used by firearms examiners are, at best, capable of including or excluding a firearm as a possible source of a bullet or casing but such techniques are not capable of making probabilistic claims, much less claims that the firearm in question was the only possible source of the bullet or casing. These interdisciplinary reports, authored by three separate committees of nationally recognized scientists and professionals, found that the fundamental assumptions underlying firearms identification have not been fully demonstrated, that the theory is not scientific, that the methodology is entirely subjective, and that there is insufficient empirical evidence to establish validity and estimate reliability. These shortcomings not only render the state witness’s conclusions described above inadmissible, but also pose the grave risk of wrongful convictions in this and other cases.

The relevant “scientific community”—which of course is not limited to the firearms examiners themselves—has found there are serious deficiencies in the theory of firearms identification. Accordingly, at a bare minimum, the Court should limit the testimony of the State’s firearms examiner to what he did and what he observed and exclude any testimony that

⁵ See Tr. 142:1-7, Dec. 12, 2013 (“[I]n staying current with my science and what’s going on with my science, there are validation studies that say that that kind of overreaching statistical accountability is not needed. In other words, the pattern matching that’s been done has been validated as being scientifically correct in the field of firearms identification.”).

purports to claim any degree of scientific certainty in the methodology he used. Amici respectfully submit that the examiner's conclusions be limited to including or excluding the weapon at issue as a potential source of the crime scene evidence; any individualization or probabilistic claims are not supported by the science. The Court also should permit Mr. Abruquah to present his own expert testimony regarding the scientific limitations of firearms identification.

Argument

I. *UNDER MARYLAND LAW, THE ADMISSIBILITY OF EXPERT TESTIMONY REQUIRES THAT EXPERT CONCLUSIONS ACTUALLY BE SUPPORTED BY THE EVIDENCE UPON WHICH THEY RELY.*

Under Maryland law, the admissibility of expert testimony is governed by Maryland Rule of Evidence 5-702 and the *Frye-Reed* standard. See *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923) ("*Frye*"); *Reed v. State*, 283 Md. 374, 381, 391 A.2d 364, 368 (1978) ("*Reed*").

Under Rule 5-702,

[e]xpert testimony may be admitted, in the form of opinion or otherwise, if the court determines that the testimony will assist the trier of fact to understand the evidence or to determine a fact in issue. In making that determination, the court shall determine (1) whether the witness is qualified as an expert by knowledge, skill, experience, training, or education, (2) the appropriateness of the expert testimony on the particular subject, and (3) whether a sufficient factual basis exists to support the expert testimony.

Md. R. Evid. 5-702.⁶ Even if admissible, "evidence may be excluded if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading

⁶ The committee note to Rule 5-702 states: "This Rule is not intended to overrule *Reed v. State*, 283 Md. 374 (1978) and other cases adopting the principles enunciated in *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923). The required scientific foundation for the admission of novel scientific techniques or principles is left to development through case law. Compare *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 113 S.Ct. 2786 (1993)."

the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence.” Md. R. Evid. 5-403.

The *Frye-Reed* standard limits expert testimony to that which is generally accepted by the relevant scientific community. *Savage v. State*, 455 Md. 138, 158, 166 A.3d 183, 194 (2017) (“*Savage*”). As part of Rule 5-702 and the *Frye-Reed* inquiry, Maryland courts have accepted the trial judge’s “gatekeeper” role in assessing the admissibility and reliability of expert testimony. *See, e.g., Clemons v. State*, 392 Md. 339, 271, 896 A.2d 1059, 1078 (2006) (finding “that a genuine controversy exists within the relevant scientific community about the reliability and validity of” comparative bullet lead analysis (“CBLA”) and concluding, despite technique’s decades-long use, “[b]ased on the criticism of the processes and assumptions underlying CBLA . . . that the trial court erred in admitting expert testimony based on CBLA because of the lack of general acceptance of the process in the scientific community.”). *See also Savage*, 455 Md. at 180, 166 A.3d at 208 (Barbera, C.J., Adkins, J. and McDonald, J., concurring) (“[L]ike *Daubert*, we have implicitly recognized that a trial judge’s gatekeeping function should not be limited to new scientific theories—old ‘junk science’ should be kept out of our courts as well.”).⁷

In *Savage*, its most recent case on the admissibility of expert testimony, the concurring opinion discussed the interplay between Md. R. Evid. 5-702 and Maryland’s “recent *Frye-Reed* jurisprudence,” 455 Md. at 179, 166 A.3d at 207, explaining that the Court “granted certiorari in this case to examine the proper scope for the threshold evaluation of expert scientific evidence,” 455 Md. at 142, 166 A.3d at 185, and noting that “[s]ince our opinion in *Reed*, however, our approach to assessing the threshold question of the admissibility of scientific and expert evidence has evolved.” 455 Md. at 160, 166 A.3d at 196. The Court of Appeals, citing *General Electric*

⁷ *See Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) (“*Daubert*”).

