Lay Understanding of Forensic Science

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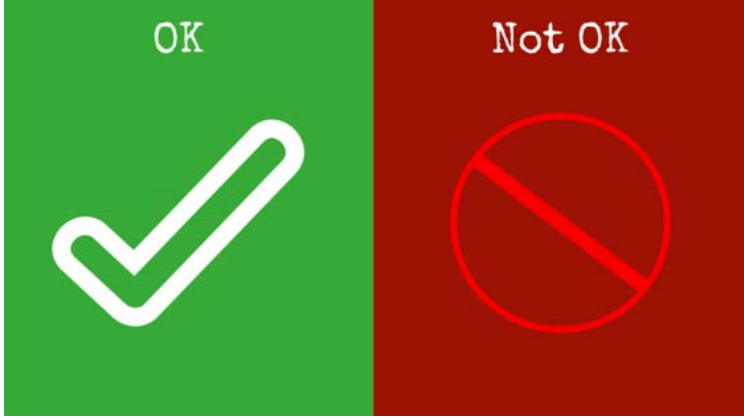
Research methods

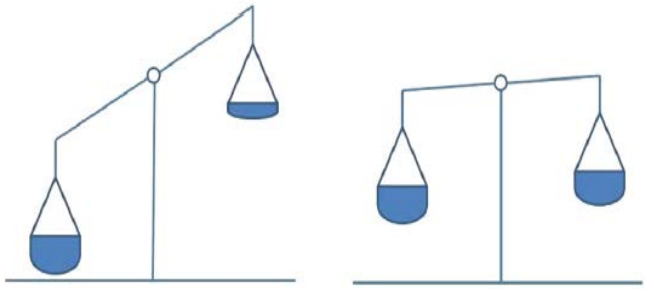
- Lay participants—jurors, online workers, students
- Trial simulations
  - Evaluate hypothetical criminal cases
  - With and without (or before and after receiving) forensic science evidence
- Evidentiary contests
  - Judge relative strength of two pieces of forensic science evidence
- Experimental variations
  - Strength/nature of forensic science evidence
  - Presentation format (e.g., quantitative or non-quantitative; RMP or LR)
  - Content of testimony; exhibits; graphics, etc.
- Key Issue—What kinds of presentations lead to the best understanding and most appropriate response?

What is an appropriate response?



- Sensitive to strength of the forensic evidence
- Logically coherent (e.g., updating in manner consistent with Bayes' rule)
- Avoids mistaken or fallacious interpretations

Sensitivity to Strength of Evidence



- People generally respond appropriately to variations in match probabilities
  - Give more weight to “non-exclusion” (match) when the RMP is lower
  - despite occasional confusion in evidentiary contests
- Mixed evidence on likelihood ratios
  - Early findings of insensitivity to likelihood ratios (e.g., Martire et al. 2013; 2014) have not generalized
- More research needed on verbal statements
  - Weight-of-evidence statements
  - Source probability statements

