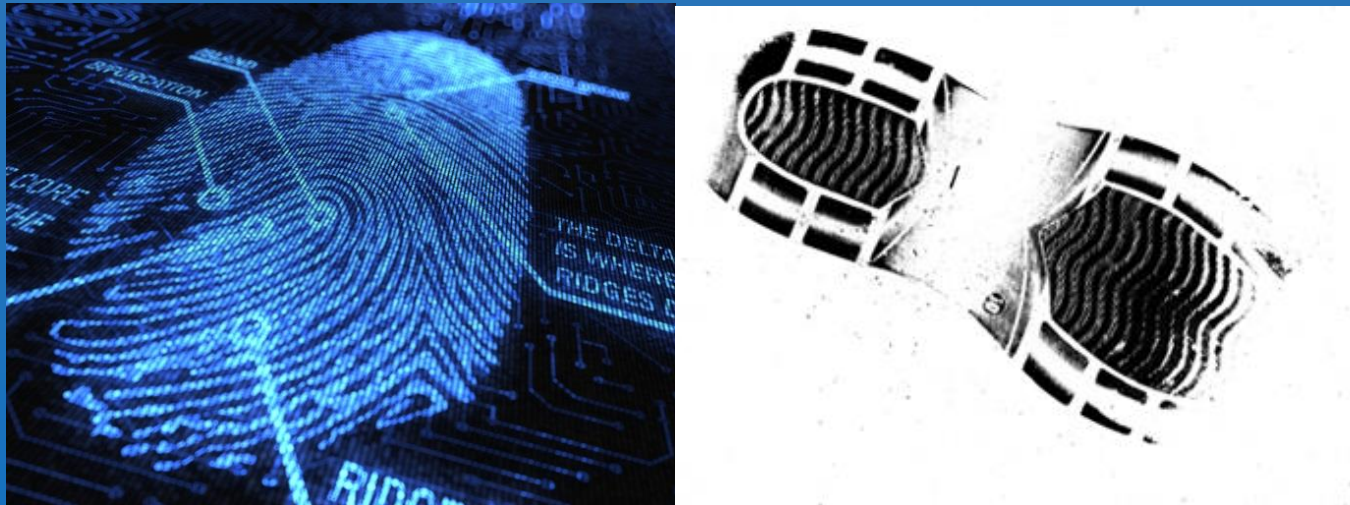




# Office of the Ohio Public Defender

## Pattern Evidence: A Primer

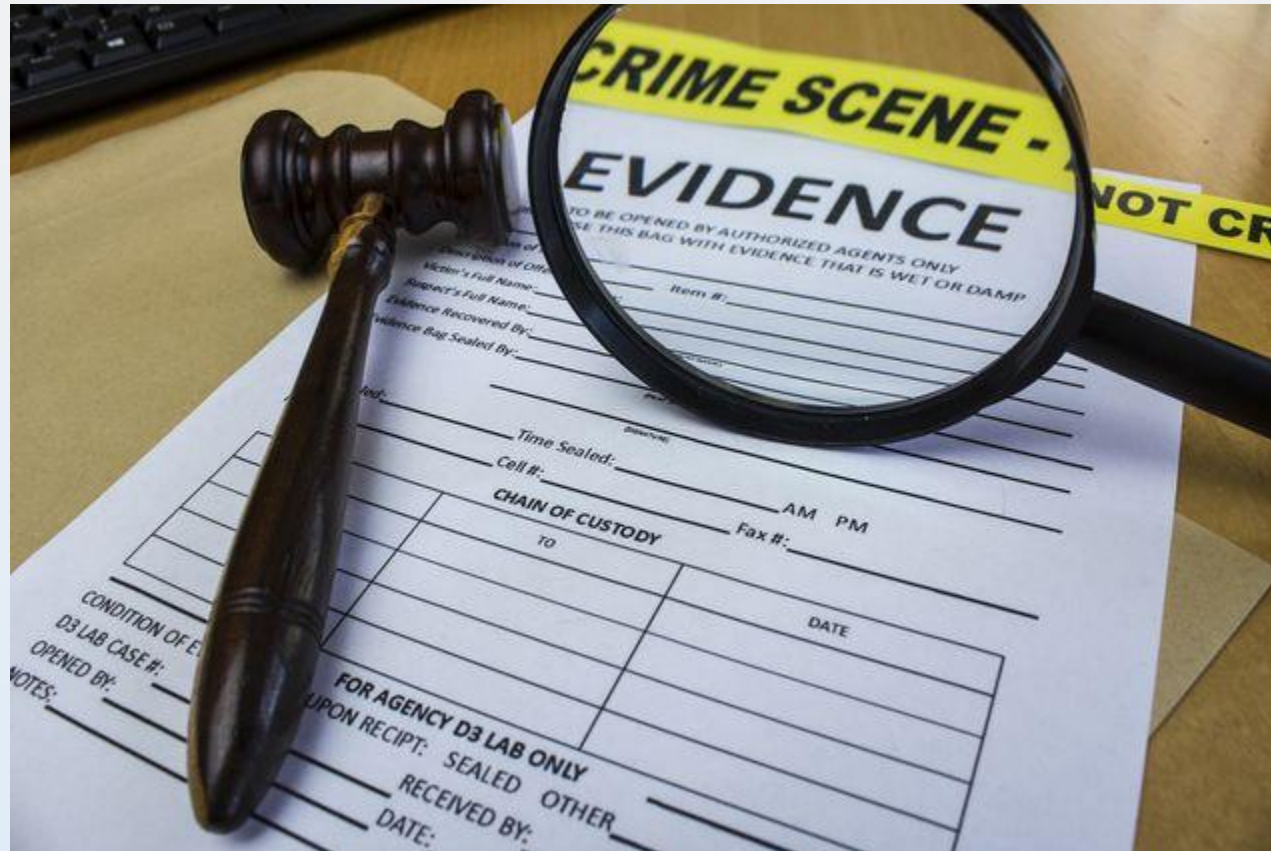


Erika LaHote

Assistant State Public Defender

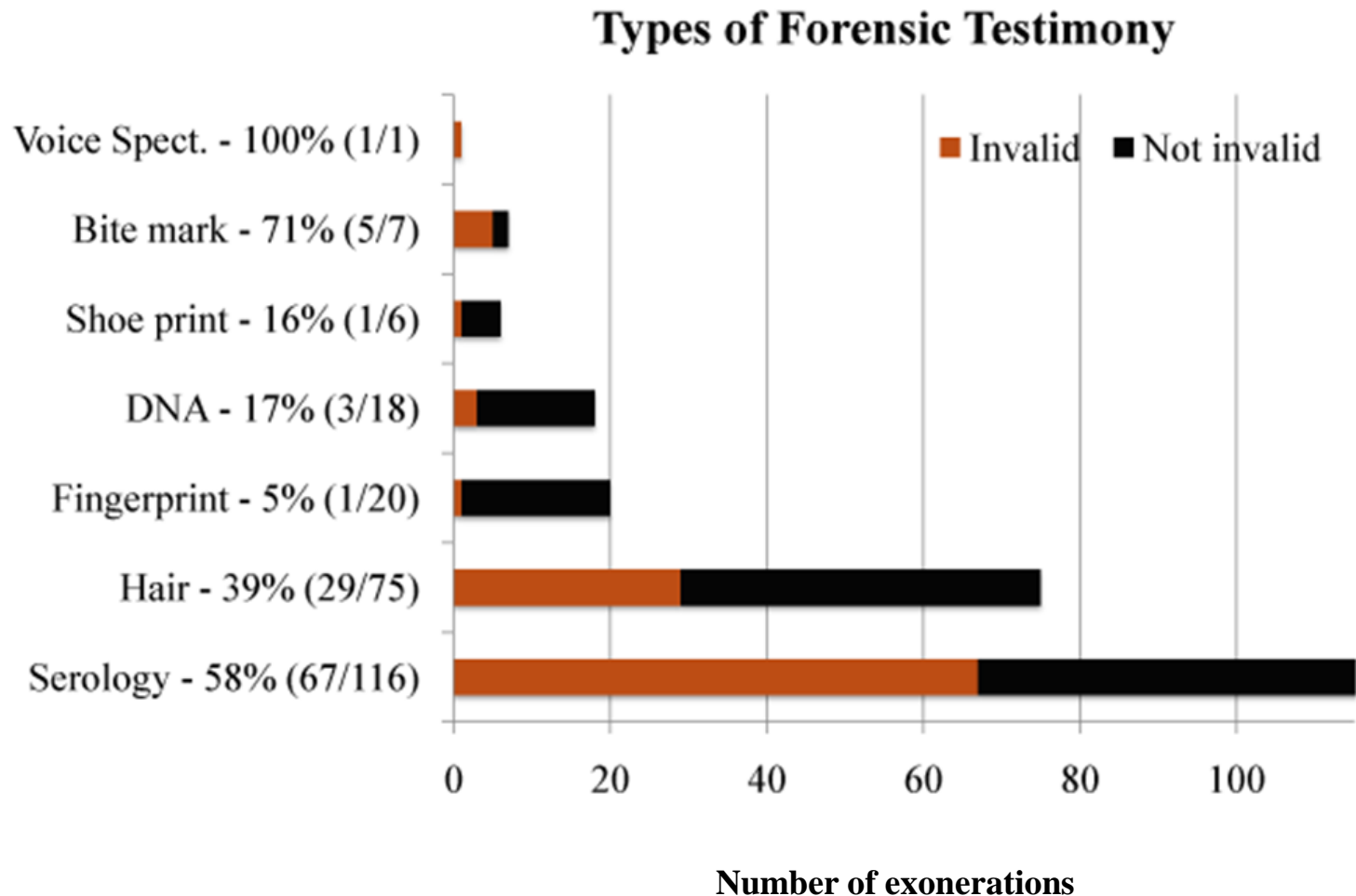
Death Penalty Department

# What is Scientific Evidence?



Reliability is key.

# Bad Forensics & Wrongful Convictions



# Exonerations in the U.S.

Last year alone, more than 150 men & women were exonerated.

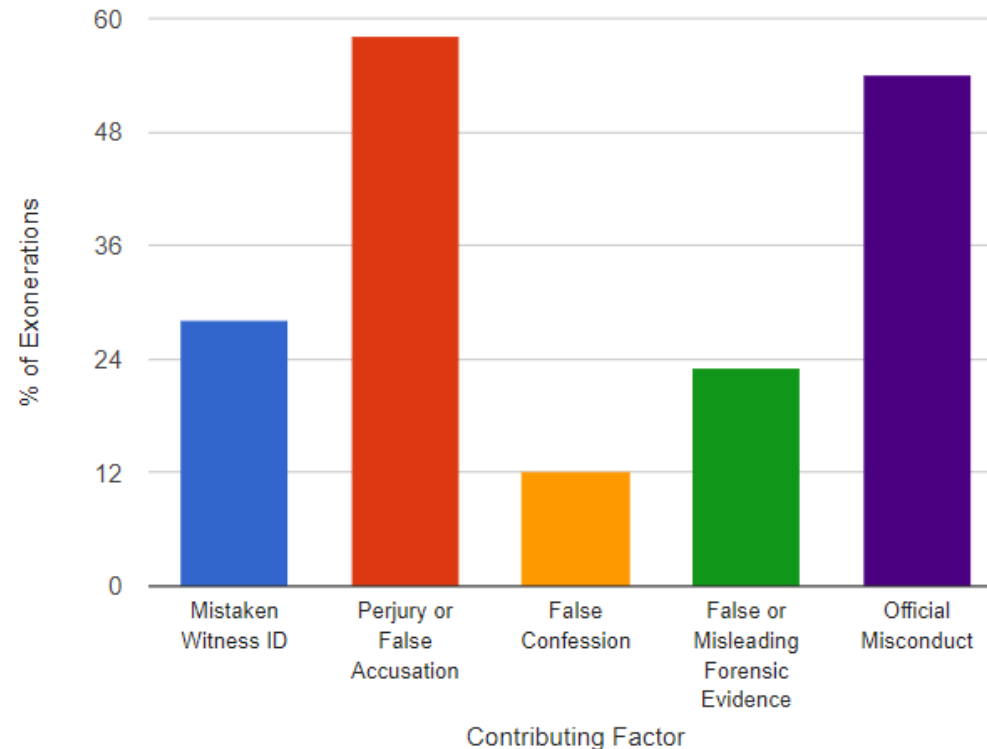
“A lot of the problem with forensic testimony is that the diagnosticity is overstated.”  
-Barbara O’Brien, professor at Michigan State University College of Law

*The National Registry*  
*of*  
**EXONERATIONS**

See Heather Murphy, *When Experts Testifying in Criminal Trials Are Guilty of Overstating Forensic Results*, NY Times (April 20, 2019).

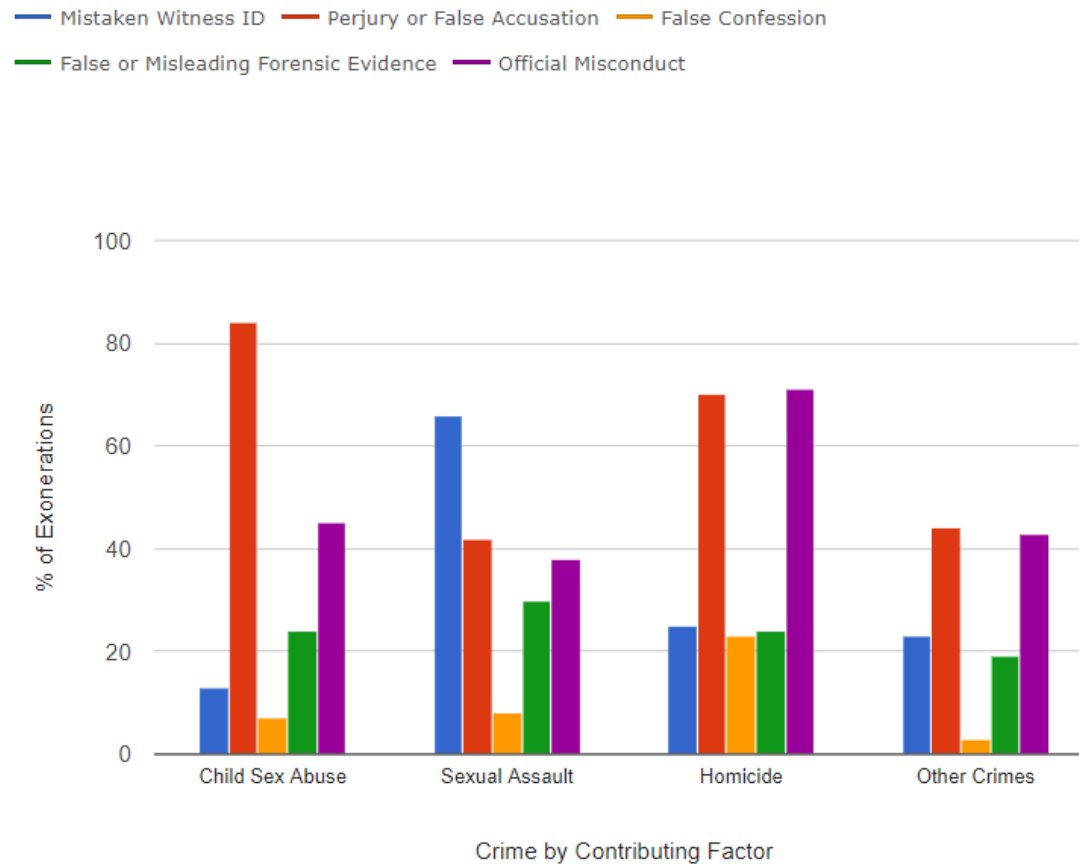
# % Exonerations by Contributing Factor

National Registry of Exonerations  
Total to Date: 2,479