Co. v. Joiner, 522 U.S. 136 (1997), affirmed the exclusion of expert testimony by a neuropsychologist regarding the defendant’s state of mind on the basis that “his analysis did not bridge the ‘analytical gap’ between the data available to him and his ultimate conclusions.” As the Court explained, “[i]t is critical under Rule 702 that there be a link between the facts or data the expert has worked with and the conclusion the expert’s testimony is intended to support. . . .” *Savage*, 455 Md. at 164, 166 A.3d at 198 (quoting *United States v. Mamah*, 332 F.3d 475, 477–78 (7th Cir. 2003)).⁸ See also *Rochkind v. Stevenson*, 454 Md. 277, 164 A.3d 254 (2017) (excluding proffered expert epidemiological testimony because the underlying government data failed to support the expert’s conclusion that lead paint exposure caused Attention Deficit Hyperactivity Disorder, resulting in an “analytical gap” between the evidence presented and the expert’s conclusions.).

These cases, decided under the Court’s “evolv[ing]” understanding of *Frye-Reed*, make clear that, as relevant here, the firearms examiners’ claims of certainty must be supported by the scientific evidence on which they purport to rely, and that a failure to bridge the “gap” between the actual evidence and the subjective conclusions reached renders such claims inadmissible.

II. FIREARMS IDENTIFICATION LACKS SCIENTIFIC SUPPORT.

The specific process by which firearm and toolmark examiners carry out their work is described in Mr. Abruquah’s July 19, 2017 Motion in Limine at pages 4–6 and will not be repeated here. See also *United States v. Monteiro*, 407 F. Supp. 2d 351, 359–62 (D. Mass. 2006) (“*Monteiro*”) (also describing the process). Instead, we concentrate on the validity of this so-called science in light of fundamental scientific principles that are accepted and relied upon

⁸ In *Savage*, the three Justices who concurred in the opinion announced they were in favor of rejecting the *Frye-Reed* standard and adopting *Daubert*. See *Savage*, 455 Md. at 174; 166 A.3d at 204.

throughout the scientific world to provide valid and reliable data. The questions we address are whether firearms examination techniques are scientifically based and whether they produce empirical results that permit examiners to conclude that a particular bullet or casing came from, or almost certainly came from, a particular weapon.

A. The AFTE "Theory" of Identification.

The Association of Firearm and Toolmark Examiners ("AFTE"), a trade organization for practitioners of firearms and toolmark identification founded in 1969, has published its "Theory of Identification as It Relates to Toolmarks" for both firearms and toolmark examiners to follow.

It consists of three declarations:

1. The theory of identification as it pertains to the comparison of toolmarks enables opinions of common origin to be made when the unique surface contours of two toolmarks are in "sufficient agreement."
2. This "sufficient agreement" is related to the significant duplication of random toolmarks as evidenced by the correspondence of a pattern or combination of patterns of surface contours. Significance is determined by the comparative examination of two or more sets of surface contour patterns comprised of individual peaks, ridges and furrows. Specifically, the relative height or depth, width, curvature and spatial relationship of the individual peaks, ridges and furrows within one set of surface contours are defined and compared to the corresponding features in the second set of surface contours. Agreement is significant when the agreement in individual characteristics exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with agreement demonstrated by toolmarks known to have been produced by the same tool. The statement that "sufficient agreement" exists between two toolmarks means that the agreement of individual characteristics is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.
3. Currently the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner's training and experience.

AFTE Theory of Identification as it Relates to Toolmarks, <https://afte.org/about-us/what-is-afte/afte-theory-of-identification> (last visited Dec. 1, 2017).

B. *The AFTE “Theory” Has Numerous Deficiencies.*

Though it is the foundation on which virtually all firearms analysis rests, “[t]he AFTE Theory of Identification is not a protocol, standardized procedure, or a proper scientific theory.” William A. Tobin & Peter J. Blau, *Hypothesis Testing of the Critical Underlying Premise of Discernible Uniqueness in Firearms-Toolmarks Forensic Practice*, 53 *Jurimetrics J.* 121, 124 (2013) (“*Tobin & Blau*”) (footnotes omitted); *see also* Jennifer E. Laurin, *Criminal Law’s Science Lag: How Criminal Justice Meets Changed Scientific Understanding*, 93 *Tex. L. Rev.* 1751, 1764–65 (2015) (“*Laurin*”) (“Forensic-science disciplines have traditionally been, and remain, technically and professionally rooted not in the scientific field but rather within law enforcement.” (footnotes omitted)). This self-styled “theory” (sometimes called the theory of association) has significant deficiencies. To begin with, the identification of potentially matching features is entirely subjective, “held in the mind’s eye of the examiner and . . . based largely on training and experience in observing the difference between known matching and known non-matching impression toolmarks.” *Monteiro*, 407 F.Supp.2d at 362-63 (quoting Grzybowski et al., *Firearm/Toolmark Identification: Passing the Reliability Test Under Federal and State Evidentiary Standards*, 35 *AFTE J.* 209, 213 (2003)).

