

Task Number: 2016-15

Article Title: Report to the President – Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods

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Article’s Subject Matter:

- As a result of a direct request from the US President “... what additional efforts could contribute to strengthening the forensic science discipline and ensuring reliability of forensic evidence...” (p. 22) the PCAST report is a follow up on the 2009 NAS Report.

Key Points in Article

- Feature comparison methods, such as DNA, Bitemark, Fingerprint, Firearms, Footwear and Hair Analysis, determine whether evidentiary sample is or is not associated with source sample based on similar patterns, impressions or features.
 - Subjective – significant human judgement
 - Objective – standardized, quantifiable detail requires little human judgement
- To support the ability of the court to make determinations about scientific validity PCAST focuses on “foundational validity” and “validity as applied”.
- Foundational validity requires that the method be shown, based on empirical studies, to be repeatable, reproducible and accurate, at levels that have been measured and are appropriate to intended application;
 - Empirical scientific validation studies require: i) a large number of examiners and large collections of known and questioned samples from relevant populations; ii) examiners that have no information regarding the correct answer, iii) design and analysis of study described in advance; iv) coordinated by groups with no stake in the outcome; v) data, software and results made available to other scientists to review; vi) completed by multiple groups.
 - Once a method’s reliability and accuracy has been established, conclusions should be expressed within this level of certainty using appropriate terminology. Terms such as “practical impossibility” and “identification” are not scientifically valid.
 - Experience or professional judgement cannot establish scientific validity nor can existence of professional societies, certification, accreditation, peer-reviewed articles, SOPs, proficiency testing and codes of ethics.
- Validity as applied means that the method has reliably been applied in practice.

- **Recommendations to ensure scientific validity of forensic science:**
 1. **National Institute of Standards & Technology (NIST) & Office of Science & Technology Policy (OSTP) - Assessment of foundational validity should be ongoing, unbiased and completed by scientific agency with no stake in the outcome**
 2. **NIST & OSTP - Development of objective methods for DNA, firearms and latent fingerprint analysis, coordinated by NIST, FBI and Defense Forensic Science Centre**
 3. **NIST & OSTP - Improve OSAC by adding metrology resource committee, and making OSAC standards freely available**
 4. **NIST & OSTP - R&D strategy for forensic science**
 5. **FBI - should expand research and black box studies, develop objective methods and blind proficiency testing within flow of casework, use linear ACE and publicly report quality issues in casework**
 6. **Attorney General (AG) – use of feature comparison methods in federal prosecutions require that attorneys ensure expert testimony in court meets standard of scientific validity**
 7. **AG – Department of Justice (DOJ) guidelines on expert testimony should revise and re-issue Uniform Language on Testimony and Reports. Where empirical studies exist they should be included in expert testimony and when they are lacking then expert testimony should not be given or at least lack of studies acknowledged. Possibilities of errors due to similarities between features or human mistakes should be stated in expert testimony.**
 8. **Judiciary – scientific validity as foundation of expert testimony. Judicial conference of US should prepare best practices guide and training concerning admissibility under Rule 702 of expert testimony based on feature comparison methods**
- **PCAST observed that latent fingerprint analysis was foundationally valid based on recent black box studies (FBI¹ and Miami-Dade²) albeit with a high false positive rate.**
 - **Proposed identification must be accompanied by limitations of reliability of conclusions including: i) only 2 black box studies; ii) false positive rates of these studies could be as high as 1 error in 306 cases¹ (or 1 in 18²); and, iii) examiners were aware they were being tested so error rate in casework might be higher.**
- **PCAST observed that latent fingerprint analysis is only valid as applied when:**
 - **confirmation bias is addressed by implementing linear ACE (additional features or changes after seeing the known are clearly documented as such);**

¹ Ulery BT, Hicklin RA, Buscaglia J, Roberts MA. Accuracy and reliability of forensic latent fingerprint decisions. Proceedings of the National Academy of Sciences, 108(19);2011:7733-8.

² Pacheco I, Cerchiai B, Stoiloff S. Miami-Dade research study for the reliability of the ACE-V process: Accuracy and precision in latent fingerprint examinations. 2014. www.ncjrs.gov/pdffiles1/nij/grants/248534.pdf.

