
David H Kaye
Penn State Law
Quick Overview of PCAST and Its Report
What is PCAST?

• Beginning in 1933 with President Franklin D. Roosevelt's Science Advisory Board, each President (except for the incumbent?) has established an advisory committee of scientists, engineers, and health professionals.

• Advanced manufacturing, defense against biological attacks, safety of drinking water, nanotechnology, restoring hearing in the elderly
19 MEMBERS (in 2017)
This report

• **Discusses the role of scientific validity in the Fed. R. Evidence;**

• Explains the criteria by which the scientific validity of forensic methods can be judged;

• Applies those criteria to the forensic feature-comparison methods mentioned above;

• Offers recommendations on federal actions that could be taken to strengthen forensic science and promote its rigorous use in the courtroom.
Policy Recommendations

• NIST should perform evaluations, on an ongoing basis, of the scientific validity of current and newly developed forensic feature-matching technologies and should issue an annual public report on the results.

• NIST should take a leadership role in transforming three important feature-comparison methods—DNA analysis of complex mixtures, latent-fingerprint analysis, and firearms analysis—from currently subjective methods, with their heavy reliance on human judgement, into objective methods, in which standardized, quantifiable processes require little or no judgment.

• OSTP should coordinate the creation of a national forensic science research and development strategy.

• The FBI Laboratory should undertake a vigorous research program to improve forensic science, building on its recent important work on latent-fingerprint analysis.

• The Attorney General should direct attorneys appearing on behalf of the Department of Justice to ensure expert testimony in court about forensic feature-comparison methods meets the standards of scientific validity.

• The Attorney General should revise and reissue for public comment the DOJ proposed “Uniform Language for Testimony and Reports” and supporting documents to bring them into alignment with standards for scientific validity.

• When deciding the admissibility of expert testimony, federal judges should take into account the appropriate scientific criteria for assessing scientific validity.
PCAST’s Conclusions on Validity

**Scientific validity (both “foundational” and “as applied”) is required for admissibility**

- **Foundational**: No predominantly subjective method of source-identity classifications is scientifically valid unless it has been shown in multiple, peer-reviewed experiments outside of casework conducted by independent researchers using specimens that are representative of casework to have a specificity of at least 95% (FPR<5%).

- **As Applied**: An examiner’s performance on realistic (preferably blind) rigorous, and published proficiency tests must be known.
PCAST’s conclusions on uncertainty

• Without appropriate estimates of 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.

• The expert should report the overall false-positive rate and sensitivity for the method established in the studies of foundational validity and should demonstrate that the samples used in the foundational studies are relevant to the facts of the case.
A Closer Look

• Validity and Reliability
• Expressing Uncertainty
• Post-PCAST Legal Developments
Validity & Reliability

*Daubert*: “[S]cientists typically distinguish between ‘validity’ (does the principle support what it purports to show?) and ‘reliability’ (does application of the principle produce consistent results?)”
# Things that Have Validity

## Arguments
- Deductive
- Inductive

## Theories
- Explain (simplify, unite, predict) observations
  - Evolution, QM
  - Features vary
- Causal
  - Bendectin $\rightarrow$ birth defects
  - *Frye*: Stress $\rightarrow$ blood pressure

## Measurement processes (instruments)
- Variables (nominal, ordinal, interval, ratio scales)
- Systematic, replicable process by which objects or events are quantified or classified with respect to a variable
Measurement Validity

• The degree to which a measurement approach or instrument succeeds in describing or quantifying what it is designed to measure (fit for purpose)
  • The 35-inch yardstick
  • The use of a 36-inch yardstick to measure weight
  • Polygraphic lie detection
Legal or “evidentiary reliability” (ER) is different!