Moreover, no scientifically acceptable standard or protocol dictates or even suggests how many characteristics the examiner must find in agreement to declare a match (or, alternatively, to exclude a match). Instead, firearms examiners utilize a subjective pattern-matching methodology that allows them to set their own criteria. *See United States v. Taylor*, 663 F. Supp. 2d 1170, 1177–78 (D. N.M. 2009) (“*Taylor*”). “[P]erhaps most troubling, there are ‘no standards in the field whatsoever’ for differentiating class and sub-class from individual characteristics,” *United States v. Green*, 405 F. Supp. 2d 104, 117 (D. Mass. 2005) (“*Green*”)—that is, between marks “which appear on all casings from the same type of weapon (‘class characteristics’),”

“those manufactured at the same time (‘sub-class characteristics’),” and those which are ostensibly “unique to a given weapon (‘individual characteristics’).” *Id.* at 107. Firearms examiners themselves concede that subclass marks “may be misinterpreted, especially in cases with very limited microscopic marks of value, or in instances in which no firearm is submitted.” Firearm Examiner Training, Physical Characteristics, Nat’l Forensic Sci. Tech. Center http://projects.nfstc.org/firearms/module11/fir_m11_t04_01.htm (last visited Dec. 1, 2017). This approach is not scientific. *Cf. United States v. Hines*, 55 F. Supp. 2d 62, 69 (D. Mass. 1999) (“*Hines*”) (“There are no peer reviews of [handwriting comparisons]. Nor can one compare the opinion reached by an examiner with a standard protocol subject to validity testing, since there are no recognized standards. There is no agreement as to how many similarities it takes to declare a match, or how many differences it takes to rule it out.”).

Third, the theory itself is plainly circular. “An examiner may make an identification when there is sufficient agreement, and sufficient agreement is defined as enough agreement for an identification.” *Taylor*, 663 F. Supp. 2d at 1177. This formulation provides no practical or consistent guidance to an individual examiner or to a trier of fact in court.

Fourth, firearms examiners claim a positive identification (individualization) even when there are substantial differences between the marks on spent bullets and casings and those on the firearm in question. Such identifications are made with some undefined amount of agreement (and disagreement), often on only a portion of the bullet or casing. One prominent study found that *only* 21–38 percent of the marks will match up on bullets fired from the *same* gun. *See Monteiro*, 407 F. Supp. 2d at 362. Moreover, when bullets fired by two *different* .38 special Smith & Wesson revolvers of the same make and model were compared, 15–20 percent of the lines still matched up. *Id.* This study concluded that, “[a]s frequently happens in actual practice,

when there is a preponderance of non-matching lines and only a few land and groove marks available for comparison, the total number of matching lines is often no higher or even less than the number which could occur as the result of chance.” A. A. Biasotti, *A Statistical Study of the Individual Characteristics of Fired Bullets*, 4 *J. of Forensic Sciences* 34, 39–40 (1959). And “even when different examiners correctly conclude paired test samples to be of common origin in proficiency tests and purported validation studies, there is limited or no accord among respondents about exactly which characteristics comprised their ‘matches.’” *Tobin & Blau*, 53 *Jurimetrics J.* at 127 (emphasis omitted).

III. THREE REPORTS BY COMMITTEES OF EXPERTS FROM THE SCIENTIFIC COMMUNITY HAVE CONCLUDED THAT FIREARMS IDENTIFICATION IS NOT SCIENTIFICALLY VALID.

Given these infirmities, it is no surprise that the scientific community has rejected the sort of conclusory testimony proffered by the expert at Mr. Abruquah’s first trial. Indeed, the reports issued by the research arm of the National Academy of Sciences and by the President’s Council of Advisors on Science and Technology (“PCAST”) have unequivocally rejected the claim that firearms identification (individualization) is valid and reliable science.

A. National Academy of Science, Ballistic Imaging Report (2008).

Acting at the request of the Department of Justice, the National Research Council (“NRC”), the research arm of National Academy of Science, assembled a committee of representatives of the relevant scientific community, including materials scientists, statisticians and other experts, to research and issue a report on bullet pattern-matching analysis. The Department charged the NRC with assessing the feasibility and utility of establishing a “national reference ballistic image database . . . that would house images from firings of all newly manufactured or imported firearms.” Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database, National Research Council, *Ballistic*

Imaging at 1 (2008) (“Ballistic Imaging Report”). The NRC committee recognized that, in order to answer the questions it was charged with answering, it must first determine the threshold issue in firearms identification: “whether firearms-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.” *Id.* at 3.

