VICTORIA POLICE

Forensic Science & Crime

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VICTORIA POLICE

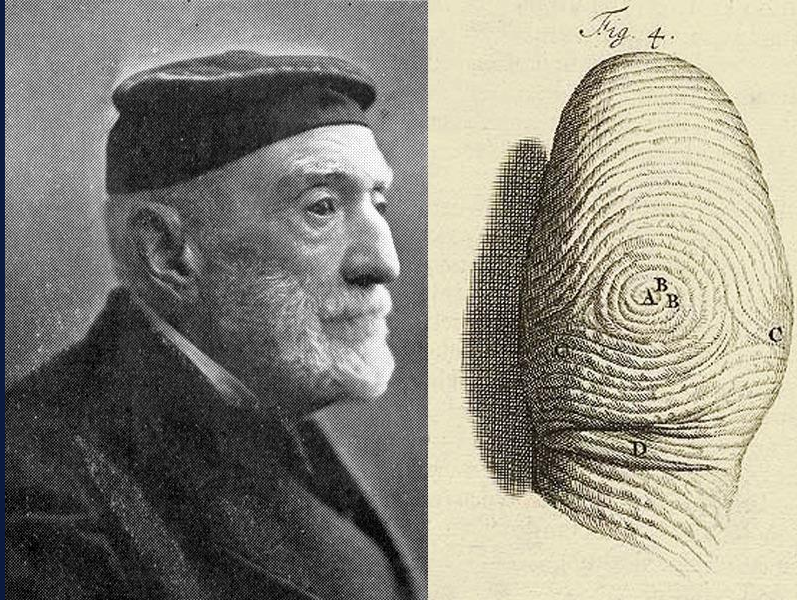What are the pressing issues for forensic science?

How will these affect evidence presented to Courts?

#1 Uncertainty and error exist

#2 Expertise differs

#3 Variation exists in application
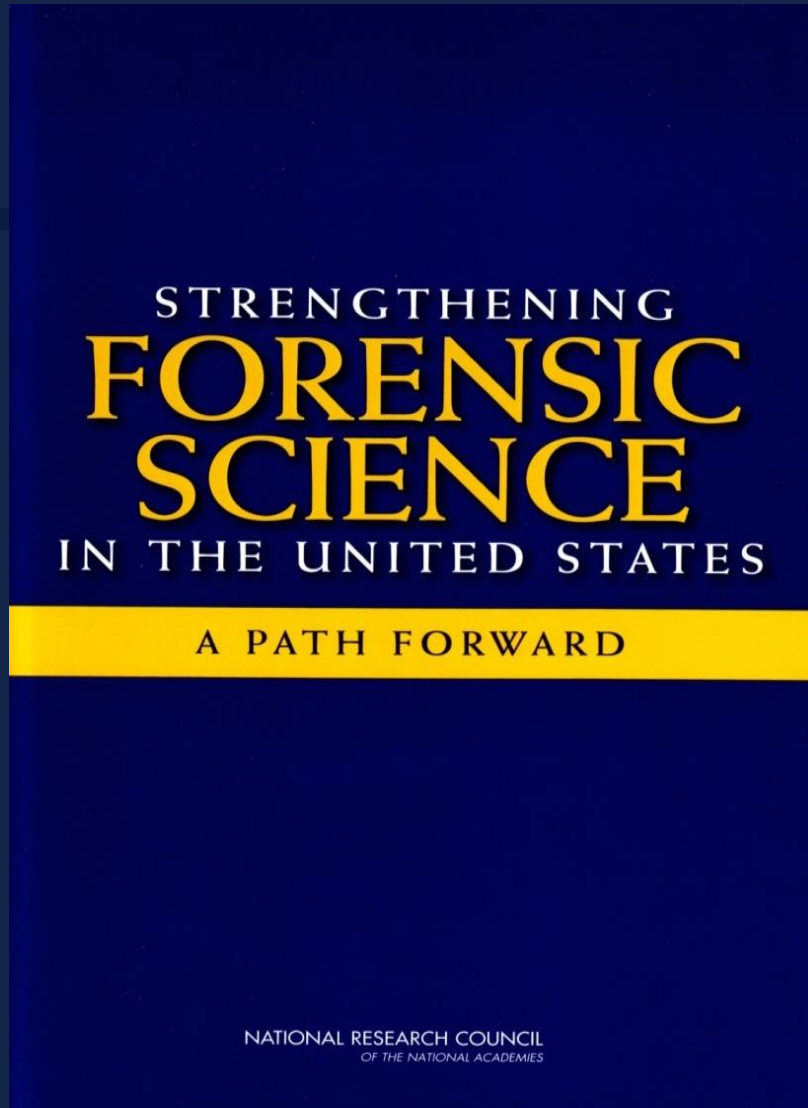
#4 Technology changes – so we need to change