Sensitivity to Strength of Evidence

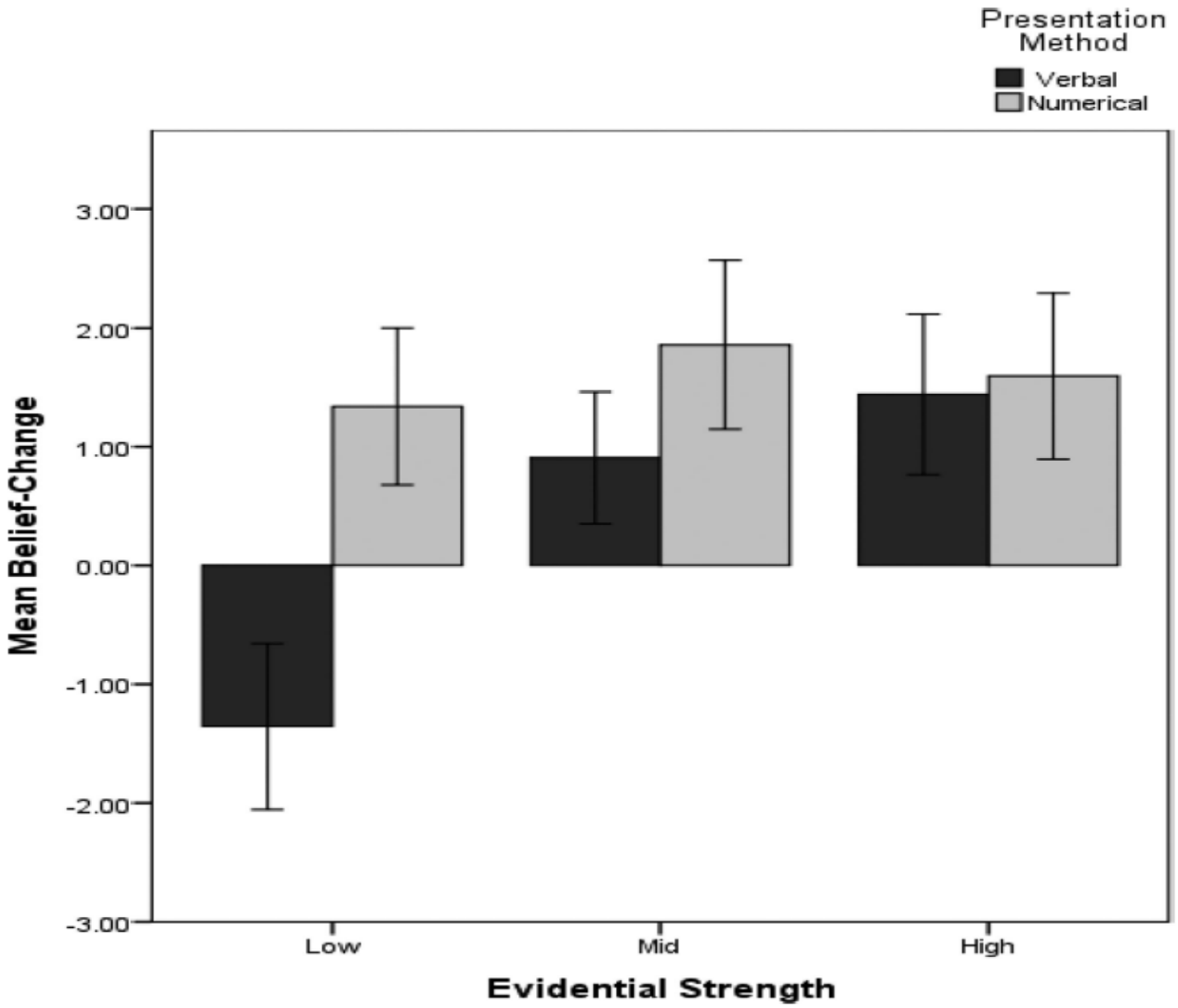