The committee determined that “the validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks has not yet been fully demonstrated.” *Id.* at 3, 81. “A significant amount of research,” the committee concluded, “would be needed to scientifically determine the degree to which firearms-related toolmarks are unique or even to quantitatively characterize the probability of uniqueness.” *Id.* at 3. The committee also expressed serious concerns about firearms examiners’ claims that they could distinguish and identify unique marks and match those to marks on another item with a zero-error rate or near certainty. It noted that examiners regularly presented statements of unqualified certainty when declaring that ammunition “matched” a firearm. “[E]xaminers tend,” in other words, “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.’” *Id.* at 82. “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.” *Id.*⁹ The report concluded: “*Conclusions drawn in firearms identification should not be made to imply the presence of a firm statistical basis when none has been demonstrated.*” *Id.* (emphasis in original). Put simply, the

⁹ *In State v. Rose*, 2007 WL 4358047, at *15 (Cir. Ct. Balt. Cty., Md., Oct. 19, 2007), a case involving fingerprint analysis, the Baltimore County Circuit Court, based on a two-day *Frye-Reed* hearing, granted the defendant’s motion to exclude the proffered testimony, finding in part that “[a]n error rate, or lack thereof, must be demonstrated by reliable scientific studies, not by assumption.”

NRC found that both firearms identification and probabilistic claims related to how likely a particular bullet was fired from a particular firearm were scientifically indefensible.

B. *The National Academy of Sciences Report (2009).*

One year later, another committee of leading experts selected by the National Academy of Sciences issued a report on pattern-matching sciences. National Academy of Science (“NAS”), National Research Council, Committee on Identifying the Needs of the Forensic Science Community, *Strengthening Forensic Science in the United States: A Path Forward* (2009) (“NAS Report”). As recommended by Congress, the committee included “members of the forensic science community, members of the legal community, and a diverse group of scientists” — “chosen for their special competences and with regard for appropriate balance.” NAS Report at ii, 2; *see also* Hon. Harry T. Edwards, *The National Academy of Science Report on Forensic Sciences: What It Means for the Bench and Bar*, 51 *Jurimetrics J.* 1 (2010) (“Seven of the 17 committee members are prominent professionals in the forensic science community, with extensive experience in forensic analysis and practice; 11 members of the committee are trained scientists (with expertise in physics, chemistry, biology, biostatistics, statistics, and medicine); 10 members of the committee have Ph.D.s, 2 have M.D.s, 5 have J.D.s, and one has an M.S. in chemistry.”). The committee’s findings, including those specific to firearms identification, were informed by its extensive review of scientific literature and consultations with numerous scientists and practitioners. NAS Report at xii, 2, 307. The committee found that there was insufficient evidence to conclude that firearms examiners could validly and reliably conclude that a piece of ammunition was fired from a *specific* firearm. *See id.* at 7, 154–155. It stated in part:

[T]he law’s admission of and reliance on forensic evidence in criminal trials depends critically on (1) the extent to which a forensic science discipline is founded on a reliable scientific methodology, leading to accurate analyses of

evidence and proper reports of findings and (2) the extent to which practitioners in those forensic science disciplines that rely on human interpretation adopt procedures and performance standards that guard against bias and error.

Id. at 111. As to firearms identification, the NAS Report found that the field had not tested and validated its methodology and that it did not employ specific and objective protocols. “Sufficient studies have not been done to understand the reliability and repeatability of the methods,” and no repeated, controlled studies exist from which to devise a “statistical foundation for estimation of error rates.” *Id.* at 154 (footnote omitted). This Report concluded, as had the Ballistic Imaging Report, that “not enough is known about the variabilities among individual tools and guns” for conclusions of individualization, i.e., the ability to match a bullet or casing to a specific gun. *Id.*

The NAS Report strongly criticized the field’s use of an entirely subjective methodology and its failure to require procedures minimizing human error and bias. It noted that the AFTE document, quoted above, which provides examiners with the “best guidance available for the field of toolmark identification, does not even consider, let alone address, questions regarding variability, reliability, repeatability, or the number of correlations needed to achieve a given degree of confidence.” *Id.* at 155. Toolmark and firearms analysis “lack[s] . . . a precisely defined process,” and while AFTE has adopted a so-called ‘theory of identification,’ it “does not provide a specific protocol.” *Id.* Finally, whereas “[s]cience takes great pains to avoid biases by using strict protocols to minimize their effects,” *id.* at 122, the field of firearms identification has not taken any steps in that regard. *Id.* at 8 n.8 (“Unfortunately, . . . there is no good evidence to indicate that the [firearms identification] community has made sufficient effort to address the bias issue.”). In short, “much forensic evidence—including, for example, bitemarks and firearm and toolmark identifications—is introduced in criminal trials without any meaningful scientific

validation, determination of error rates, or reliability testing to explain the limits of the discipline.” *Id.* at 107–08.