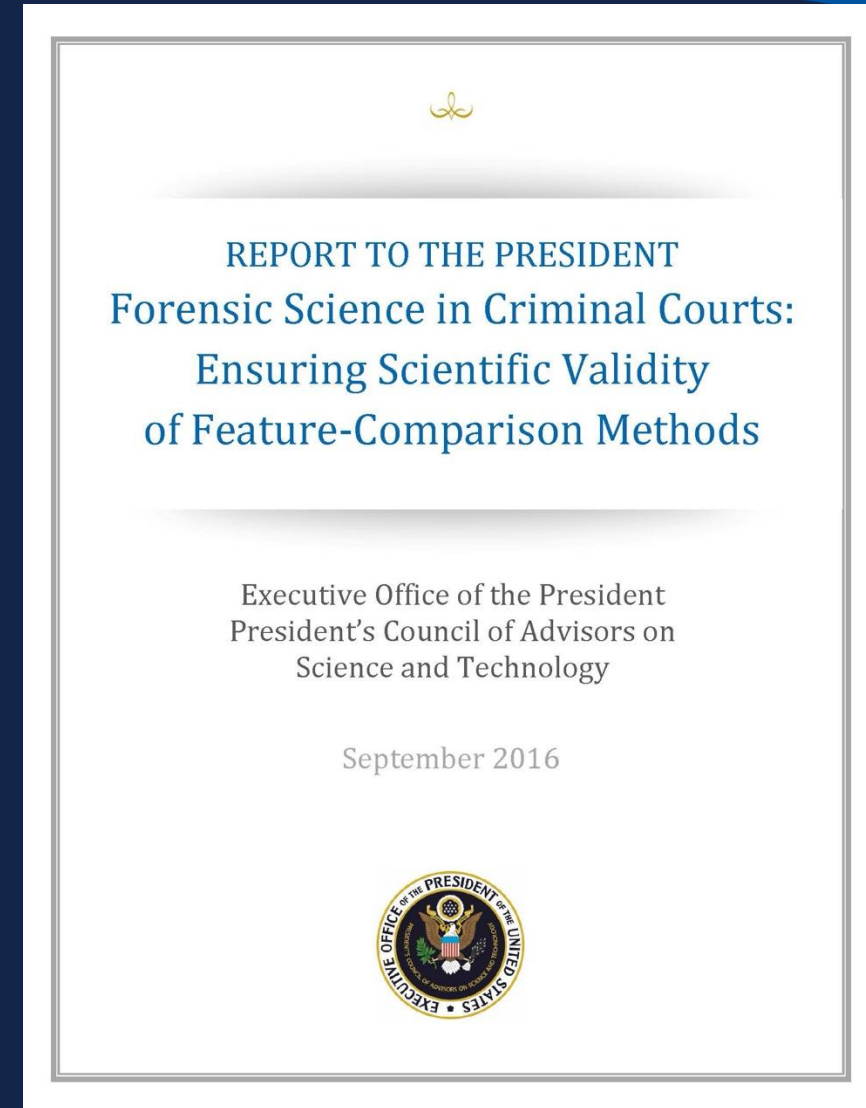Henry Faulds – missionary, doctor, and fingerprinting pioneer

Calvin Goddard, the "Father of Ballistics"

Edmond Locard – "every contact leaves a trace"

2009

2016

Accuracy and reliability of forensic latent fingerprint decisions

Bradford T. Ulery[a], R. Austin Hicklin[a], JoAnn Buscaglia[b,1], and Maria Antonia Roberts[c]