# % Exonerations by Contributing Factor & Type of Crime

National Registry of Exonerations  
Total to Date: 2,479



# Impression vs. Pattern Evidence

“**Impression evidence** is created when two objects come in contact with enough force to cause an ‘impression.’ *Typically impression evidence is either two-dimensional—such as a fingerprint—or three-dimensional—such as the marks on a bullet caused by the barrel of a firearm.*”

- National Institute of Justice

# Impression vs. Pattern Evidence

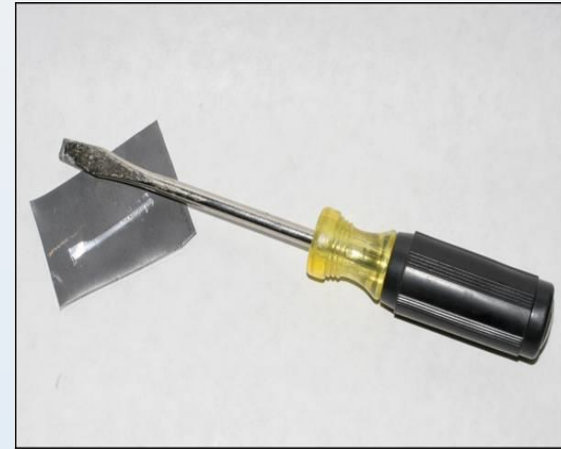
**“Pattern evidence** *may be additional identifiable information found within an impression.* For example, an examiner will compare shoeprint evidence with several shoe-sole patterns to identify a particular brand, model or size. If a shoe is recovered from a suspect that ~~matches~~ this initial pattern, the forensic examiner can look for unique characteristics that are common between the shoe and the shoeprint, such as tread wear, cuts or nicks.”