C. *The President's Council of Advisors on Science and Technology, Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods (2016).*

In 2016, the President’s Council of Advisors on Science and Technology issued a report to the President, *Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods* (Sept. 2016) (“PCAST Report”). The authors were “an advisory group of the Nation’s leading scientists and engineers, appointed by the President to augment the science and technology advice available to him from inside the White House and from cabinet departments and other Federal agencies.” PCAST Report at iv.

PCAST focused on six “forensic feature comparison” disciplines, including firearms identification. In all, the group evaluated over 2,000 papers and studies from various sources, including papers submitted in response to PCAST’s request for information from the forensic-science community. It consulted with forensic scientists, including those at the Federal Bureau of Investigation and the National Institute of Standards and Technology. *Id.* at 2.

Much like the NAS Report, PCAST asked whether each forensic discipline met two key requirements for scientific validity: “*foundational validity*”—whether the method can, in principle, be reliable; and “*validity as applied*”—whether the method has been reliably applied in practice. *Id.* at 47–48, 56–58.

To be “*foundationally valid*,” a field must utilize a method that has been subject to “*empirical testing by multiple groups, under conditions appropriate to its intended use.*” *Id.* at 5 (emphasis in original). *Id.* More specifically, “the procedures that comprise it must be shown, based on empirical studies, to be repeatable, reproducible, and accurate, at levels that have been

measured and are appropriate to the intended application.” *Id.* at 4.¹⁰ The studies must also provide “valid estimates of the method’s accuracy,” demonstrating how often an examiner is likely to draw the wrong conclusions even when applying the method correctly, i.e., a scientifically valid error rate. *Id.* at 5. “Without appropriate estimates of [the method’s] accuracy, an examiner’s statement that two samples are similar—or even indistinguishable—is scientifically meaningless: it has no probative value and considerable potential for prejudicial impact.” *Id.* at 6.

The second requirement for scientific acceptance, “validity as applied,” requires that the method or technique be “reliably applied *in practice.*” *Id.* at 4–5 (emphasis in original). An examiner must be *capable* of reliably applying the method, and he or she must have *actually* reliably applied the method. To ensure that the examiner is capable of applying the technique, the examiner must undergo appropriately designed proficiency tests that evaluate how often the examiner reaches the correct answer under conditions modeling the procedures actually used in

¹⁰ The PCAST Report explained in part:

By “repeatable,” we mean that, with known probability, an examiner obtains the same result, when analyzing samples from the same sources.

By “reproducible,” we mean that, with known probability, different examiners obtain the same result, when analyzing the same samples.

By “accurate,” we mean that, with known probabilities, an examiner obtains correct results both (1) for samples from the same source (true positives) and (2) for samples from different sources (true negatives).

By “reliability,” we mean repeatability, reproducibility, and accuracy.

By “scientific validity,” we mean that a method has shown, based on empirical studies, to be reliable with levels of repeatability, reproducibility, and accuracy that are appropriate to the intended application.

By an “empirical study,” we mean test in which a method has been used to analyze a large number of independent sets of samples, similar in relevant aspects to those encountered in casework, in order to estimate the method’s repeatability, reproducibility, and accuracy.

PCAST Report at 47–48 (footnotes omitted).

case work. *Id.* at 56. The examiner must also disclose exposure to biasing information, i.e., “whether, when performing the examination, he or she was aware of any other facts of the case that might influence the conclusion.” *Id.* at 113.

PCAST found that the field of firearms identification failed the test for foundational validity. The PCAST Report, like the NAS Report and the Ballistic Imaging Report, criticized the field of firearms identification as a “theory” based on assumptions rather than scientific data on the frequency of toolmark characteristics or an “empirical demonstration of accuracy.” *Id.* at 59. A “scientific theory,” PCAST explained, is “a comprehensive explanation of some aspect of nature that is supported *by a vast body of evidence.*” *Id.* at 60 (emphasis added). The “theory” promoted in the toolmark field “is clearly not a scientific theory.” *Id.* Instead, “it is a claim that examiners applying a subjective approach can accurately individualize the origin of a toolmark. Moreover, a ‘theory’ is not what is needed. What is needed are empirical tests to see how well the method performs.” *Id.*

The PCAST Report stressed that neither “experience, nor judgment, nor good professional practices . . . can substitute for actual evidence of foundational validity and reliability.” *Id.* at 6. “The frequency with which a particular pattern or set of features will be observed in different samples, which is an essential element in drawing conclusions, is not a matter of ‘judgment.’” *Id.* Similarly, “an expert’s expression of *confidence* based on personal professional experience or expressions of *consensus* among practitioners about the accuracy of their field is no substitute for error rates estimated from relevant studies.” *Id.* (emphasis in original).

PCAST was unequivocal: experience, judgment, and years of use in court cannot establish scientific validity and a degree of reliability:

The *only* way to establish the scientific validity and degree of reliability of a *subjective* forensic feature comparison method—that is, one involving significant human judgment—is to test it *empirically* by seeing how often examiners actually get the right answer.