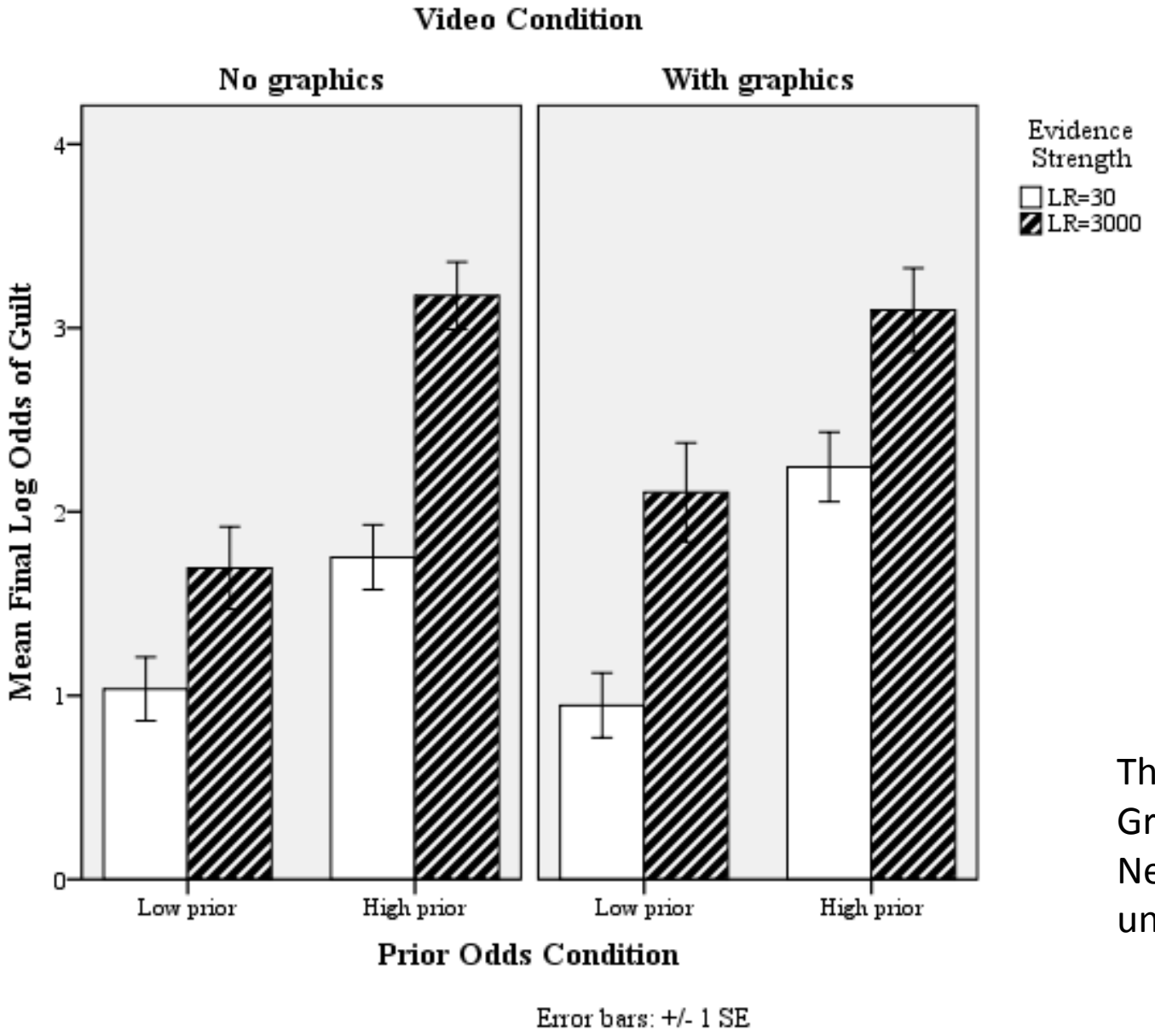