ER = TRUSTWORTHINESS = SCIENTIFIC RELIABILITY + VALIDITY

(ER) = (how precise) + (how well variables relate to desired quantity)

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Reliability

• The degree to which a measurement technique can be depended upon to secure consistent results upon repeated application
  • The rubber ruler problem

• Forensic examples
  • IQ test, LT-DNA STRs, latent fingerprint examination
Daubert’s “Evidentiary Reliability”

Popper and the “Reliability” of Theories
Daubert’s Definition of “Scientific Knowledge” as Used in Rule 702

The subject of an expert's testimony must be "scientific ... knowledge." In order to qualify as "scientific knowledge," an inference or assertion must be derived by the scientific method. Proposed testimony must be supported by appropriate validation—i. e., "good grounds," based on what is known. In short, the requirement that an expert's testimony pertain to "scientific knowledge" establishes a standard of evidentiary reliability.
9. We note that scientists typically distinguish between "validity" (does the principle support what it purports to show?) and "reliability" (does application of the principle produce consistent results?). Although "the difference between accuracy, validity, and reliability may be such that each is distinct from the other by no more than a hen's kick," ... our reference here is to evidentiary reliability—that is, trustworthiness. Cf., e.g., [ACN] on Fed. Rule Evid. 602 ("[T]he rule requiring that a witness who testifies to a fact which can be perceived by the senses must have had an opportunity to observe, and must have actually observed the fact' is a 'most pervasive manifestation' of the common law insistence upon 'the most reliable sources of information’” ... ); [ACN] on Art. VIII ... (hearsay exceptions will be recognized only "under circumstances supposed to furnish guarantees of trustworthiness"). In a case involving scientific evidence, evidentiary reliability will be based upon scientific validity.
[A] key question to be answered in determining whether a theory or technique is scientific knowledge is whether it can be (and has been) tested. See also C. Hempel, Philosophy of Natural Science 49 (1966) ("[T]he statements constituting a scientific explanation must be capable of empirical test"); K. Popper, Conjectures and Refutations: The Growth of Scientific Knowledge 37 (5th ed. 1989) ("[T]he criterion of the scientific status of a theory is its falsifiability, or refutability, or testability").
Daubert Scores Poorly as an Essay on the Philosophy of Science, But

- The understanding of Popper among working scientists is helpful to the law.
- Withstanding severe tests is the hallmark of a successful theory (along with other things).

Whether we want to call this the philosophical Popper or the pop-science Popper is not crucial.
PCAST’s New Definitions of Validity and Reliability

**Foundational**
- requires that it 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. Foundational validity, then, means that a method can, in principle, be reliable. It is the scientific concept we mean to correspond to the legal requirement, in Rule 702(c), of “reliable principles and methods.”

**As applied**
- the method has been reliably applied in practice. It is the scientific concept we mean to correspond to the legal requirement, in Rule 702(d), that an expert “has reliably applied the principles and methods to the facts of the case.”
Why does it matter?

- If validity involves fitness for purpose, then we need to ask whether the purpose is to inform or to decide.
- Reliable (reproducible, repeatable) measurements may be insufficient to decide an issue but still valid to inform a decisionmaker (if properly presented).
A Closer Look

• Validity and Reliability
• Expressing Uncertainty
• Post-PCAST Legal Developments
Decide Whether $H$ Is True
and give a quantitative measure of uncertainty
Decide whether $H$ is true and give

- **False-positive error probability**
  - $Pr(+|\sim H)$

- **Sensitivity and false-positive probability**
  - $Pr(+|H)$ and $Pr(+|\sim H)$

- **Sensitivity and specificity**
  - $Pr(+|H)$ and $Pr(-|\sim H)$

- **$LR_+= sensitivity / (1 – specificity)$**

- PCAST promotes it with a CI
- PCAST recommends
- Variation on PCAST
- PCAST ignores
Some medical tests

**Nitrite dipstick test for urinary tract infection**
- $P(\text{+|infect}) = 0.27$
- $P(\text{+|\sim infect}) = 0.06$
- $LR_+ = 4.5$

**Uriscreen test for infection**
- $P(\text{+|infect}) = 1$
- $P(\text{+|\sim infect}) = 0.32$
- $LR_+ = 3.1$

**IVD assay for Ebola**
- $P(\text{+|Ebola}) = 0.92$
- $P(\text{+|\sim Ebola}) = 0.15$
- $LR_+ = 6.1$

**PSA test for prostate cancer**
- $P(\text{+|cancer}) = 0.7$
- $P(\text{+|\sim cancer}) = 0.1$
- $LR_+ = 7$

False-positive probability = 6%

+ is 4.5 times more common with an infection than without.
Microscopic hair comparisons

<table>
<thead>
<tr>
<th>~mito</th>
<th>+mito</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>69</td>
</tr>
<tr>
<td>26</td>
<td>69</td>
</tr>
</tbody>
</table>

- is a negative finding (the examiner decided there was no association).
+ is a positive finding (the examiner decided there was an association).
~mito indicates different mitotypes.
mito indicates same mitotypes.