An Addendum to the PCAST Report on Forensic Science in Criminal Courts 1 (Jan. 6, 2017)

<https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/>

[pcast_forensics_addendum_finalv2.pdf](#) (“PCAST Addendum”) (emphasis in original).

Despite the findings of the NRC in 2008 and the NAS in 2009, by the time of PCAST’s work in 2016, the group identified only one appropriately designed empirical study attempting to replicate the circumstances of actual case work. See PCAST Report at 111.¹¹ That study—performed by the Ames Laboratory—found that out of 2,178 different source comparisons there were 735 “inconclusive” results and 22 false positives. *Id.* at 110. That false positive rate correlates to an estimated error rate between 1 in 46 cases and 1 in 66 cases, *id.*—a far cry from the claim of near perfect identification. Above and beyond these error rates, which far exceed the alleged level of certainty presented at Mr. Abruquah’s first trial, a *single* study is an insufficient basis upon which to base decisions involving life or liberty. As PCAST concluded,

¹¹ The PCAST Report noted that, while other studies evaluating firearms identification exist, those studies made no effort to replicate the actual case work performed by examiners in criminal cases and underestimated the false positive rate. See *id.* For example, as described in the PCAST report, “set-based” study designs can artificially inflate examiners’ performance by allowing them to take advantage of internal dependencies in the data. *Id.* at 106. These tests are essentially multiple choice tests in which the examiner knows in advance that ‘right’ answer is among the options, and ‘none of the above’ is not one of the options. These “closed-set” tests have underestimated the false-positive and inconclusive rates by “more than 100-fold.” *Id.* at 109. PCAST also found two other studies using other set designs that produced upper confidence bounds corresponding to error rates in the range of 1 in 20. *Id.* at 97. And PCAST reported additional weaknesses in *proficiency* testing, including that the examiners knew they were being tested, small sample sizes, and tests conducted by self-interested groups. *Id.* at 57-58.

“[t]he scientific criteria for foundational validity” requires “appropriately designed studies by *more than one group* to ensure reproducibility.” *Id.* at 111 (emphasis in original).¹²

Proponents of the current methodology frequently point out that PCAST did not conclude that firearms identification should be ruled inadmissible in court. Quite rightly, PCAST did not opine on the legal standards, noting that “[i]t is the proper province of the scientific community to provide guidance concerning scientific standards for scientific validity,” *id.* at 43 (emphasis omitted), and that “[w]hether firearms analysis should be deemed admissible based on current evidence is a decision that belongs to the courts.” *Id.* at 150. Nonetheless, PCAST recommended that the Attorney General should revise and reissue for public comment the Department of Justice’s (“DOJ’s”) then proposed “Uniform Language for Testimony and Reports” and supporting documents to bring them into alignment with the standards for scientific validity. Specifically, PCAST urged that the Attorney General should issue instructions directing that:

(i) Where empirical studies and/or statistical models exist to shed light on the accuracy of a forensic feature-comparison method, an examiner should provide quantitative information about error rates, in accordance with guidelines to be established by DOJ and the National Institute of Standards and Technology, based on advice from the scientific community.

(ii) Where there are not adequate empirical studies and/or statistical models to provide meaningful information about the accuracy of a forensic feature-comparison method, DOJ attorneys and examiners should not offer testimony based on the method. If it is necessary to provide testimony concerning the method, they should clearly acknowledge to courts the lack of such evidence.

(iii) In testimony, examiners should always state clearly that errors can and do occur, due both to similarities between features and to human mistakes in the laboratory.

¹² Also of note is that the Ames Study involved “newly purchased 9 mm Ruger pistols.” PCAST Report at 110. How examiners would perform on comparisons involving a non-newly purchased Taurus revolver like the one at issue in this case is not known.

Id. at 141.

D. *The Conclusions Offered in These Reports Represent the Consensus Views of the Relevant Scientific Community.*

Frye-Reed requires general acceptance by the relevant scientific community. *Frye*, 293 F. at 1014; *Reed*, 283 Md. at 381, 391 A.2d at 368. Here, the larger scientific community, including NAS, NRC, PCAST, and other scientists is very much a part of the relevant scientific community. As described above, the committees themselves were chosen for their “special competence” in core sciences—physics, chemistry, biology, materials science, engineering, biostatistics, statistics, and medicine—and “with regard for appropriate balance.” Ballistic Imaging Report at ii. Each committee either included or consulted with independent scientists, statisticians, medical examiners, judges, forensic practitioners, lawyers, and professors with expertise in scientific issues. Each committee also heard testimony from forensic scientists working in the relevant field, reviewed nearly every available journal article and study involving firearms examination, and read every article or study submitted by members of the forensic community. PCAST Addendum at 2-3; *see also* PCAST Report at v-vii. With trained scientists on each committee, they were uniquely qualified to both define the steps necessary to transform a hypothesis or observation into a valid, reliable scientific principle or methodology; and to determine whether each forensic discipline reviewed performed these steps.¹³ At the same time, the State’s firearms identification evidence—despite its long lineage—is open to scrutiny. *See Savage*, 455 Md. at 180, 166 A.3d at 208 (“[W]e have liberally applied the *Frye-Reed* analysis to testimony based on any scientific principle—new or old.”).