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PLoS one

Repeatability and Reproducibility of Decisions by Latent Fingerprint Examiners

Bradford T. Ulery[1], R. Austin Hicklin[1], JoAnn Buscaglia[2*], Maria Antonia Roberts[3]

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PLOS ONE

Measuring What Latent Fingerprint Examiners Consider Sufficient Information for Individualization Determinations

Bradford T. Ulery[1], R. Austin Hicklin[1], Maria Antonia Roberts[2], JoAnn Buscaglia[3*]

Assessing the frequency of general fingerprint patterns by fingerprint examiners and novices

Erwin J.A.T. Mattijssen[a,b,*], Cilia L.M. Witteman[a], Charles E.H. Berger[b,c], Reinoud D. Stoel[b,1]

Testing the accuracy and reliability of palmar friction ridge comparisons – A black box study

Heidi Eldridge[a,b,*], Marco De Donno[b], Christophe Champod[b]

Accuracy and reproducibility of bullet comparison decisions by forensic examiners

R. Austin Hicklin[a,*], Connie L. Parks[a], Kensley M. Dunagan[a], Brandi L. Emerick[a], Nicole Richetelli[a], William J. Chapman[a], Melissa Taylor[b], Robert M. Thompson[b]

[a] Noblis, Inc, USA
[b] National Institute of Standards and Technology, USA

Accuracy of comparison decisions by forensic firearms examiners

Keith L. Monson PhD | Erich D. Smith MSFS | Eugene M. Peters PhD

Repeatability and reproducibility of comparison decisions by firearms examiners

Keith L. Monson PhD | Erich D. Smith MSFS | Eugene M. Peters PhD

PNAS   RESEARCH ARTICLE | PSYCHOLOGICAL AND COGNITIVE SCIENCES   OPEN ACCESS

Validity of forensic cartridge-case comparisons

Max Guyll[a,1], Stephanie Madon[a], Yueran Yang[b], Kayla A. Burd[c], and Gary Wells[d]

A study of examiner accuracy in cartridge case comparisons. Part 1: Examiner error rates

David P. Baldwin[a], Stanley J. Bajic[a], Max D. Morris[b,*], Daniel S. Zamzow[a]

#1 Uncertainty & error exist

Discipline	Error Rate
Fingerprints	0.17% - 0.67%
Handwriting/Signatures	1 - 7%
Firearms	1 - 3%
Footwear	1 - 3%
Blood Pattern Analysis	1 – 25%
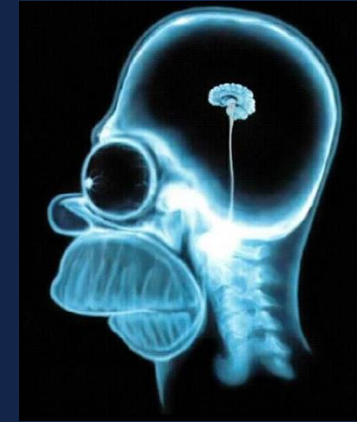
Radiology
3-5%

Diagnostics
10-20%
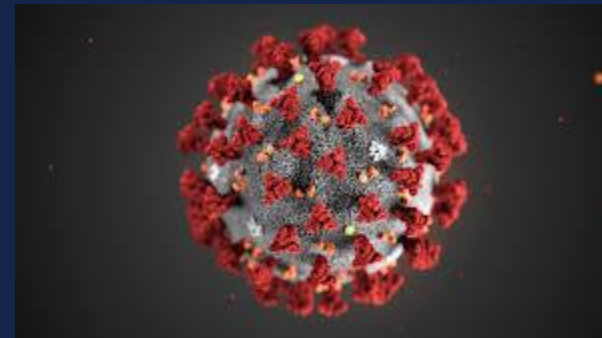
COVID-19
10-20% false
negative

"the touchstone of reliability for this purpose is proof of appropriate validation, both of the underlying science (where necessary) and of the particular methodology being employed"