- National Institute of Justice

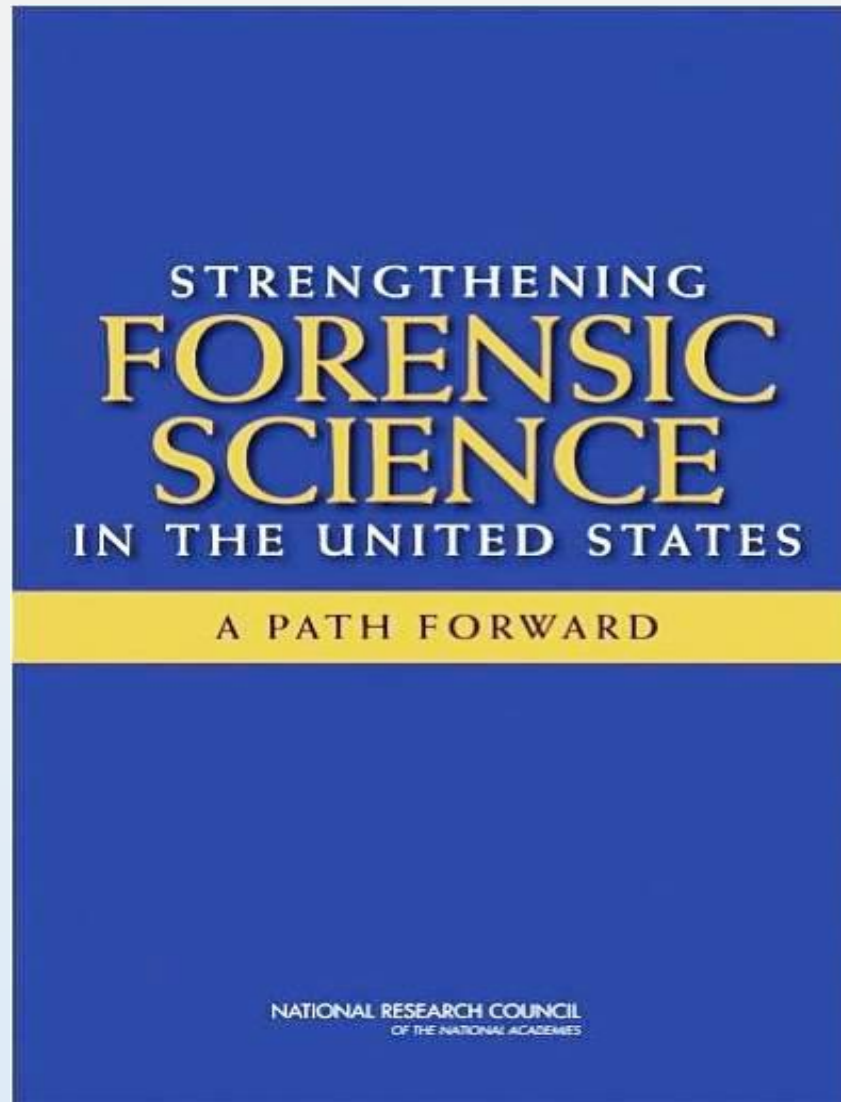


# Types of Pattern and Impression Evidence

- Friction-ridge analysis
- Shoeprints and tire tracks
- Toolmark and firearm identification
- Hair analysis
- Fiber analysis
- Questioned-document examination
- Paint and coatings
- Forensic odontology (the worst)
- Bloodstain analysis



# National Academy of Sciences, 2009



# NAS Report, p. 7

## Problems Relating to the Interpretation of Forensic Evidence

Often in criminal prosecutions and civil litigation, forensic evidence is offered to support conclusions about “individualization” (sometimes referred to as “matching” a specimen to a particular individual or other source) or about classification of the source of the specimen into one of several categories. With the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source. In terms of scientific basis, the analytically based disciplines generally hold a notable edge over disciplines based on expert interpretation. But there are important variations among the disciplines relying on expert interpretation. For example, there are more established protocols and available research for fingerprint analysis than for the analysis of bite marks. There also are significant variations within each discipline. For example, not all fingerprint evidence is

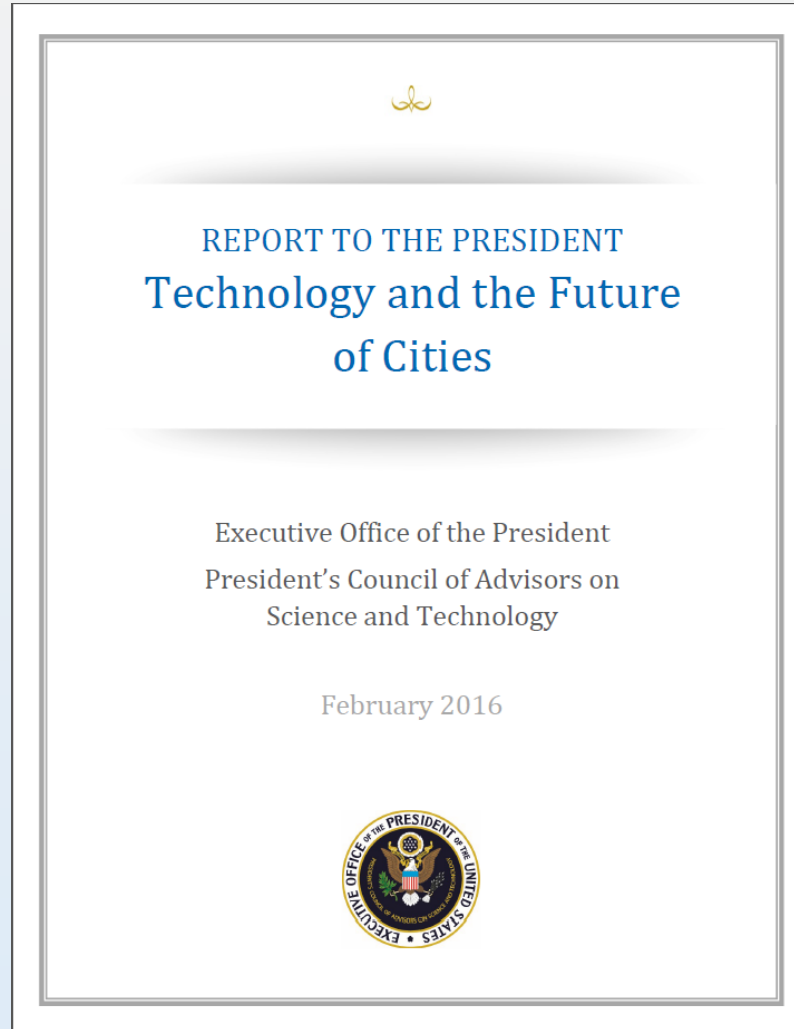
**HELLO**

**I AM...**

**The Expert  
in WHATEVER**

“Little rigorous systemic research has been done to validate the basic premises and techniques in a number of forensic science disciplines.”  
NAS Report, p. 189.