Prop(+|mito) = 69/69 = 100%  \(\leftarrow\) True Positive Rate
Prop(+|~mito) = 9/26 = 35%  \(\leftarrow\) False Positive Rate
Prop(+|mito) / Prop(+|~mito) = 2.9  \(\leftarrow\) Likelihood Ratio
Cartridges: Baldwin et al. (2015)

<table>
<thead>
<tr>
<th></th>
<th>~S</th>
<th>+S</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>−</td>
<td>1421</td>
<td>4</td>
<td>1425</td>
</tr>
<tr>
<td>+</td>
<td>22</td>
<td>1075</td>
<td>1097</td>
</tr>
<tr>
<td></td>
<td>1443</td>
<td>1079</td>
<td></td>
</tr>
</tbody>
</table>

− is a negative finding (the examiner decided there was no association).
+ is a positive finding (the examiner decided there was an association).
~S indicates that the cartridges came from bullets fired by a different gun.
+S indicates that the cartridges came from bullets fired by the same gun.

Prop(+|S) = 1075/1079 = 99.63% \(\leftarrow\) True Positive Rate
Prop(+|~S) = 22/1443 = 1.52% \(\leftarrow\) False Positive Rate
Prop(+|S) / Prop(+|~S) = 66 \(\leftarrow\) Likelihood Ratio
Latent Prints: Noblis-FBI (2011)

<table>
<thead>
<tr>
<th></th>
<th>~S</th>
<th>+S</th>
</tr>
</thead>
<tbody>
<tr>
<td>−</td>
<td>3622</td>
<td>450</td>
</tr>
<tr>
<td>+</td>
<td>6</td>
<td>3663</td>
</tr>
<tr>
<td></td>
<td>3628</td>
<td>4113</td>
</tr>
</tbody>
</table>

− is a negative finding (the examiner decided there was no association).
+ is a positive finding (the examiner decided there was an association).
~S indicates that the prints came from different fingers.
+S indicates that the prints came from the same finger.

\[
\text{Prop}(+|S) = \frac{3663}{4113} = 89.06\% \quad \leftarrow \text{True Positive Rate}
\]
\[
\text{Prop}(+|\sim S) = \frac{6}{3628} = 0.17\% \quad \leftarrow \text{False Positive Rate}
\]
\[
\frac{\text{Prop}(+|S)}{\text{Prop}(+|\sim S)} = 539 \quad \leftarrow \text{Likelihood Ratio}
\]
Posterior Probabilities

Qualitative
Handwriting

1. Identification (definite conclusion of identity)
2. Strong probability (highly probable, very probable)
3. Probable
4. Indications (evidence to suggest)
5. No conclusion (totally inconclusive, indeterminable)
6. Indications did not
7. Probably did not
8. Strong probability did not
9. Elimination

But where is the uncertainty at the extremes?

ASTM E1658-08
Fingerprints

The examiner may offer any of the following conclusions:

1. Source identification (i.e., came from the same source)
2. Inconclusive
3. Source exclusion (i.e., came from different sources)

But where is the uncertainty at the extremes?
Toolmarks

- [O]pinions of common origin [are] made when toolmarks are in “sufficient agreement.”
- “[S]ufficient agreement” ... 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.
- Currently the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner’s training and experience.