Tuite v The Queen [2015] VSCA 148

No method is free from error

Assumptions

Uncertainty

Limitations
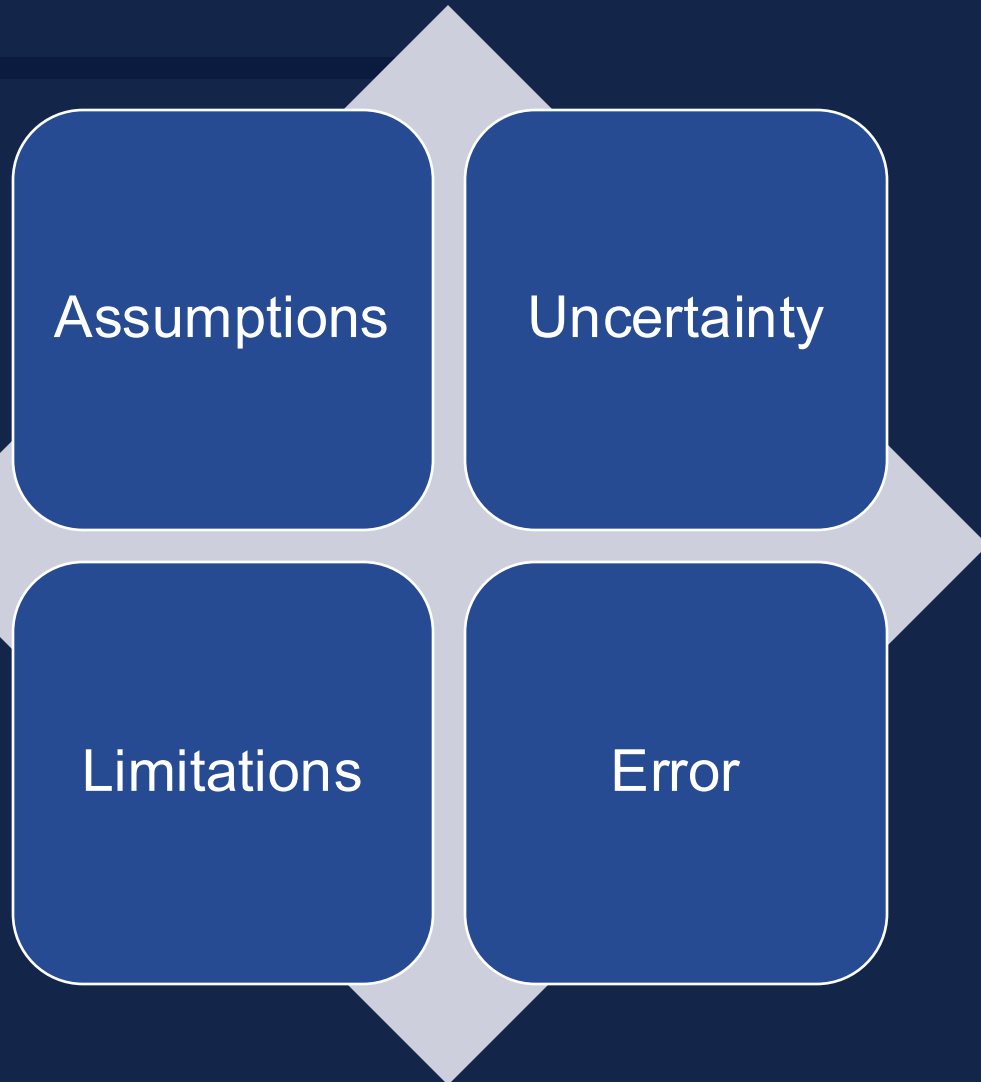
Error

- Error rates will vary depending on the quality of the evidence

- Assumptions and uncertainty increase the possibility of error

- No validation studies exist for some disciplines
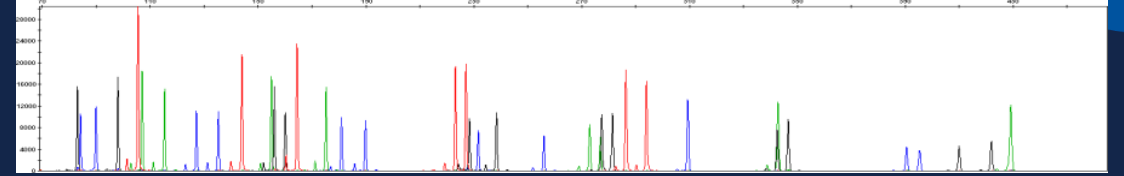
#1 Validity of forensic science evidence

- If the evidence doesn't fit – consider validity and error

- If there is a single piece of evidence – is the error rate sufficiently known (and low?)