Figure 1. Mean adjusted belief change by presentation method and evidential strength (error bars ± 2 standard errors).

Martire et al. LHB (2013)



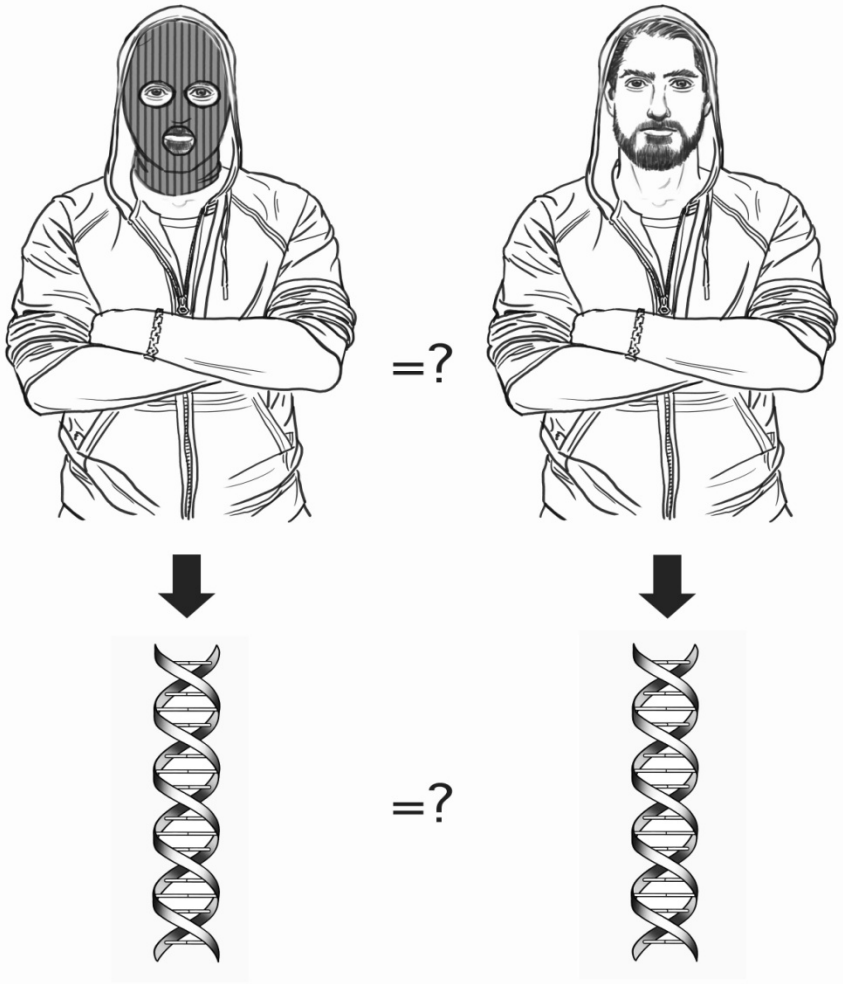
Thompson, Grady & Newman, unpublisehd.