How improbable is a “practical impossibility”?
Posterior Probabilities

Quantitative
# Hummel’s Verbal Predicates

<table>
<thead>
<tr>
<th>W</th>
<th>Likelihood of paternity</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.80 - 99.90</td>
<td>Practically proved</td>
</tr>
<tr>
<td>99.1 - 99.75</td>
<td>Extremely likely</td>
</tr>
<tr>
<td>95 - 99</td>
<td>Very likely</td>
</tr>
<tr>
<td>90 - 95</td>
<td>Likely</td>
</tr>
<tr>
<td>80 - 90</td>
<td>Undecided</td>
</tr>
<tr>
<td>&lt; 80</td>
<td>Not Useful</td>
</tr>
</tbody>
</table>

Kinship

- A hunter discovered remains of a woman and her unborn child on Fort Benning Military Reservation.
- She had been shot, and gov’t charged N with murder.
- It claimed N’s motive for the crime was that she was pregnant with his child.
- $Q = \text{fetal bones}; \ K = \text{N’s cells (and the woman’s?)}$

Opinion

[T]here is a 96.30% probability that Defendant is the father.

• [T]his level ... is substantially lower than the [99.99%] probability that the DNA scientific community is comfortable relying upon to establish paternity. ... Therefore, Weiss would not opine to a reasonable degree of certainty that Defendant was the father of the fetus.

• The possibility that Defendant is the father may be higher than others at 26 to 1, but it does not rise to any reasonable level of scientific certainty. It would be sheer speculation for a jury to determine from Weiss's testimony that Defendant is the father. Therefore, ... the testimony is not relevant and ... not admissible under Federal Rules of Evidence 702, 401, and 402.
Biostatistician reported that “the posterior odds in favour of twin A (rather than twin B) ... exceed 12,000 to one.”

- Dwayne’s saliva STRs matched semen but so did MZ twin Dwight’s.
- Eurofins sequenced saliva DNA of both twins.
- Twins’ saliva DNA differed at 9 loci (SNPs). Of those, Dwayne’s saliva matched semen at 7 loci; Dwight’s matched at 2 loci -- both twins seemingly excluded, but explained as prenatal, post-twinning mutations.
Q. Is the use of likelihood ratios generally accepted in the biostatistical community? A. Yes, it is.
Q. Is there any controversy that you are aware of about the validity of the use of likelihood ratios in biostatistics?
A. No, the ... concept of likelihood ratio has been used in forensic genetics for ... 20, 30 years at least.
Q. ... Is there anything challenging for a statistician in calculating a likelihood ratio?
A. No, it's not. [A]t least for a statistician it's very straightforward and it's not difficult.
The Underlying Biology
<table>
<thead>
<tr>
<th>no.</th>
<th>zygote</th>
<th>saliva A</th>
<th>sperm</th>
<th>saliva B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C</td>
<td>C/T</td>
<td>C/T</td>
<td>C</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>A/G</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G/A</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>A/C</td>
<td>A/C</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G/T</td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>C/T</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>8</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T/A</td>
</tr>
<tr>
<td>9</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G/A</td>
</tr>
<tr>
<td>10</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C/T</td>
</tr>
</tbody>
</table>

zygote:
1 2 3 4 5 6 8 9 10
C A G A G C T G C

twinning:

?       ?       ?

saliva A:

1 2 3 4 5 6 8 9 10
C A G A G C T G C

sperm:

1 2 3 4 5 6 8 9 10
C A G A G C T G C

saliva B:

1 2 3 5 6 8 9 10
C A G A G C T A A T
HYPOTHESIS A

- Germ cell emigration
- Saliva A
- Saliva B
- Zygote
- Twinning
- Embryo A
- Embryo B
- Germ cell emigration
HYPOTHESIS B-1 (concurrent mutations)

(2 additional somatic mutations)
HYPOTHESIS B-2 (depletion/enrichment)
(somatic depletion + re-enrichment of mutations 1 and 4)
HYPOTHESIS B-3 (depletion)
(somatic depletion of mutations 1 and 4)
HYPOTHESIS A-2 (depletion)
(somatic depletion of mutations 1 and 4)

Twinning

Saliva A

Saliva B

Zygote

Embryo A

Germ cell emigration

Sperm

Depletion
Q. And if you could briefly explain what a likelihood ratio is.
A. A likelihood ratio is a ratio that compares the likelihood of two hypotheses in the light of data. In the present case there are two hypotheses: the sperm came from twin A or the sperm came from twin B, and then you calculate the likelihood of each hypotheses in the face or in the light of the data, and then you form the ratio of the two. So the ratio tells you how much more likely one hypothesis is than the other in the light of the experimental data.
Lost in Translation

\[ L = \frac{P(\text{semen vs saliva}|Dwayne)}{P(\text{semen vs saliva}|Dwight)} = 12,000 \]

What was calculated

- The data are 12,000 times more probable for Dwayne than Dwight

What was reported

- Dwayne is 12,000 times more probable than Dwight
Transposition Fallacy: $\Pr(A|B) = \Pr(B|A)$?