# PCAST Report, 2016



# Fingerprint Evidence/Ridge-Analysis



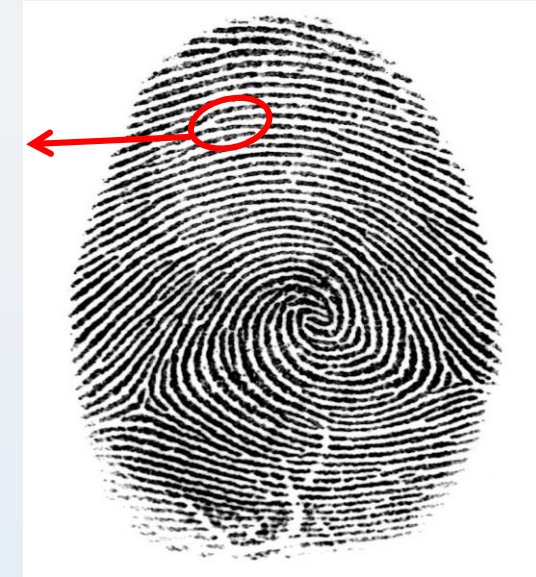
# Fingerprints; Friction-Ridge Analysis

Fingerprint evidence has been used for over a century

*You might think a hundred years of practice and the courtroom admissibility of fingerprint analysis demonstrate the method's accuracy. But....*

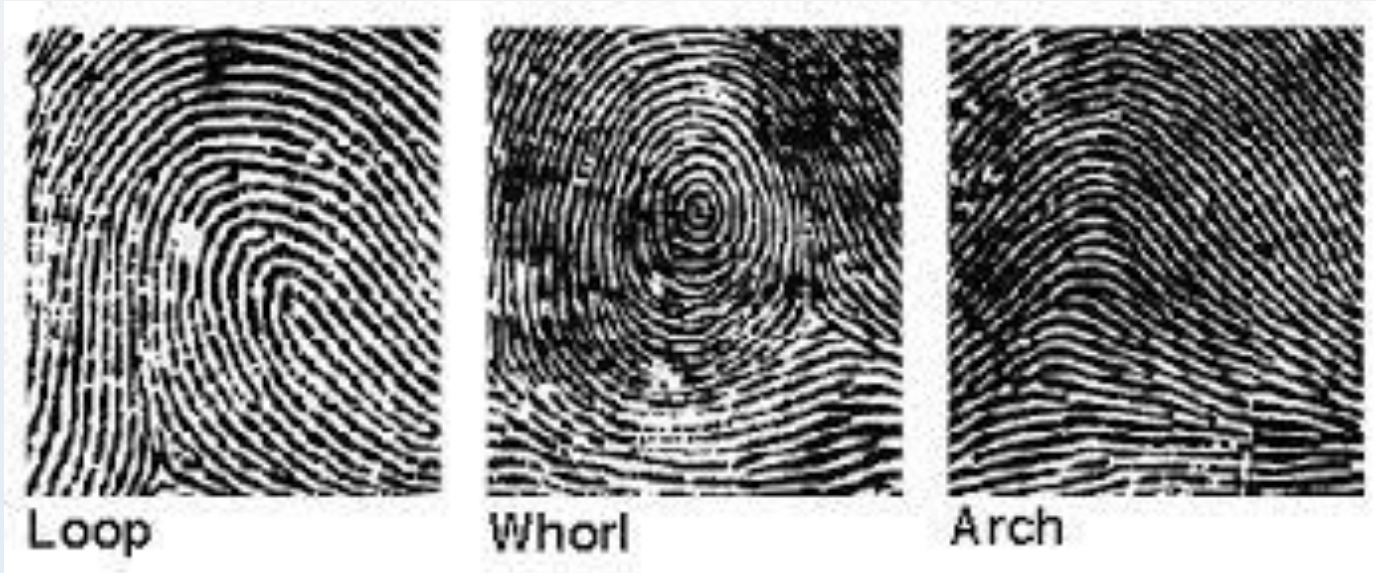
Hampered by the problems of partials, smears, and smudges

Examiner test experiments show problems with accuracy and bias.





# Fingerprints; Friction-Ridge Analysis







I.A. Plain Arch



I.B. Tented Arch



II.A. Radial Loop



II.B. Ulnar Loop



III.A. Plain Whorl



III. B. Central Pocket Whorl



III.C. Double Loop
















III.D. Accidental Whorl



## More Minutiae



1.—Right Thumb	2.—R. Index Finger	3.—R. Middle Finger	4.—R. Ring Finger	5.—R. Little Finger	
					
6.—Left Thumb	7.—L. Index Finger	8.—L. Middle Finger	9.—L. Ring Finger	10.—L. Little Finger	
					
Four fingers taken simultaneously		Four fingers taken simultaneously			
Left hand		Amputations <i>AMS</i>	Right hand		
		Left Thumb 	Right Thumb 		

Exemplar

## Typical Partial



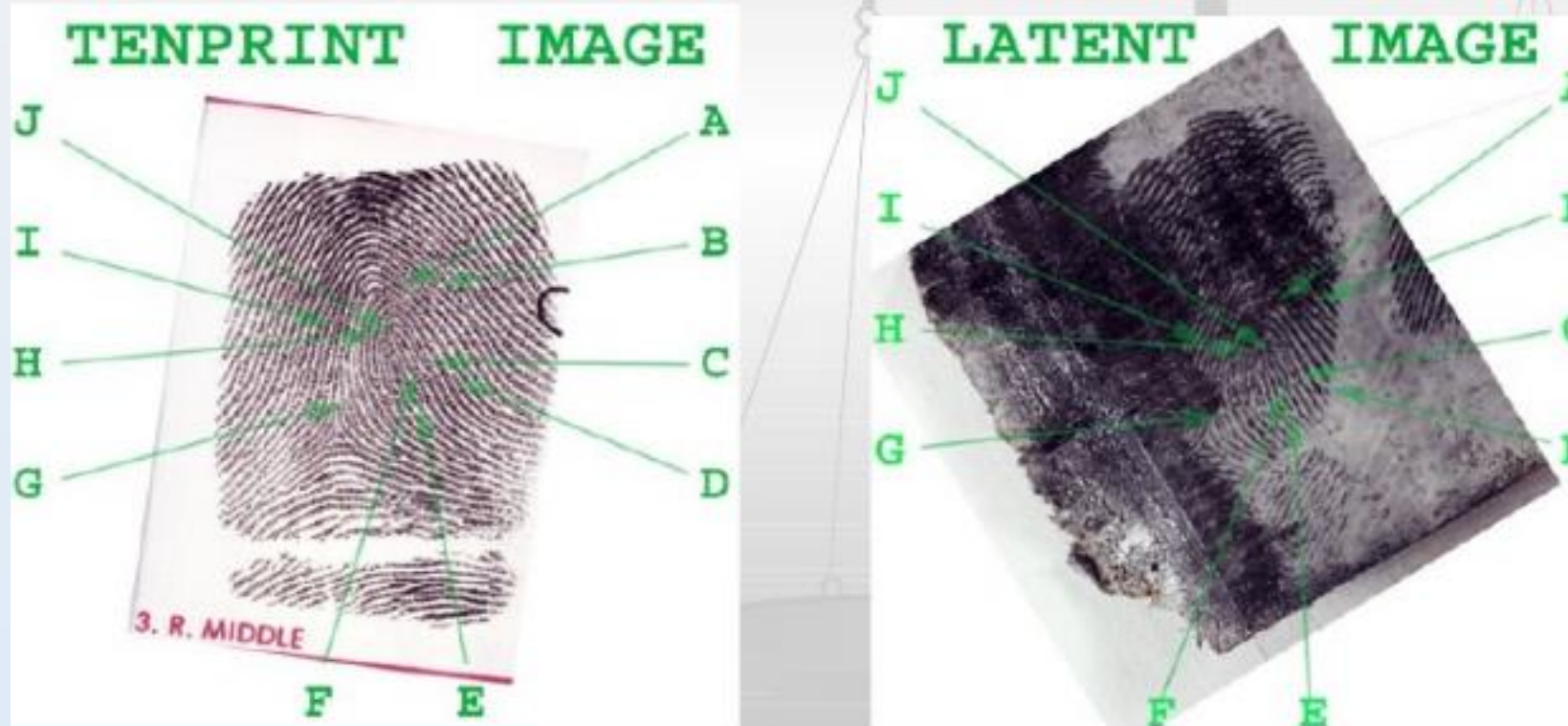
# ACE-V

- Analysis – Look at the latent and exemplar
  - Comparison – Compare them
  - Evaluation – Make a decision
    1. Source Identification/Individualization
    2. Source Exclusion
    3. Inconclusive
  - Verification – Someone else does the same
- ... no really, that's about it



## What Constitutes a Good Latent Identification?

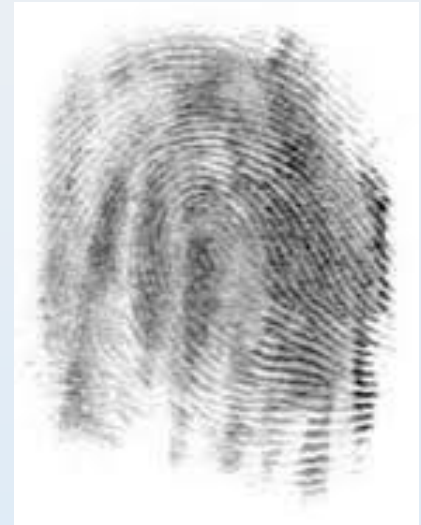
- How many points are required ?
- What is the process used to draw a conclusion ?
- Are there standardized policies and procedures?
- Training and proficiency required for the examiners ?