- contextual bias must be limited as much as possible and disclosed when unavoidable;
- proficiency testing should be rigorous, blind, within casework flow and disclosed to scientific community, and,
- statement indicating that case samples are similar quality to samples used in foundational studies.
- Options for moving forward: 1) improve subjective method by completing more black box studies to estimate errors involving third party researchers (i.e. NIST) with no stake in the outcome; or, 2) convert to objective method utilizing advances in automated image analysis, machine learning and large databases of known fingerprints with simulated latent prints to varying quality and completeness.
- PCAST observed that DNA (complex mixtures), bitemark, firearms and footwear analysis all lacked foundational validity.

Fallacies and Issues

- PCAST error rates for fingerprints do not include any form of verification so the quoted rates do not reflect casework.
- PCAST hypothesizes that error rates may be even higher for casework because examiners knew they were being tested, however, the anonymity of the examiners may cause examiners to be less accurate since there will be no personal consequences for mistakes.
- PCAST states “[t]he false positive rate for latent fingerprint analysis may depend on the quality of the latent print.” (page 50) but then quotes error rates for the ACE method from studies that used only difficult latent fingerprint comparisons.
- PCAST calculations of false positive rates for the Miami-Dade study were incorrect. PCAST did not incorporate that erroneous identifications could occur on any trial, not just non-mated. Taking this into account, the actual false positive rate including the potential clerical errors and excluding inconclusive decisions is (42/3,687) 1.14%, with a 95% upper bound of 1.47% (using the same confidence interval methodology as PCAST). Removing the potential clerical errors while still excluding the inconclusive decisions returns a false positive of (7/3,652) 0.19%, with a 95% upper bound of 0.36%.
- PCAST failed to mention alongside the false positive rates that the assessment of examiners in the Miami-Dade study was fundamentally different from the FBI study. The Miami-Dade study had examiners comparing a latent to a set of prints as opposed to a latent to a single exemplary print. This offers some ambiguity into the calculation of the false positive rate.

- PCAST committee does not include sufficient forensic science experts and did not fully address the input of forensic identification community in the report (IAI response³).
- PCAST developed its own criteria for scientific validity without providing documentation showing that such criteria are well accepted within the scientific community. For example, how many black box studies are required to establish foundational validity? (FBI response⁴).
- PCAST proposed that federal government criminal justice databases are made available to researchers but overlooked the legal authorization and limitations regulating such databases (FBI response).
- PCAST Working Group Chair, Eric Landers, sits on Board of Directors of the Innocence Project⁵ which could be considered a conflict of interest (American Congress of forensic Science Laboratories (ACFSL) response⁶).
- PCAST report shows pervasive bias as the majority of the working group are well-known critics of forensic science (Kay Chopard, National District Attorneys Association (NDAA) response⁷).
- PCAST unilaterally declares forensic feature comparison methods as belonging to metrology but no metrologists were included on the working group (NDAA response).
- PCAST recommendation that no forensic discipline is acceptable without numerous peer-reviewed studies yet they rely on a single cognitive bias study that was not replicated by other researchers (NDAA response).
- PCAST indicates that latent fingerprint analysis is on the right path forward and further investment in research and technology as well as development of improved standards and guidelines is good news!

³ https://www.theiai.org/president/IAI_PCAST_Response.pdf (accessed 2016-11-17).

⁴ <https://www.fbi.gov/file-repository/fbi-pcast-response.pdf> (accessed 2016-11-17).

⁵ Innocence Project Board of Directors, available at <http://www.innocenceproject.org/disciplines/directors/>

⁶ <http://www.crime-scene-investigator.net/american-congress-of-forensic-science-laboratories-response-to-forensic-science-in-federal-criminal-courts-ensuring-scientific-validity-of-pattern-comparison-methods.html> (accessed 2016-11-17).

⁷ <http://www.ndaajustice.org/pdf/PCAST%20Statement%209%2030%2016%20FINAL.pdf> (accessed 2016-11-17).