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Error Rates in Forensic Science

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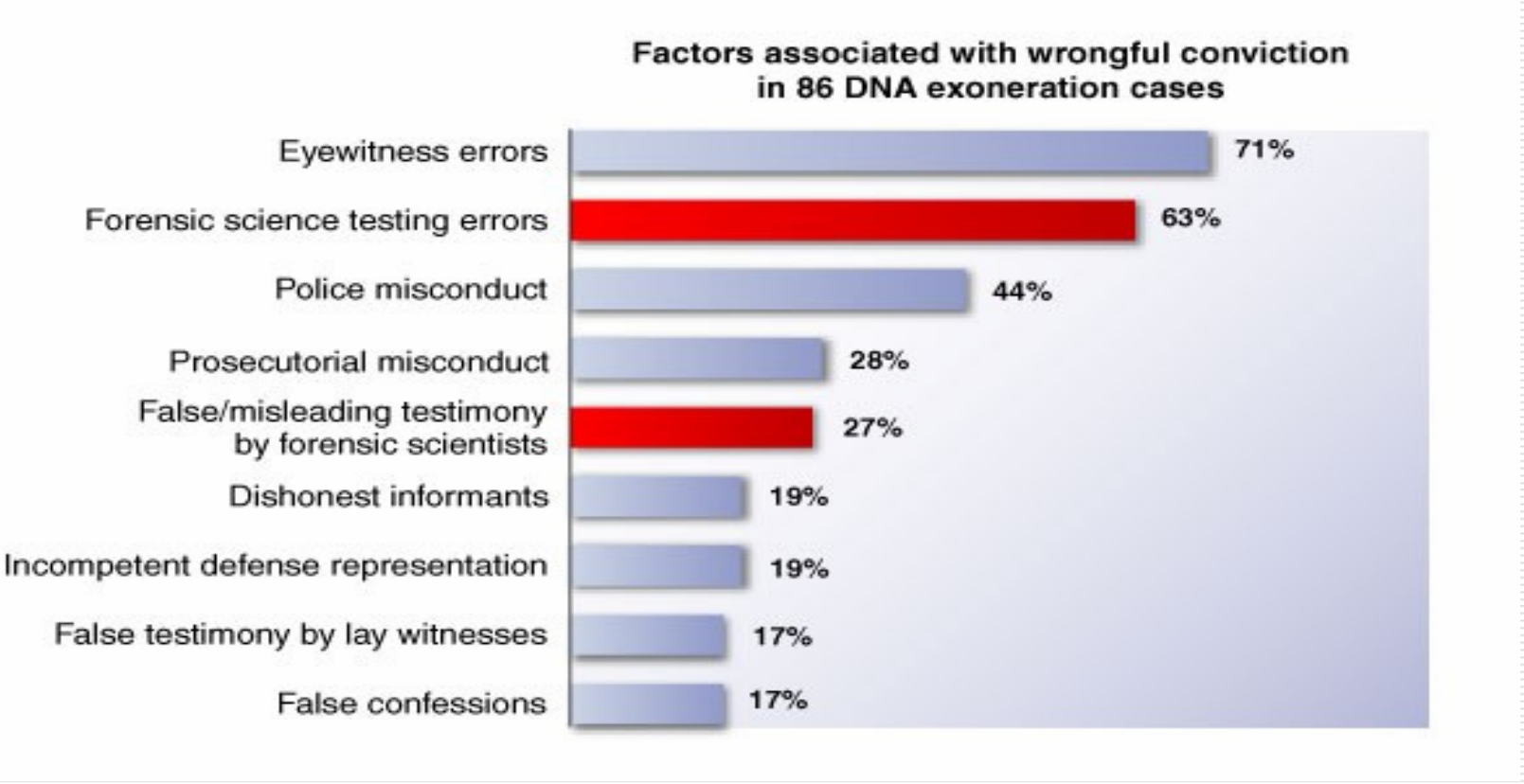
Forensic Scientists Make Errors

Source: Saks & Koehler, 309 *Science* 892 (2005)



Why Do Error Rates Matter?

Because the probative value of a reported association (or “match”) is restricted by the chance that a false positive error occurred

Error Rates by Area

Modality	Error Rate
Bitemarks	64%
Voice Identification	63%
Handwriting	40%
Hair	35%
Fingerprints (by person)	4% to 7%
Fingerprints (by sample)	0.6%
DNA (through 1998)	0.2% to 1.2%

Interpret these error rates with great caution …

Why the Caution?

- Because existing studies and tests were not designed to provide a reliable indication of error rates in the various forensic sciences
- Because the data are minimal (sometimes based on a single study)
- Because “error rate” can be defined in various ways

Hair Study—Microscopic Analysis vs. mtDNA

Source: Houck & Budowle, 47 *J. Forensic Sci.* 964 (2002)

Four Outcomes:

- Association
- Exclusion
- Inconclusive
- No Exam (samples unsuitable for testing)

Omitting Inconclusives and No Exams: N=95 hair pairs

Error Chart

***Source*: Koehler, 59 *Hastings L. J.* 1077 (2008)**

		State of Nature (i.e., Truth)	
		Same Source (association)	**Different Source (exclusion)**
Examiner's Judgment	**Association**	A True Positives	B False Positives
	Exclusion	C False Negatives	D True Negatives

False Negative Error: Examiner reports an exclusion between two items / marks when, in fact, they came from the same source.