# Problems

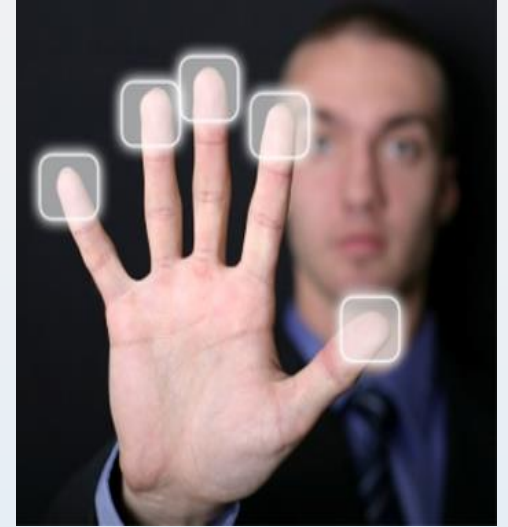
- Has changed very little over the years
- Still not science (lacking reliability studies and application of method)
- Prone to analyst and reviewer biases
- Collected prints are often imperfect.
  - \* Partial, smears, smudges, dirt,
- Experts are overconfident in their abilities
- Literally looking back and forth and making a call



Ultimately, it's subjective & falls to the individual examiner

# Uniqueness

- Maybe . . .
- Theories of development, twins, redevelopment
- But, still not proven
- And even if they are, still comes down to the process and examiner



# The case of Brandon Mayfield







may Over Iraq

pe John Paul II in the Vatican yesterday, with the pope  
and urging speedy restoration of Iraqi sovereignty. Page A8.

## ls on Mistaken Terror Arrest



from a bag in Spain, left,  
on Mayfield's, provided  
art who examined them.

flawed link — including what the  
Spanish described as tell-tale foren-  
sic signs — and seemingly refusing  
to accept the notion that they were  
mistaken.

“They had a justification for ev-  
erything,” said Pedro Luis Melida  
Lledo, head of the fingerprint unit for  
the Spanish National Police, whose  
team analyzed the prints in question  
and met with the Americans on April  
21. “But I just couldn’t see it.”

The Spaniards, who continued to

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# FBI Review- It wasn't us; it was the prints!

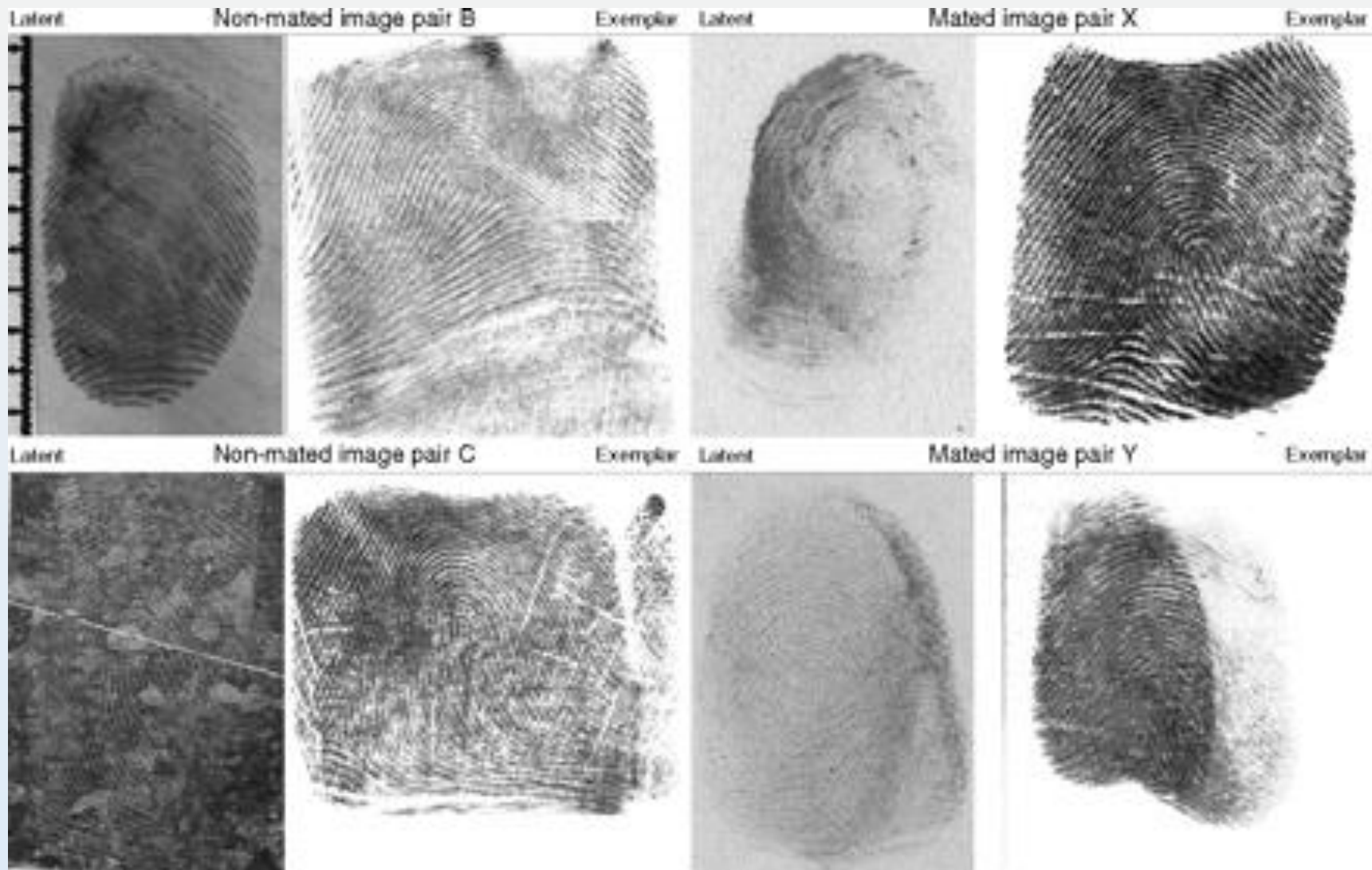
The FBI released an official statement on the Brandon Mayfield case which posited that the **“identification was based on an image of substandard quality**, which was particularly problematic because of the remarkable number of points of similarity between Mr. Mayfield's prints and the print details in the images submitted to the FBI.”

Following its own review, the FBI hired a panel of independent experts to analyze what went wrong. The independent reviews concluded that the problem was not the quality of the digital images reviewed, but rather the **bias** and **“circular reasoning”** of the FBI examiners.

**“All of the committee members agree that the quality of the images that were used to make the erroneous identification was not a factor.”**

[https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/jan2005/special\\_report/2005\\_special\\_report.htm](https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/jan2005/special_report/2005_special_report.htm)

# PNAS Study



# NAS Report on Fingerprints

*“We have reviewed available scientific evidence of the validity of the ACE-V\* method and found none.”* (p. 143)

# “Subjective Interpretations, Exaggerated Testimony, and a Paucity of Research.”

- 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.
- The Committee’s Report rejects as scientifically implausible any claims that fingerprint analyses have “zero error rates.”
- We also found a dearth of scientific research to establish limits of performance, to ascertain quantifiable measures of uncertainty, and to address the impact of the sources of variability and potential bias in fingerprint examinations and in other forensic disciplines that rely on subjective assessments of matching characteristics.