- The witness should be able to articulate the limitations, assumptions, and conditions under which error may be higher

#1 Validity of forensic science evidence

- "New" sciences should have proof of validation

- If validation does not exist – treat the opinion with caution and in context of the case

#2 Expertise differs
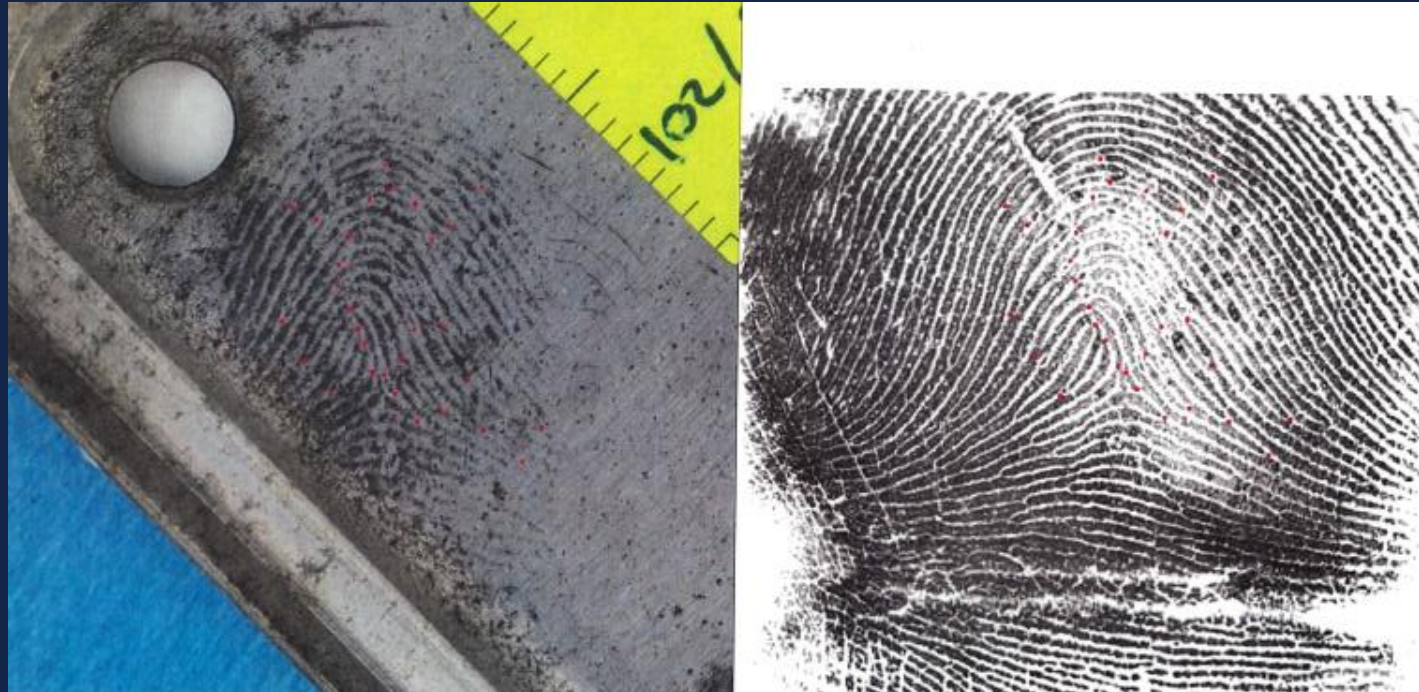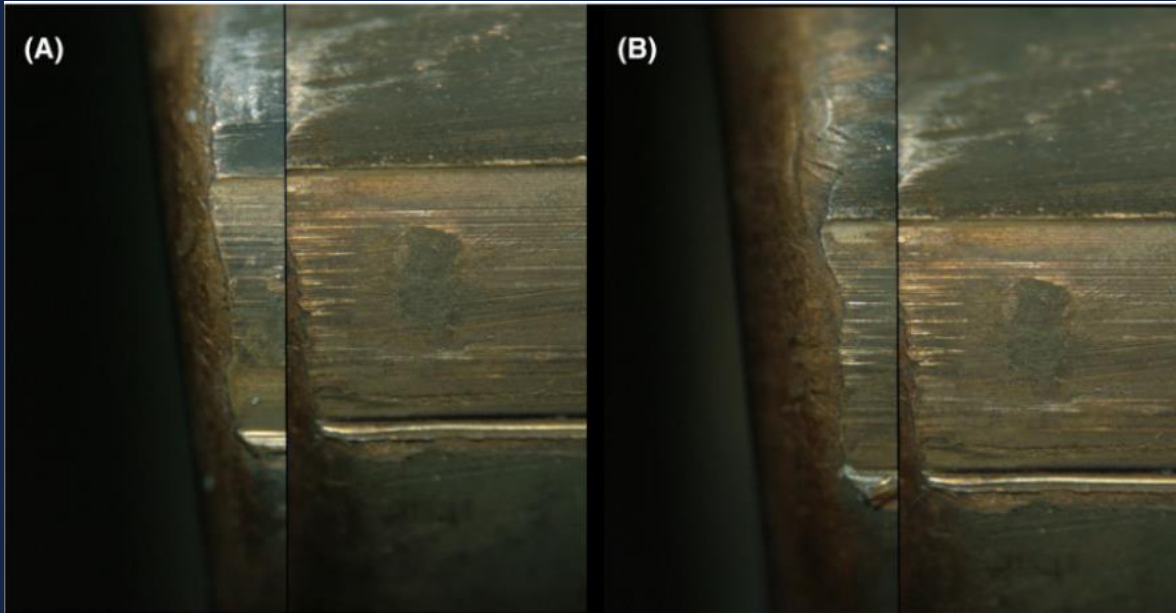
- 95% examiners made no false positive calls