¹³ In *Motorola Inc. v. Murray*, 147 A.3d 751, 757 (D.C. 2016) (en banc), the D.C. Court of Appeals adopted *Daubert* and Fed. R. Evid. 702 as the standards for admissibility. The Court reasoned in part that the “ability to focus on the reliability of principles and methods, and their application, is a decided advantage that will lead to better decision-making by juries and trial judges alike.”

These multidisciplinary groups of nationally renowned scientists and professionals must be viewed as an essential part of the relevant community to determine whether firearms identification adherents have conducted the requisite research and data to demonstrate scientific validity and reliability. Indeed, the Court of Appeals squarely addressed this issue when it examined so-called voice printing in *Reed*, finding that there is

no basis for “restricting the relevant field of experts” to those who have performed voiceprint experiments, and eliminating from consideration the opinions of those scientists in the fields of speech and hearing, as well as related fields, who, by training and education, are competent to make professional judgments concerning experiments undertaken by others. The purpose of the *Frye* test is defeated by an approach which allows a court to ignore the informed opinions of a substantial segment of the scientific community which stands in opposition to the process in question.

Reed, 283 Md. at 382, 391 A.2d at 368. See also *United States v. Porter*, 618 A.2d 629, 634 (D.C. 1992) (quoting *Reed*). In *Frye* itself, the D.C. Circuit considered whether the proffered lie detector test had “gained such standing and scientific recognition among physiological and psychological authorities.” It did not limit its inquiry to lie detector experts. *Frye*, 293 F. at 1014.

Narrowly defining the relevant scientific community as limited only to the practitioners of the technique at issue was rejected in *Reed* and would render the *Frye-Reed* test meaningless; in effect, such a definition would require courts to inquire of those who generally accept the technique whether the technique is generally accepted. Professionals from relevant and foundational disciplines also ensure an unbiased review of the field’s validity.

IV. THE COURT SHOULD LIMIT THE SCOPE OF THE EXPERT’S TESTIMONY TO WHAT HE DID AND WHAT HE OBSERVED AND EXCLUDE ALL CONCLUSIONS THAT IMPLY ANY DEGREE OF SCIENTIFIC CERTAINTY.

In its July 26, 2017 Opposition to Defendant’s Motion in Limine, the State contends that “Mr. McVeigh must be allowed to testify as to the evidence that the bullets in question were

fired from the defendant's gun. His testimony will aid the finder of fact in interpreting the evidence before it, namely the spent bullets." Opp'n Def.'s Mot Lim. 2. This argument presumes (a) absolute certainty on the part of Mr. McVeigh or any other testifying firearms examiner and (b) the jury's ready acceptance of the expert's testimony as scientific fact—when the truth is that there is no scientific certainty in the field of firearms identification.¹⁴

At a minimum, in light of the legal authority and scientific reports discussed above, this Court should limit the State's firearms examiner's testimony to a factual description of the method he applied and the similarities and differences he observed between the limited ammunition recovered and the ammunition test fired from the gun owned by Mr. Abruquah. This Court should not allow the examiner's conclusions to exceed what can be supported by the underlying data: including or excluding a particular firearm as a potential source. *See Missouri v. Goodwin-Bey*, Case No. 1531-CR00555-01, at 7 (Cir. Ct. Greene Cty., Mo. Div. V Dec. 16, 2016) ("*Goodwin-Bey*") (limiting the examiner to testifying only that "this gun could not be eliminated as the source of the bullet."); *State v. Bridges*, 2015 WL 12670468 at *2 (N.C. Super. Oct. 1, 2015) (consent order) ("The admission of the testimony containing the identified error types at trial violated defendant's right to due process because it exceeded the limits of the science and overstated the significance of the hair analysis to the jury."). Thus, the expert should not be allowed to testify that the copper jackets he examined were fired from a specific gun or

¹⁴ As previously mentioned, frequently-used terms like "to a reasonable degree of scientific certainty" do not set any kind of meaningful standard. *See Nat'l Comm'n on Forensic Science, Views of the Commission: Use of the Term "Reasonable Scientific Certainty"* (Mar. 22, 2016), www.justice.gov/ncfs/file/839726/download ("[F]orensic experts are often required to testify that the opinions or facts stated are offered 'to a reasonable degree of scientific certainty' or 'to a reasonable degree of [discipline] certainty.' Such statements have no scientific meaning and may mislead factfinders."); *United States v. Glynn*, 578 F. Supp. 2d 567 (S.D.N.Y. 2008) ("[T]o allow [the proffered examiner], or any other ballistics examiner, to testify that he had matched a bullet or casing to a particular gun 'to a reasonable degree of ballistic certainty' would seriously mislead the jury as to the nature of the expertise involved.").