Appropriate Weight?

- Under-weighting of forensic evidence (relative to Bayesian norms) has been widely reported
- But…
  - Bayesian models may not have captured all relevant variables
  - Measurement/calibration issues complicate analysis
  - Results appear to vary depending on context
    - E.g., evidence of over-weighting of DNA evidence (where potential for error is high)

Fallacious interpretations: a DNA example

A DNA profile thought to be from a criminal is found to match a suspect.



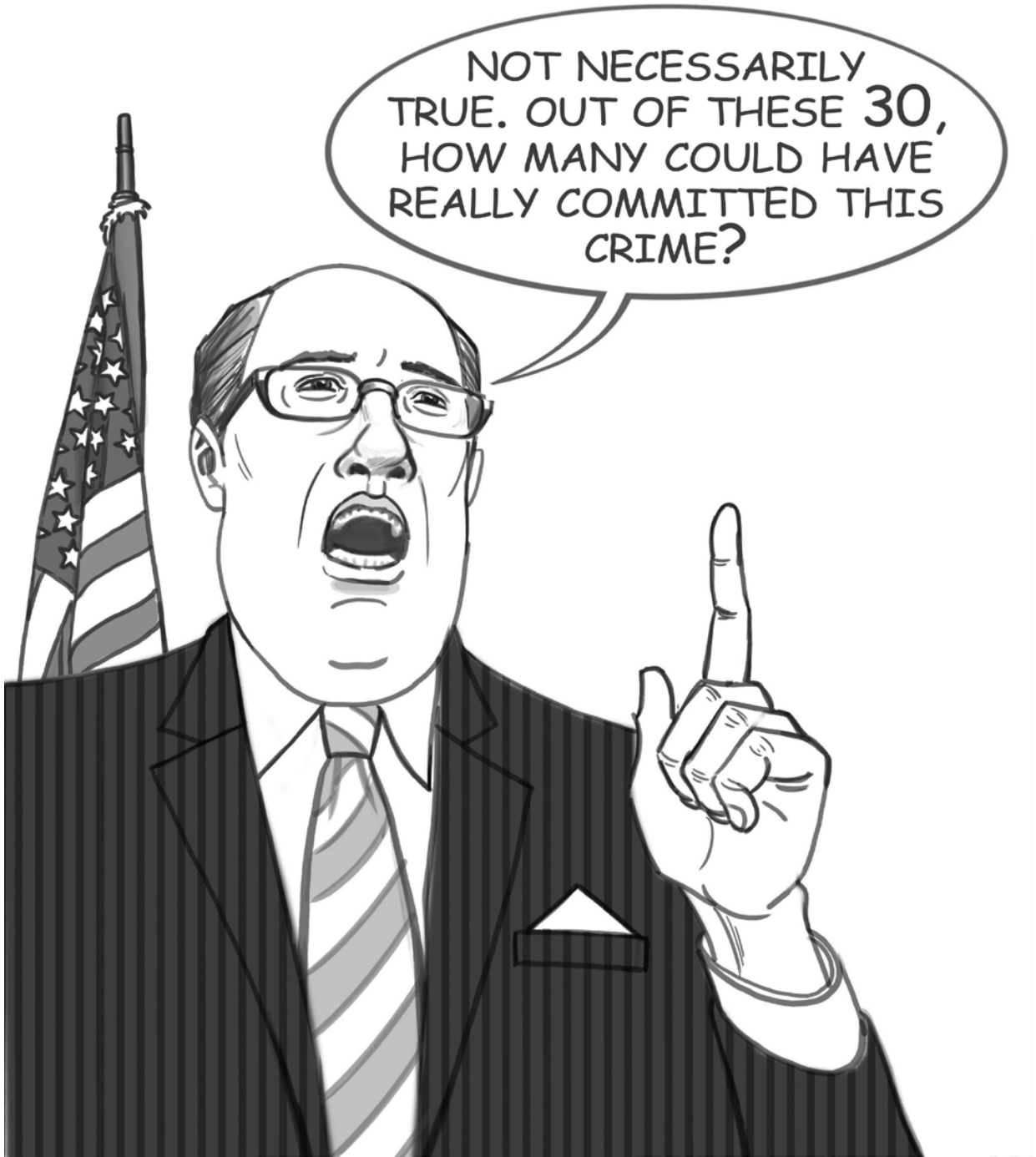
The DNA Expert Says:

Prosecutor's Fallacy

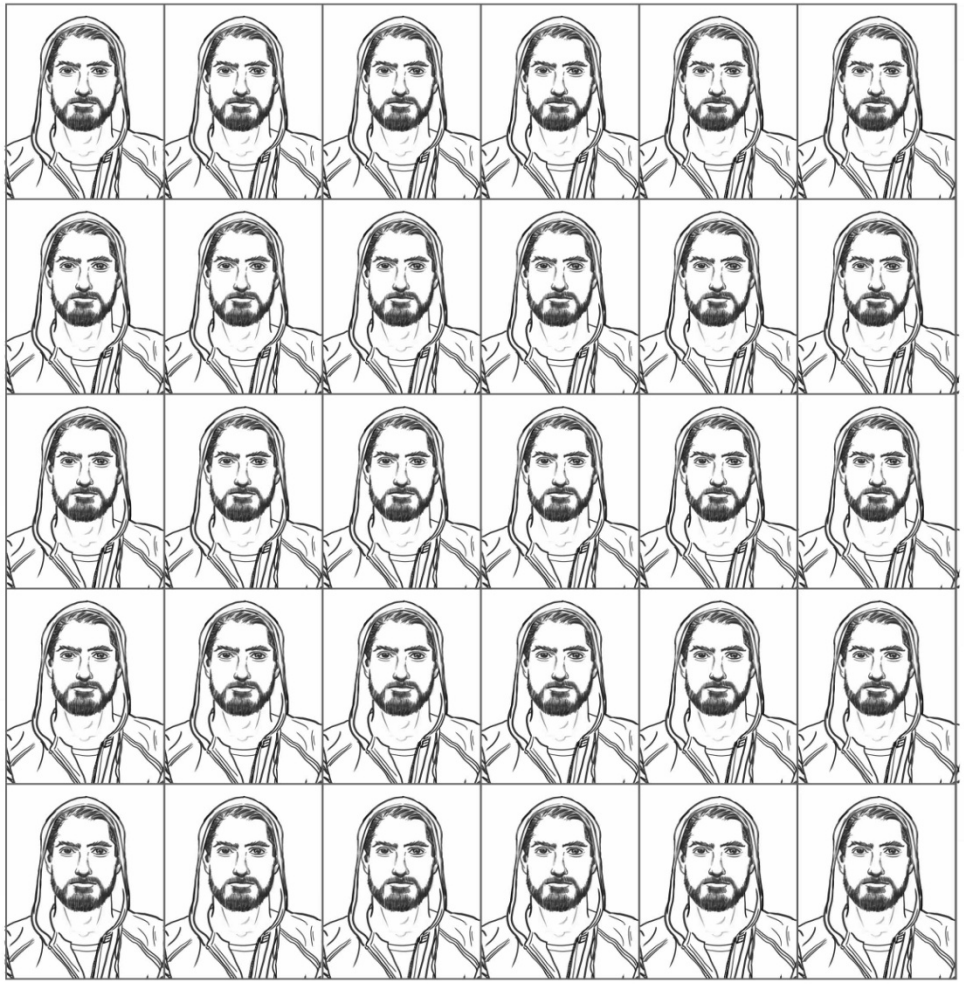
Explaining the Fallacy

Defense Attorney's Fallacy

That means there is only one chance in 30 that he is the source of the DNA!


NOT NECESSARILY TRUE. OUT OF THESE 30, HOW MANY COULD HAVE REALLY COMMITTED THIS CRIME?

Are all 30 plausible suspects?



What does the other evidence tell us?


You can’t tell how likely he is to be the source from the DNA evidence alone…
…you also have to consider the other evidence

Disjunction

What the expert can say *based on a scientific analysis*:

What the jury wants to know:

What's the probability it came from the defendant?

Table 1.
Percentage of subjects who endorsed the source probability error, defense attorney's fallacy, both errors or neither error and conviction rates, log change scores and implicit LRs within each group.

Error Endorsed	Percentage Endorsing Fallacy	Conviction Rate	Log Scale Change Score	Implicit LR
Source Probability Only	35.49% (192)	32.29% (62)	1.93 (3.19)	12.1 (22.18)
Defense Fallacy Only	17.93% (97)	3.09% (3)	1.14 (1.84)	3.09 (9.79)
Both Errors	28.10% (152)	5.26% (8)	1.26 (2.21)	1.4 (.58)
Neither Error	12.20% (66)	15.15% (10)	1.46 (3.25)	4.12 (10.91)

Thompson & Newman, *Law & Human Behavior*, 2015.

Do you want my opinion on whether the suspect is the source…

…if that requires me to evaluate (or make assumptions) about all the other evidence in the case?

Forensic Science Conclusions

Require evaluation of (or assumptions about) strength of non-scientific evidence

- Source probabilities
- Verbal statements about likelihood of common source
- Identification (when expert considers size of suspect population)

Can be based solely on evaluation of physical evidence

- Likelihood ratios
- Verbal statements about weight of evidence
- Verbal statements about strength of support for a hypothesis or proposition

Perceived strength of statements about a shared DNA profile

LR –"10 million times more likely" [if same source]	76%
RMP-"1 in 10 million"	74%
Weight of Evidence -"Extremely Strong Support" [for same source]	64%
"was the source"	60%
LR—"100,000 times more likely"	58%
RMP—"1 in 100,000"	52%
Weight of Evidence—"very strong support"	51%
Source probability--"highly probable was the source"	28%
"Could have been the source"	7%

- Categories with different shading differ significantly, $p<0.05$.

Perceived strength of statements about a fingerprint comparison

Practically certain same source	82%
RMP=1 in 100,000	74%
Extremely strong support for same source	74%
Highly probable same source	63%
RMP=1 in 1000	51%
Moderately probable same source	36%
Moderate Support for same source	36%
RMP=1 in 10	20%
Weak support for same source	13%

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Standards for Numerical and Verbal Expression of Likelihood Ratios (Association of Forensic Science Providers, 2009)

Recommended likelihood ratio terminology

Numerical expression	Verbal expression (support)
> 1–10	Weak or limited
10–100	Moderate
100–1,000	Moderately strong
1,000–10,000	Strong
10,000–1,000,000	Very strong
> 1,000,000	Extremely strong

Perceived strength of statements about a fingerprint comparison

Match	79.6[a]
1 in 10 million	77.6[a]
Identified	63.0[b]
1 in 100,000	56.2[b]
Individualized	54.3[b]
Extremely strong support	40.7[c]
Extremely law likelihood of correspondence (Army)	29.3[d]
1 in 1000	27.9[e]
Highly probable	21.5[e]

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