- 1 qualified examiner made 6 errors from 20 judgements (~30% false identification rate)

Monson et al. Accuracy of comparison decisions by forensic firearms examiners. J Forensic Sci 2023 68:86-100

#2 Competence is more than knowledge and experience.

- Examiners should practice, make mistakes, learn, and develop their skill

- Skills degrade – so there needs to be ongoing practice and learning

- Yearly proficiency tests provide *some* information on competence

#3 Variation exists in application

OSAC Human Forensic Biology Subcommittee Process Map

FROM 3525/3530/3950/3955/4310

7005 Input: Projectiles suitable for comparison

7010 Are one of the unknowns described as test fire (TF) at time of submission?

7012 Treat as knowns?

GO TO 7300 (P TO F)

7015 Set up Evidence Items for Comparison (e.g. comparison microscope, 3-D scanning software images etc)- See Considerations for Comparison; Optimize lighting, magnification, and focus

7020 Compare class characteristics of the two items

7025 Are the class characteristics in agreement?

7030 TM Selection Determine which toolmark/area of interest to compare (markings that the firearm would reproduce)
• rifling
• land, groove impression
• misalignment/slippage
• feedramp marks
• forcing cone/shave marks
• Other

7040 Determine which of the two items to hold in fixed position

7050 Position fixed item using area of interest features

7060 Rotate other item to find corresponding area of interest

7065 Is there a corresponding area of interest (in phase)?

GO TO 7200 P TO P (2 of 2)

FROM 7210/7235 P TO P (2 of 2)

7070 Is there an additional area of interest?

2500 Evidence Testing Plan

Is there more evidence to examine per testing plan?

Return to 3100 (Item Determination)

GO TO REPORTING

10000 GRC Database Search *GRC search may be appropriate when the evidence item(s) are not identified to a firearm.

Enter information into GRC?

Launch Search

Report results?