• The brown-eyed lawyer

- $\Pr(\text{brown-eyed} \mid \text{lawyer}) = ?$
- $\Pr(\text{lawyer} \mid \text{brown-eyed}) = ?$

In general, $\Pr(A|B) \neq \Pr(B|A)$

Recognized in McDaniel v. Brown
558 US 120 (2010)
[T]he substantial complexity of DNA evidence and concomitant advanced mathematical computations here may leave jurors confused and uncertain. … Although the court has the utmost respect for the ability of jurors to comprehend complicated scientific principles, they would not have the luxury of many days of rumination, as this gatekeeper has needed, to untie this Gordian knot.
Strength of Evidence

AKA Likelihood, Support, Bayes Factor, Weight of Evidence
LR as the Strength of Evidence

Law of likelihood (not Bayesian)

- “The likelihood ratio is to be interpreted as the degree to which the data support the one hypothesis against the other.” Edwards, p. 31

Bayes factor

- $LR = \frac{Pr(E|H)}{Pr(E|\sim H)}$ shifts the odds (as seen in the next slide).
Bayes Rule

\[ \text{Odds}(H|E) = \frac{\text{Pr}(E|H)}{\text{Pr}(E|\sim H)} \times \text{Odds}(H) \]

- Expert can help jury assess strength of evidence by presenting the Bayes factor or data that affect it.
Strength of the evidence

- Likelihoods $\alpha \Pr(E | H)$ and $\Pr(E | \sim H)$
- $LR = \Pr(E | H) / \Pr(E | \sim H)$

PCAST ignores this way to present findings.
DoJ Is Conflicted About It

The basis for a 'source identification' conclusion is an examiner's decision that the observed corresponding friction ridge skin features provide extremely strong support for the proposition that the two impressions came from the same source and extremely weak support for the proposition that the two impressions came from different sources.

A source identification is a statement of an examiner's belief ... that the probability that the two impressions were made by different sources is so small that it is negligible. ...

• Likelihood statement
• Posterior probability statement
Forensic science practitioners should confine their evaluative statements to the support that the findings provide for the claim linked to the forensic evidence.

- Nat’l Commission on Forensic Science Subcomm. on Reporting and Testimony, Statistical Statements in Forensic Testimony, Mar. 27, 2017, p. 4 (final draft)

We also strongly advise forensic science practitioners to confine their evaluative statements to expressions of support for stated hypotheses: e.g., the support for the hypothesis that the samples originate from a common source and support for the hypothesis that they originate from different sources.

- Am. Statistical Ass’n Position on Statistical Statements for Forensic Evidence, Jan. 2, 2019, p.4
DNA Mixture Cases and “Probabilistic Genotyping”

**Commonwealth v. McClellan**

- [T]he DNA sample taken from the gun's grip was at least 384 times more probable if the sample originated from Appellant and two unknown, unrelated individuals than if it originated from a relative to Appellant and two unknown, unrelated individuals. Therefore, the laboratory concluded there was “strong support” that Appellant contributed to this mixture.

<table>
<thead>
<tr>
<th>LR for $H_p$ Support and 1/LR for $H_d$ Support</th>
<th>Verbal Qualifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Uninformative</td>
</tr>
<tr>
<td>2 – 99</td>
<td>Limited Support</td>
</tr>
<tr>
<td>100 – 9,999</td>
<td>Moderate Support</td>
</tr>
<tr>
<td>10,000 – 999,999</td>
<td>Strong Support</td>
</tr>
<tr>
<td>$\geq 1,000,000$</td>
<td>Very Strong Support</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS OF THE SWGDAM AD HOC WORKING GROUP ON GENOTYPING RESULTS REPORTED AS LIKELIHOOD RATIOS
A Closer Look

• Validity and Reliability
• Expressing Uncertainty
• Post-PCAST Legal Developments
[T]he report does not dispute the accuracy or acceptance of firearm toolmark analysis within the courts. Rather, the report laments the lack of scientifically rigorous “blackbox” studies needed to demonstrate the reproducibility of results ... [T]he Court hopes researchers will in fact conduct such studies.