from the same gun or suggest there is any scientific significance to his findings.¹⁵ This Court should also instruct the jury that the examiner's analysis is based on his subjective opinion, that different examiners can reach different conclusions, and that there is no known error rate.¹⁶

Because permitting the examiner to state conclusions beyond those supported by the data runs the significant risk of the jury giving the examiner's testimony more significance than is due,¹⁷ an increasing number of courts have refused to allow firearms examiners to make conclusions of absolute certainty when declaring a "match." *United States v. Willock*, 696 F. Supp. 2d 536, 549 (D. Md. 2010) (requiring the expert to state his opinions and conclusions without any characterization to the degree of certainty); *Taylor*, 663 F. Supp. 2d at 1180 ("[B]ecause of the limitations on the reliability of firearms identification evidence . . . [the examiner] will not be permitted to testify that his methodology allows him to reach this conclusion as a matter of scientific certainty."); *United States v. Glynn*, 578 F. Supp. 2d 567,

¹⁵ There are many ways for witnesses to convey certainty, and all should be excluded: For example: "the bullets came from this gun" / "toolmarks are unique" / "to the exclusion of all other weapons" / "to a scientific certainty" / "chances are so remote so as to be a practical impossibility" / "no doubt in my mind" / "in my considered opinion" / "to the exclusion of all other guns in the world" / "the methodology has been validated as being scientifically correct" / "I would stake my professional reputation on it".

¹⁶ Further, to the extent the Court admits *any* firearms testimony from the state, it must allow the defense to present expert testimony about the limitations of the methodology at trial. *See Monteiro*, 407 F. Supp. 2d at 369; *see also State v. Romero*, 365 P.3d 358, 360 (Ariz. 2016) (reversing lower courts and permitting a defense expert to testify "that firearms examiners use subjective rather than scientifically rigorous methods in drawing conclusions from indentations on shell casings."). As the Arizona Supreme Court explained in *Romero*, "[u]nder Rule 702, when one party offers an expert in a particular field . . . the opposing party is not restricted to challenging that expert by offering an expert from the same field or with the same qualifications. The trial court should not assess whether the opposing party's expert is as qualified as—or more convincing than—the other expert. Instead, the court should consider whether the proffered expert is qualified and will offer reliable testimony that is helpful to the jury." *Id.* at 362.; *Laurin*, 93 Tex. L. Rev. at 1758–59 (citing studies "finding in the context of the emergence of newly available scientific evidence is that jurors are far less apt to perceive weaknesses brought out by attorney cross-examination of expert witnesses than those highlighted by competing experts.").

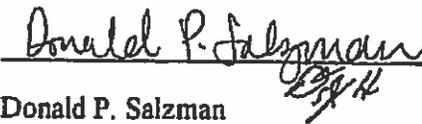
¹⁷ *See, e.g., United States v. Frazier*, 387 F.3d 1244, 1263 (11th Cir. 2004) ("[E]xpert testimony may be assigned talismanic significance in the eyes of lay jurors, and, therefore, the district courts must take care to weigh the value of such evidence against its potential to mislead or confuse.").

574-75 (S.D.N.Y. 2008) (permitting the ballistics examiner to testify only that a firearms match was “more likely than not” and precluding the witness from testifying that ballistics was a science or that he reached his conclusions to any degree of certainty”); *Green*, 405 F. Supp. 2d at 108 (the witness “may only describe and explain the ways in which the earlier casings are similar to the shell casings test-fired from the [alleged weapon.]”); *Goodwin-Bey*, Case No. 1531-CR00555-01, at 7 (limiting the examiner to testifying only that “this gun could not be eliminated as the source of the bullet.”); *cf. Hines*, 55 F. Supp. 2d at 70-71 (admitting handwriting witness testimony “to the extent that she restricts her testimony to similarities or dissimilarities between the known exemplars and the robbery note” but finding that the witness “may not render an ultimate conclusion on who penned the unknown writing.”). Although such restrictions cannot guarantee that the jury will understand the utterly subjective nature of the conclusions reached, they are essential to moving toward that goal.

Conclusion

The victims of erroneous firearms identifications are the wrongfully convicted and the criminal justice system itself. This Court should preclude the government from introducing testimony suggesting there is any statistical significance tied to similar toolmarks found on ammunition unless and until the firearms community presents valid scientific data showing that certain characteristics are unique.

Respectfully submitted,


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CERTIFICATE OF SERVICE

I HEREBY CERTIFY that on December 5, 2017, I caused a copy of the foregoing to be mailed via first-class mail, postage prepaid to each of the following counsel:

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