Document/Report GRC results PAP

STOP/ Document PAP or go to 2500 (Evidence Testing Plan)

Exclusion / Elimination

GO TO 2500 (Evidence Testing Loop) OR 10000 (GRC) PAP

7075 Is there disagreement among individual detail present?

7100 Able to eliminate based on individual detail Per Agency Policy (PAP)?

7130 Is the level of disagreement sufficient to exclude?

7135 Can exclusion be made without Firearm?

Exclusion / Elimination

GO TO 2500 (Evidence Testing Loop) OR 10000 (GRC) PAP

Considerations for Comparison

Selecting which unknown or known to compare first/next: Select the applicable criteria:
• Quality/complexity of toolmarks
• Administratively chosen
• Customer driven; investigative question
• Random order
• Perceived probative value based on examiner discretion

7080 Are one of the unknowns described as TF at time of submission?

7082 Request the Firearm?

7085 Request Firearm PAP

7120 Are one of the unknowns described as TF at time of submission?

7140 Request the Firearm?

7145 Request Firearm PAP

Conclusions

Identification

Inconclusive

Inconclusive - A

GO TO 3100 Item Determination

GO TO 3100 Item Determination

Technology Assist
• Computer aided comparison (3D Modeling)
• Computer aided documentation
• Computer aided selection of the known / unknown to compare (NIBIN)
• Comparison Microscope
• Imaging System

7087 Use three levels of inconclusive (PAP)?

Inconclusive - B

Inconclusive

GO TO 2500 (Evidence Testing Loop) OR 10000 (GRC) PAP

7125 Use three levels of inconclusive (PAP)?

Inconclusive - C

Inconclusive

GO TO 2500 (Evidence Testing Loop) OR 10000 (GRC) PAP

Inconclusive - B

Inconclusive - C

Exclusion / Elimination

Collection	Extraction	Quantification	Amplification	Genotyping	Interpretation
Swab	DNA IQ	Quantifiler Trio	PowerPlex 21	GeneMapper ID-X	STRMix
Tapelift	Prepfiler		Identifiler	FaSTR	TrueAllele
Cut out	DNA Investigator		Globalfiler		LRMix
Vacuum	Phenol/ chloroform		Minifiler		EuroForMix
	Chelex		Yfiler Plus		DNAStatisX
			Verifiler		

#3 Valid science isn't enough. Valid application is required

- Laboratories must have checked the method <u>works in their hands</u> via internal validation

- The method must have been applied <u>as validated</u>
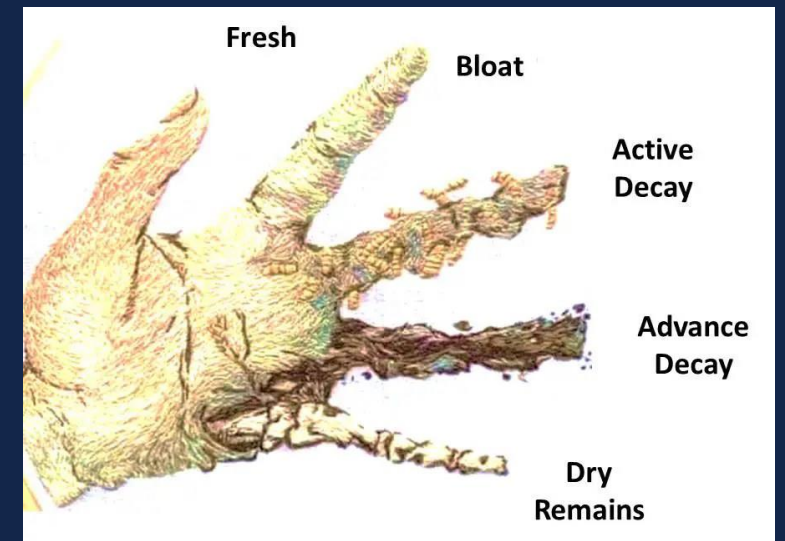
#3 Valid application

- Can the expert point to studies that show that the validation was conducted <u>on similar cases</u>?

- Was the expert exposed to potentially biasing information?

- Is the opinion reported with appropriate information, caveats, assumptions and limitations?