PCAST finds that firearms analysis currently falls short of the criteria for foundational validity ...
• PCAST did find one scientific study that met its requirements ... That study ... found that toolmark analysis has a false positive rate between 1 in 66 and 1 in 46. ... Thus, the defendants’ submission places the error rate at roughly 2%. The Court finds that this is a sufficiently low error rate to weigh in favor of allowing expert testimony.

• FN: Because the experts will testify as to the likelihood that rounds were fired from the same firearm, the relevant error rate in this case is the false positive rate (that is, the likelihood that an expert’s testimony that two bullets were fired by the same source is in fact incorrect).

<table>
<thead>
<tr>
<th>Cartridges: Baldwin et al. (2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>~S</td>
</tr>
<tr>
<td>-</td>
</tr>
<tr>
<td>+</td>
</tr>
<tr>
<td>1443</td>
</tr>
</tbody>
</table>

\[
\text{Prop}(+|\sim S|) = \frac{22}{1443} = 1.52\% = 1/66
\]

95% CI = (.010, .023) = (1/100, 1/43)

\[
\text{False-Positive Fallacy (Transposition)}
\]

\[
\Pr(+|\sim S) \neq \Pr(\sim S|+) \\
\text{Odds}(\sim S|+) = LR \text{ Odds}(\sim S)
\]

where \( LR = \frac{\Pr(+|\sim S)}{\Pr(+|S)} = 66 \)
While these proficiency tests do not validate the underlying assumption of uniqueness upon which the AFTE theory rests, they do provide a mechanism by which to test examiners' ability.

Even accepting the PCAST Report’s assertion that the error rate could be as high as 1 in 46, or close to 2.2%, such an error rate is not impermissibly high.

The absence of a definite error rate for toolmark identification does not require that such evidence be precluded.
State v. Patel
No. LLICR130143598S (Conn. Super. Ct., Dec. 28, 2016)

• **Defendant**: PCAST “no appropriate empirical studies to support the foundational validity of footwear analysis to associate shoeprints with particular shoes based on specific identifying marks ... . Such conclusions are unsupported by any meaningful evidence or estimates of their accuracy and thus are not scientifically valid.”

In Connecticut, there is no need to prove that the “expert testimony ... albeit scientific in nature” was based on a scientifically validated procedure because the physical comparison was “neither scientifically obscure nor instilled with ‘aura of mystic infallibility.’”

“Lisa Ragaza, a ‘forensic science examiner 1’ ... testified regarding her extensive training and experience in the field of footwear comparison analysis.

- analysis is generally accepted in the relevant scientific community ...
  - has been admitted ... since the 1930s ...
- there are numerous treatises and journals ...
- there have been studies relative to the statistical likelihood of randomly acquired characteristics ...
- her work is subject to peer review, including having a second trained examiner carry out a blind review of each analysis that she does.”
Mark Adrian Hughes was convicted for breaking into two newly constructed homes and stealing the appliances in them.

Sean Matusko, a "forensic scientist with the ISP laboratory's latent-print unit" testified "that shoeprints found at both crime scenes were made by Hughes's shoes."

Hughes objected before trial. IRE 702(b) states "[e]xpert scientific testimony is admissible only if the court is satisfied that the expert testimony rests upon reliable scientific principles." Hughes pointed to PCAST.
Hughes

- The trial court went one step beyond Chester. It reasoned that Matuska was merely a “skilled witness” under Rule 701 rather than an expert witness under Rule 702.
- Court appeals found no abuse of discretion.
- Trial court barred CX of a “skilled” Rule 701 witness about PCAST.
- On retrial (for another error), CA cautioned that the judge should not give an expert witness instruction and “Although we did not reach the merits of the admissibility of the PCAST publication, cross-examination regarding the findings therein was permissible regardless of whether Matusko was an expert or a skilled witness.”
Admissibility of PCAST Report