# PCAST on Fingerprints

Over the years, the courts have admitted fingerprint evidence, even though this evidence has “made its way into the courtroom without empirical validation of the underlying theory and/or its particular application.”

The courts (and jurors!) often appear to assume that fingerprint evidence is irrefutable

In *United States v. Crisp*, the court noted that “[w]hile the principles underlying fingerprint identification have not attained the status of scientific law, they nonetheless bear the imprimatur of a strong general acceptance, not only in the expert community, but in the courts as well.”

M.A. Berger. Procedural paradigms for applying the Daubert test. 78 Minn. L. Rev. 1345, 1354 (1994).

PCAST, 102-103





# PCAST on Fingerprints

PCAST found that latent fingerprint analysis is a foundationally valid subjective methodology—albeit with a false positive rate that is substantial and is likely to be higher than expected by many jurors based on longstanding claims about the infallibility of fingerprint analysis. Conclusions of a proposed identification may be scientifically valid, provided that they are accompanied by accurate information about limitations on the reliability of the conclusion.

Informing the PCAST's findings: (1) only two properly designed studies of the foundational validity and accuracy of latent fingerprint analysis have been conducted, (2) these studies found false positive rates that could be as high as 1 error in 306 cases in one study and 1 error in 18 cases in the other, and (3) because the examiners were aware they were being tested, the actual false positive rate in casework may be higher.

*Still subject to the interpretation, judgment, experience, and bias of individual examiners.*

PCAST, 88-103



Leading into other areas....

The same,  
only maybe worse.



# Tire & Shoeprint Analysis



# SWGTTREAD

- The Scientific Working Group for Shoeprint and Tire Tread Evidence (SWGTTREAD) was created in 2004 by the FBI Laboratory to standardize and advance the forensic analysis of footwear and tire impression evidence. The first meeting took place in September 2004 and the last in March 2013
- In October 2014, the [Footwear and Tire Subcommittee](#) of the [National Institute for Standards and Technology](#) (NIST) [Organization of Scientific Area Committees](#) (OSAC) was created. At that point, SWGTTREAD decided to discontinue its operations and focus its efforts on supporting the subcommittee.

# NAS Report on Shoeprint & Tire Evidence

“Most of the research in the field is conducted in forensic laboratories, with the results published in trade journals, such as the Journal of Forensic Identification. With regard to reporting, SWGTREAD is moving toward the use of standard language\* to convey the conclusions reached. *But neither IAI nor SWGTREAD addresses the issue of what critical research should be done or by whom, critical questions that should be addressed include the persistence of individual characteristics, the rarity of certain characteristic types, and the appropriate statistical standards to apply to the significance of individual characteristics. Also, little if any research has been done to address rare impression evidence. **Much more research on these matters is needed.***”

NAS Report, p. 150.



**DON'T  
WORRY,  
IT GETS  
WORSE!**

# PCAST on Shoeprint & Tire Evidence

*“PCAST finds there are no appropriate empirical studies to support the foundational validity of footwear analysis to associate shoeprints with particular shoes based on specific identifying marks (sometimes called “randomly acquired characteristics”). Such conclusions are unsupported by any meaningful evidence or estimates of their accuracy and thus are not scientifically valid. PCAST has not evaluated the foundational validity of footwear analysis to identify class characteristics (for example, shoe size or make).”*