$$= \frac{C}{A + C}$$

False Positive Error: Examiner reports an association between two items / marks when, in fact, they came from different sources.

$$= \frac{B}{B + D}$$

False Discovery Error Rate: Proportion of times examiner is wrong when he/she reports an association.

$$= \frac{B}{A + B}$$

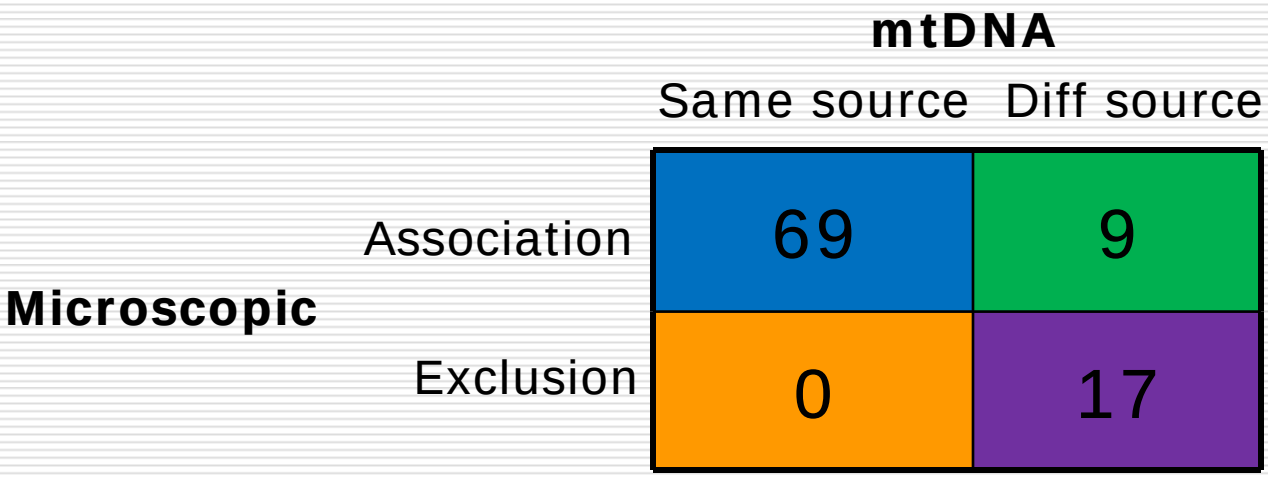
Hair Study: False Negative Rate

Microscopic	mtDNA: Same source	mtDNA: Diff source
Association	69	9
Exclusion	0	17

False negative error rate:

$$P(\text{Microscopic Exclusion} \mid \text{mtDNA Same Source}) = \frac{0}{0 + 69} = 0\%$$

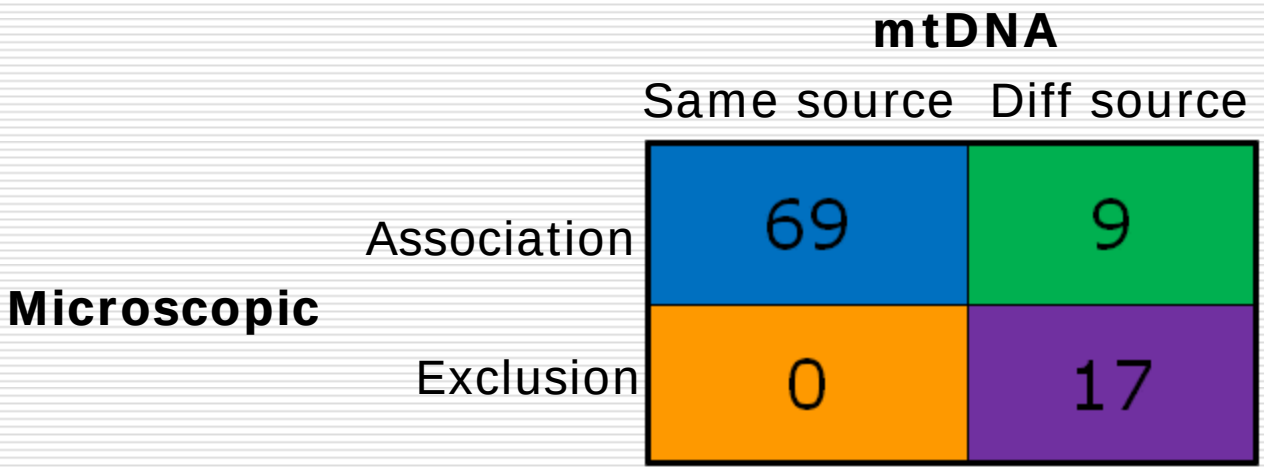
Hair Study: False Positive Rate



False positive error rate:

$$P(\text{Microscopic Association} \mid \text{mtDNA Diff Source}) = \frac{9}{9 + 17} = 35\%$$

Hair Study: False Discovery Rate



False discovery error rate:

$$P(\text{mtDNA Diff Source} \mid \text{Microscopic Association}) = \frac{9}{9 + 69} = 12\%$$

What Do We Need Right Now?

DATA

Specifically …

- We need proficiency test data that estimate error rates under various conditions

- Current Proficiency Tests
  - Internal
  - External: voluntary, infrequent
  - Open

- Future Proficiency Tests
  - Administrators: Disinterested
  - Participants: Representative of field (track experience)
  - Samples: Representative of case work (track difficulty)
  - Method: Blind