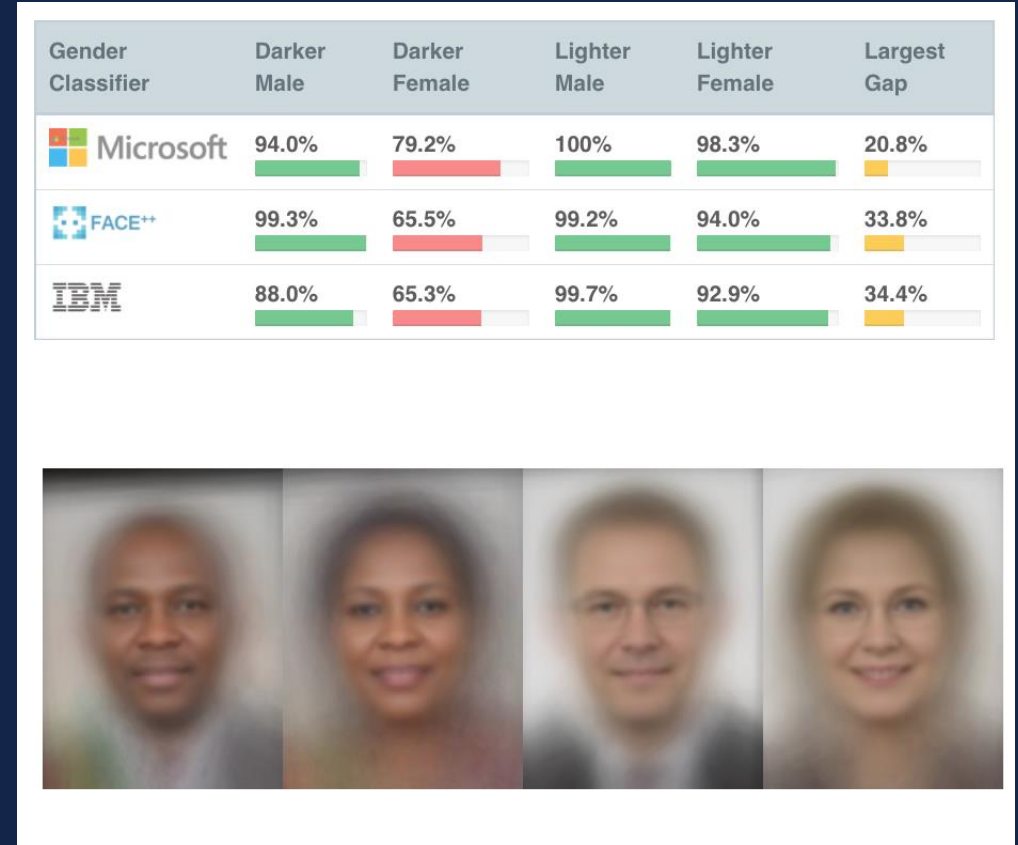# #4 Technology changes – so we need to change

New forms of evidence and investigation

New ways of working with AI

New challenges to evidence

Original Video for Input Speech   Our Result

Gender Classifier	Darker Male	Darker Female	Lighter Male	Lighter Female	Largest Gap
Microsoft	94.0%	79.2%	100%	98.3%	20.8%
FACE++	99.3%	65.5%	99.2%	94.0%	33.8%
IBM	88.0%	65.3%	99.7%	92.9%	34.4%

#4 Advancements bring opportunity & challenges

- Digital evidence is ubiquitous – and highly technical

- AI will enable faster results and ability to disrupt/prevent

- Deep fakes will pose a significant issue

- Bias and error will require more attention with machine learning

Technical complexity will increase

- More disciplines will use complex algorithms and machine learning – how will we convey this to the jury?

- Expertise will no longer just be in the discipline – it will have to cover machine learning/mathematical formula

- Non-explainable AI will mean focus will have to be on accuracy/bias testing, not just reasoning

#1 Uncertainty and error exist

#2 Expertise differs

#3 Variation exists in application

#4 Technology changes – so we need to change

◉ Science should never be static – it is a constantly learning, evolving and changing endeavour

◉ New technology enables a reset – as our 'historical' methods use new algorithms they should be evaluated and tested by courts

◉ Validity, application and error should always be considered – and questioned.

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