# BUT....

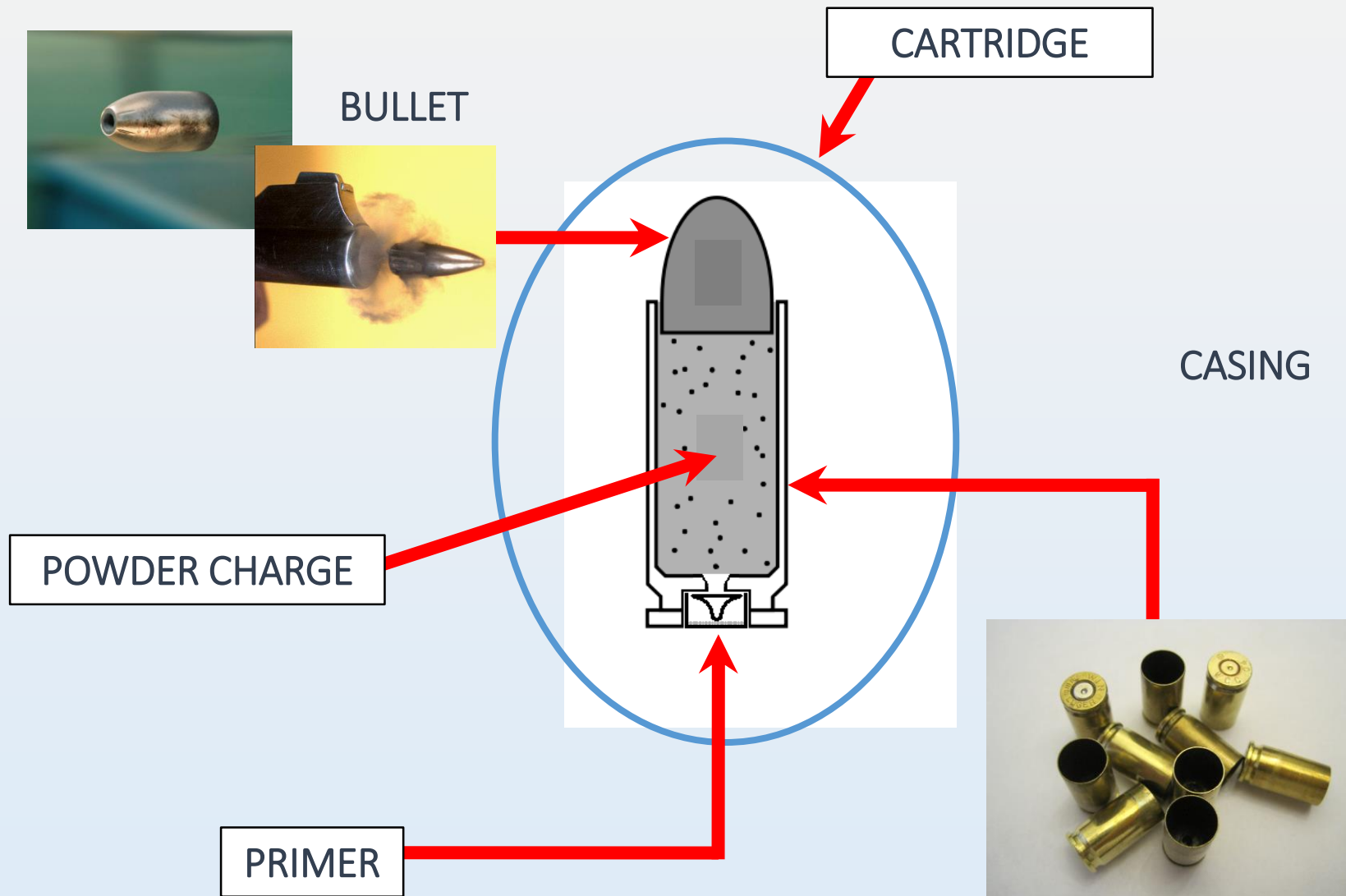




# Ballistics & Firearms



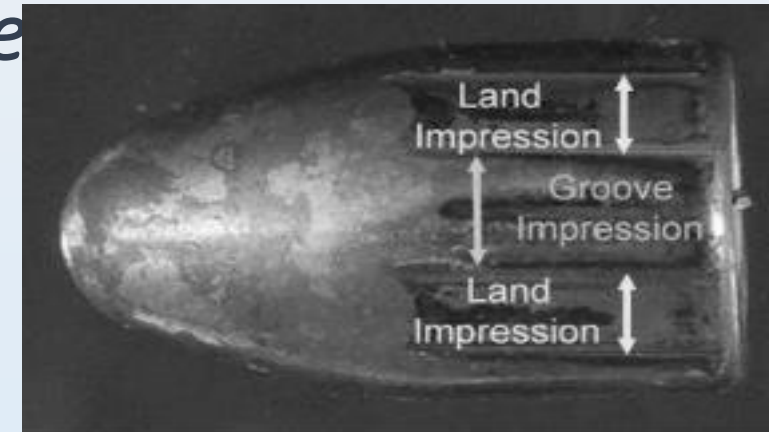
# Components of a Cartridge



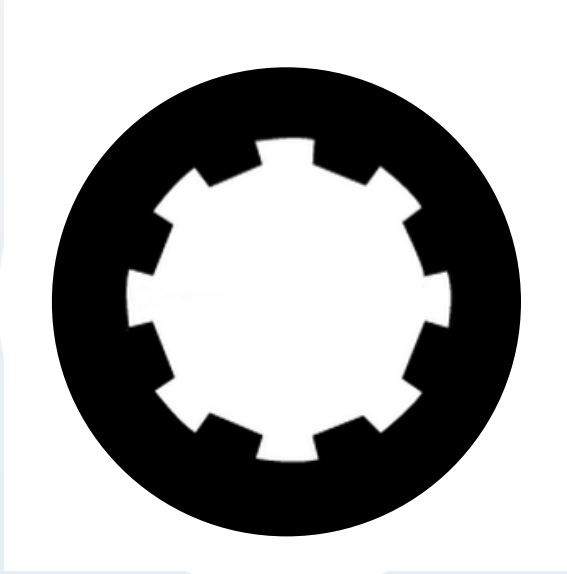


# Firearm Identification (Ballistics)

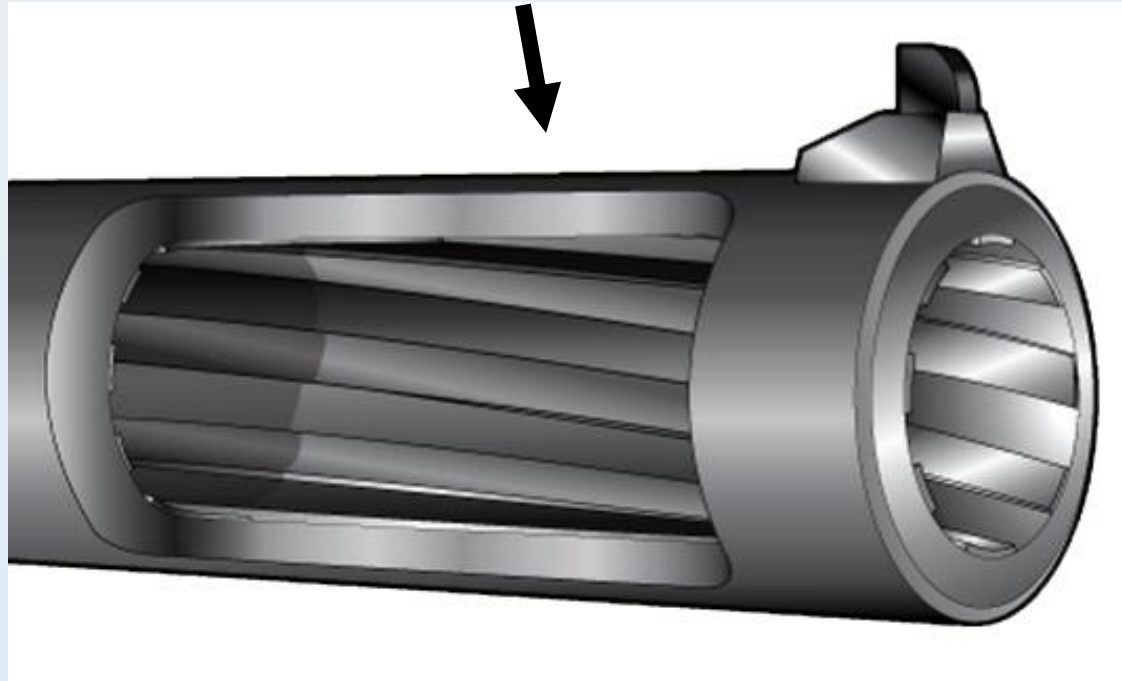
- Attempt to connect a bullet or shell casing to a particular gun (shell casings are easier).
- Performed by optical comparison of visual characteristics.
- Determinations are *subjective and not quantifiable*
- No uniform standards: “Sufficient agreement” or “consistent with.”
- **NIBIN**



# General Rifling Characteristics



8 Lands  
8 Grooves  
Right Twist



# NAS Report on Firearms

- Not enough is known about the variables among individual guns to specify how many points of similarity are necessary for a given level of confidence in the result
- Sufficient studies have not been done to understand the reliability and repeatability of the methods
- More studies are needed to support the process of “individualization” to make it more precise and repeatable

# NAS Report on Firearms

- Discipline lacks a precisely defined process
- Though there's an adopted "theory of identification" there's no specific protocol
- AFTE standard does not define terms and ignores questions regarding the variability, reliability, repeatability or the number of correlations needed to achieve a degree of confidence
- Upon review of the literature and studies performed, the scientific base is "fairly limited"
- No known error rate

# PCAST on Firearms

-Toolmark and firearms analysis suffers from the same limitations discussed above for impression evidence. Because not enough is known about the variabilities among individual tools and guns, we are not able to specify how many points of similarity are necessary for a given level of confidence in the result. Sufficient studies have not been done to understand the reliability and repeatability of the methods.

-The AFTE document, 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 degree of confidence.

# PCAST on Firearms

“A significant amount of research would be needed to scientifically determine the degree to which firearms-related toolmarks are unique or to even quantitatively characterize the probability of uniqueness.”

“Heavy reliance on the subjective findings of examiners.”

(p. 154, 155).



# Practical tips for Litigation



# Strategy

## I. Discovery

- A. Collect the foundational research in the field
- B. Conduct pre-trial interview using this research
- C. Collect best practices guidance, NCFS and OSAC publications

## II. Move to exclude

- A. Sixth Amendment/Cross-examination (insufficient documentation)
- B. Due Process  
*FRYE/DAUBERT*
- C. Is the expert qualified? Does he have the training to be able to explain the limits?



# What does this mean?

- Request all lab and bench notes, data produced or used as basis for conclusion
- Standard Operating Procedures: what guidelines do labs use to assess evidence, produce reports, and render conclusions?
- Review expert CV: articles, affiliations, etc.
- Other guidelines? What other types of experts are needed to make evaluations of this type of evidence, or to render conclusions regarding rates or implied frequency language utilized by analyst (including “consistent with,” etc.)?

# Strategy

## III. Move to limit

- A. Unknown error rate (not zero)
- B. Cannot exclude, similar in all microscopic/observable characteristics (even better if you can include limitation that the significance of that fact is unknown/subjective assessment)
- C. Evaluation if not science (measureable)

If the Court Rules “to a reasonable degree of \_\_\_\_\_ certainty”

 “best subjective estimate based on current experience”

 **THIS IS NOT SCIENCE!**

\* Jurors must be informed what this means

# SWGFAST Response

Year	Definition of Individualization
2003	The determination that corresponding areas of frictions ridge impressions originated from the same source to the exclusion of all others
2009	The <del>determination</del> <u>conclusion</u> that corresponding areas of friction ridge impressions originated from the same source <del>to the exclusion of all others (identification).</del>
2011	<u>Individualization is the decision by an examiner that there are sufficient features in agreement to conclude</u> <del>The conclusion that corresponding two</del> areas of friction ridge impressions originated from the same source. <u>Individualization of an impression to one source is the decision that the likelihood the impression was made by another (different) source is so remote that it is considered as a practical impossibility.</u>

# DOJ Response

## Identification:

“The examiner may state or imply that an identification is the determination that two friction ridge points originated from the same source because there is sufficient quality and quantity of corresponding information so that the examiner would not expect to see the same arrangement of features repeated in another source”



# DOJ Response

## Statements not Allowed in Reports or Testimony:

1. Exclusion of all other sources
2. Absolute or numerical certainty
3. Zero error rate

# DOJ 2016 Memo

“Department forensic laboratories will review their policies and procedures to ensure that forensic examiners are not using the expressions **“reasonable scientific certainty”** or **“reasonable [forensic discipline] certainty”** in their reports or testimony. Department prosecutors will abstain from use of these expressions when presenting forensic reports of questioning forensic experts in court unless required by a judge or applicable law.”

# NCFS 2017

“Forensic science practitioners should not state that a specific individual or object is the source of the forensic science evidence and should make it clear that, even in circumstances involving extremely strong statistical evidence, it is possible that other individuals or objects could possess or have left a similar set of observed features.”