<table>
<thead>
<tr>
<th>For CX</th>
<th>As an Exhibit</th>
</tr>
</thead>
<tbody>
<tr>
<td>• FRE (&amp; IRE) 803(18) -- “the publication is established as a reliable authority by the expert’s admission or testimony, by another expert’s testimony, or by judicial notice.”&lt;br&gt;• What if the judge won’t take judicial notice and the expert denies that PCAST is authoritative? Is the Indiana CA right that D can present the content for CX even though it is hearsay?</td>
<td>• The report is hearsay, but the 803(8) public records exception to the rule against hearsay extends to “factual findings from a legally authorized investigation.”&lt;br&gt;• However, is it the case that &quot;neither the source of information nor other circumstances indicate a lack of trustworthiness&quot;?</td>
</tr>
</tbody>
</table>
Affidavit

• The reports in this case and the published literature ... do not demonstrate that the method for concluding that one twin but not the other is associated with a semen sample possesses “foundational validity,” defined as requiring “that a method has been subjected to empirical testing by multiple groups, under conditions appropriate to its intended use. The studies must (a) demonstrate that the method is repeatable and reproducible and (b) provide valid estimates of the method’s accuracy (that is, how often the method reaches an incorrect conclusion) that indicate the method is appropriate to the intended application.” [PCAST Report to the President, at 5.] The requisite “empirical testing by multiple groups, under conditions appropriate to its intended use” have yet to be undertaken.

reliance on the controversial and debatable report of the President's Council of Advisors on Science and Technology gave this court pause

CX was about the fact that various organizations criticized different parts of the report and that the report was not published in a peer-reviewed scientific journal.
[T]he [PCAST] report … provide[s] … an objective yardstick against which proffered forensic evidence can be measured, as well as critiques of particular types of forensic evidence. In addition, the PCAST Report contains recommendations for trial judges performing their gatekeeping role under Rule 702:

- courts should never permit scientifically indefensible claims such as: “zero,” “vanishingly small,” “essentially zero,” “negligible,” “minimal,” or “microscopic” error rates; “100 percent certainty” or proof “to a reasonable degree of scientific certainty;” identification “to the exclusion of all other sources;” or a chance of error so remote as to be a “practical impossibility.”
Latent fingerprint evidence is admissible as nonscientific expert testimony (like an art expert’s opinion on who painted a picture).

PCAST: “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.”

“An FBI study published in 2011 reported a false positive rate (the rate at which the method erroneously called a match between a known and latent print) of 1 in 306, while a 2014 Miami-Dade Police Department Forensic Services Bureau study had a false positive rate of 1 in 18.”
United States v. Cantoni
No. 18-cr-562 (ENV) (E.D.N.Y. Mar. 19, 2019) (palm prints)

He wanted “the government [to] acknowledge, through the examiners or by stipulation, that studies have found the [false positive] error rate to be as high as 1 in 18 or 1 in 306.”

The government suggests that the studies Cantoni cites are inapposite because they involved the Federal Bureau of Investigation and the Miami-Dade Police Department. However, because each of these laboratories uses the ACE-V method of the NYPD lab and because the government itself has relied on these studies for confirmation that ACE-V is reliable, Cantoni may explore the error rates generated by the studies on cross-examination.
[T]he PCAST report did not wholly undermine the science of firearm analysis or fingerprint identification nor did it actually establish unacceptable error rates for either field of expertise.

specifically states that fingerprint analysis remains “foundationally valid” and that “whether firearms should be deemed admissible based on current evidence is a decision that belongs to the courts.”
Advisory Committee on Evidence Rules

• In conjunction with its fall 2017 meeting, the Advisory Committee will host a symposium on scientific and technological developments regarding expert testimony, including challenges raised in the last few years to forensic expert evidence, which might justify amending Evidence Rule 702. The symposium will take place on Friday, October 27, 2017, at Boston College Law School.
References

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- Bernard Robertson et al., Interpreting Evidence: Evaluating Forensic Science in the Courtroom (Wiley, 2d ed. 2016)