# PCAST 2016

“(B) Federal judges, when permitting an expert to testify about a foundationally valid feature-comparison method, should ensure that testimony about the accuracy of the method and the probative value of proposed identifications is scientifically valid in that it is limited to what the empirical evidence supports...”

# PCAST 2016

“...Statements suggesting or implying greater certainty are not scientifically valid and should not be permitted.

Courts should never permit scientifically indefensible claims.”



# Strategy

## IV. Trial Strategy

A. Prepare to challenge claim of source attribution  
with research in the field

B. Defense Expert?

C. Jury Instructions



# Proposed Instruction # 1

Testimony was presented that the Mr. Defendant's fingerprint impression shares characteristics with the latent print recovered and that it matches within a "reasonable degree of fingerprint certainty." If you find this testimony to be credible and believable you are instructed "reasonable degree of fingerprint certainty" means that the defendant is among a pool of individuals, the size of which is unknown, whose fingerprint impressions are indistinguishable from this latent print.

# Proposed Instruction # 2

- The error rate for this procedure is yet unknown.
- The opinion offered is not a scientific opinion (no basis in science, not scientifically validated).
- There is no statistical basis that has been demonstrated, and the that the witness testified to “a reasonable degree of ballistic/fingerprint certainty” does not imply that there is one.
- The research in this field is incomplete and ongoing.
- The measurement error for this procedure has yet to be established.

# Trial Court Responses: Exclusion!

## I. EXCLUSION

How can there be a  
“relevant scientific  
community” when  
there is no science?

### A. DAUBERT/FRYE GROUNDS

- *E.g., U.S. v. Smallwood*, 2010 U.S. Dist. LEXIS 108671 (W.D. KY 2010) (experience is not transferable).

### B. NO DOCUMENTATION OF OBSERVATIONS OR MEASUREMENTS ANOTHER EXPERT COULD USE AND/OR COULD BE USED TO CROSS-EXAMINE

- *Smallwood* (W.D. KY 2010) (insufficient documentation).

# Trial Court Responses

- SPLIT TESTIMONY
  - REPORT ONLY OBSERVABLE SIMILARITIES
- LIMITATIONS
  - NO ZERO ERROR RATE
  - NO UNIQUE MATCH OR IS THE SOURCE
  - NO “ABSOLUTE CERTAINTY”
  - NO “PRACTICAL IMPOSSIBILITY”
  - NO “REASONABLE DEGREE OF SCIENTIFIC CERTAINTY”



# Court Responses: Split Testimony of Ridge Analysis

Case	Not Allowed	Allowed
<i>United States v. Llera Plaza</i> , 179 F. Supp. 2d 492 (E.D. Pa. 2002) at 516 (vacated and withdrawn)	“that a particular latent print is in fact the print of a particular person”	“point out observed similarities”
<i>State v. Pope</i> , No. 07CR62135 (Super. Ct. Bibb. Cty. Ga. 2008)	“identified to the exclusion of all others”; “positive, absolute, or certain”	“consistent with”
<i>State v. Johnson</i> , No. 07-47108 (Cir. Ct. Howard Cty. Md. 2008) at 21	“no other person in the world could match”	“point out observed similarities”
<i>United States v. Faison</i> , 2008-CF2-16636 (Super. Ct. D.C. 2010)	“absolute terms, i.e. testimony from an examiner that a print is unique to one person to the exclusion of all others”	“match to a reasonable degree of fingerprint certainty”
<i>State v. Doe</i> (Ore. 2010)	“100% match”; “zero percent error rate”; “identified to the exclusion of all others”	Defendant is source of the print
<i>US v. Zajac</i> , No. 2:06-cr-0811 (D. Ut. 2010)	“individualization”, “the degree of probability of that the fingerprints match”	“consistent with”; “match closely”



# Judicial Restrictions of Firearms Testimony

Case	Allowed
<i>U.S. v. Green</i> , 405 F. Supp. 2d 104 (D. Mass. 2005)	Experts can only describe similarities
<i>U.S. v. Glynn</i> , 578 F. Supp. 2d 567 (S.D.N.Y. 2008)	“More likely than not”
<i>U.S. v. Taylor</i> , 663, F. Supp. 2d 1170 (D.N.M. 2009)	“Reasonable ballistic certainty”. Explicitly forbade the use of “scientific” and “practical” certainty
<i>Commonwealth v. Heang</i> , 458 Mass. 827 (2010)	“match to a reasonable degree of ballistic certainty”. Explicitly forbade the use of “practical impossibility” and “reasonable degree of scientific certainty”.
<i>U.S. v. McCluskey</i> , (D.N.M. 2012)	“Likelihood that the impression was made by another (different) source is ‘so remote that it is considered as a practical impossibility’” was allowed. Explicitly forbade the use of “100% certainty” and “to the exclusion of all others”.

# *United States v. Saunders*, (7<sup>th</sup> Cir. June 2016)

The most consistent effect in Study 2 involved the error information variable: when the examiner admitted that fingerprint examiners sometimes make mistakes and that the identification in this case could thus be wrong, participants reduced their judgments about the likelihood the defendant committed the crime, reduced their estimates of the probability that the defendant left his prints at the crime scene, and had less confidence in their guilt judgments. These effects were found regardless of the certitude with which a positive match conclusion was stated, whether method information was provided, and whether the possibility of error came out on direct or cross (although the trend in the means was for revelation of the risk of error during cross-examination to have a more depressing effect on judgments of guilt). In short, when an examiner admitted the undeniable fact that fingerprint examiners can make identification errors, and that the identification at hand was thus not foolproof, significantly less weight was given to the fingerprint evidence. This result

# *U.S. v. Willock* (D. Md. 2010)

- (1) The government must provide bases and reasons that support the opinion that includes the sketches, diagrams, notes, and photographs that the accepted methodology for application of the AFTE theory requires that the firearms examiner make;
- (2) Firearms toolmark identification evidence is only relevant, reliable, and helpful to a jury if it is offered with the proper qualifications regarding its accuracy.



# *U.S v. St. Gerard* (U.S. Army 2010)

(e) Considering the Daubert factors in light of Mrs. Sevigny's anticipated testimony, the Court finds that any testimony indicating that the shell casing must have come from the AK-47 would be unreliable. While it is clear that Mrs. Sevigny has training and expertise in identifying toolmarks that would undoubtedly assist the trier of fact in this case, the subjective nature of the process, lack of quantitative standards, and limited scope of foundational testing do not demonstrate the scientific principles necessary to establish the origin of the marks with any specific amount of certainty.

(8) Conducting a balancing test under MRE 403, the Court concludes that the probative value of Mrs. Sevigny's proffered testimony that it would be practically impossible for a tool other than the seized AK-47 to have made the marks on the cartridge case would be substantially outweighed by the unfair prejudice associated with its unreliability.

3. Ruling. Accordingly, the defense motion to exclude the testimony of Mrs. Sevigny that it would be a practical impossibility for the cartridge case to have been fired by any weapon other than the seized AK-47 is GRANTED. This ruling is limited solely to testimony concerning the level of certainty of the origin of the marks.

# *U.S. v. Amen*

“The absence of a known error rate, the lack of population studies, and the involvement of examiner judgment all raise important questions about the rigorousness of friction-ridge analysis. To be sure, further testing and study would likely enhance the precision and reviewability of fingerprint examiners’ work, the issues defendant raises concerning the ACE-V method are appropriate topics for cross-examination, not exclusion.”



# *United States v. Saunders*, (7<sup>th</sup> Cir. June 2016)

In criminal cases when the government seeks to call an expert witness, the government must at the defendant's request provide a summary of any expert testimony the government intends to use, including “the witness's opinions, the *bases and reasons* for those opinions, and the witness's qualifications.” Fed. R. Crim. P. 16(a)(1)(G) (emphasis added). We agree with the defendants that the government's Rule 16 disclosure was insufficient because it failed to provide the number of points of identification that were the basis for Ambrozich's opinion that the fingerprints were a match. See *United States v. Robinson*, 44 F.Supp.2d 1345, 1347 (N.D. Ga. 1997) (excluding fingerprint testimony for failure to comply with defendant's request for disclosure of documentation of the points of comparison relied on by expert to make identifications).



Thank you for all that you do!