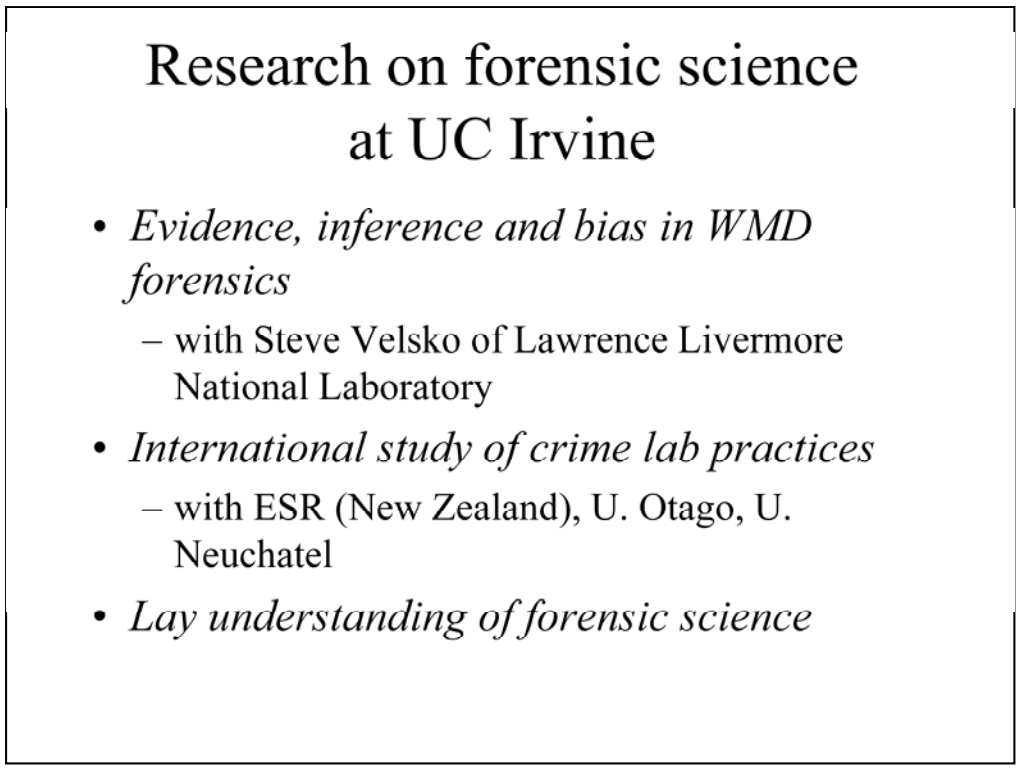
Minimizing Contextual Bias in Forensic Science

William C. Thompson
University of California, Irvine
National Commission on Forensic Science—August 26, 2014



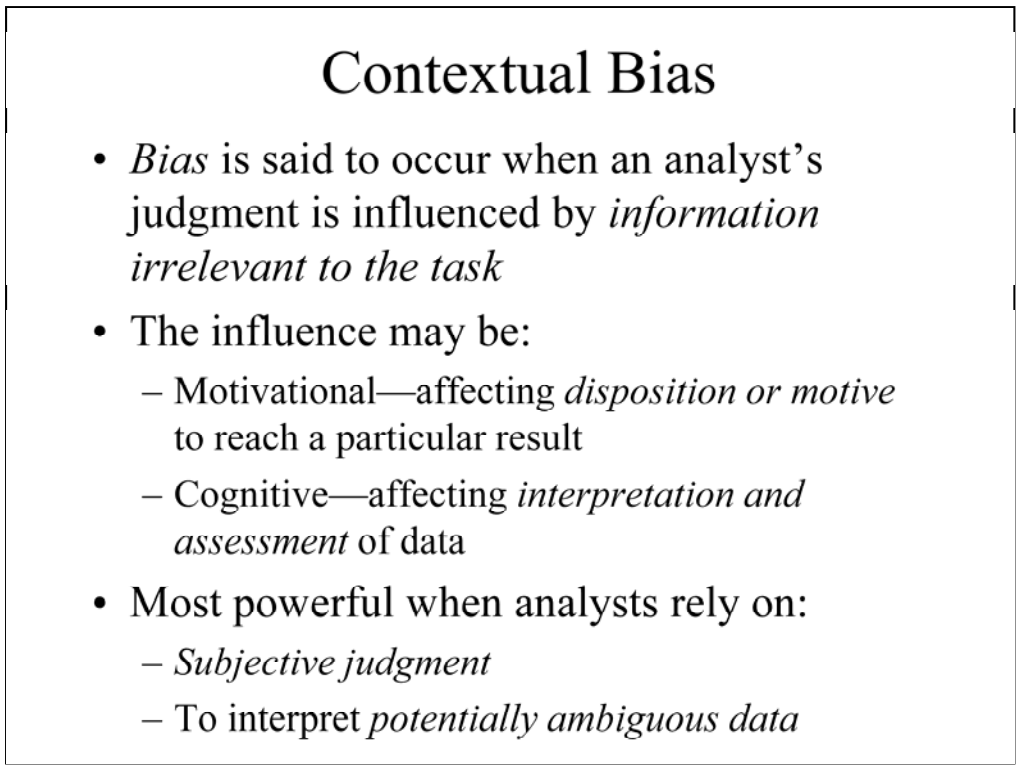
I am an academic psychologist. I study human judgment and decision making and I have been particularly interested in the production and use of forensic science.

I am also a lawyer. I have litigated a number of cases involving contested forensic evidence.

My research group at UC Irvine is currently engaged in three lines of research on forensic science. First, we are collaborating with researchers from Lawrence Livermore National Lab on a study of problems of inference and bias in national security investigations involving forensic science, particularly those involving weapons of mass destruction. (The project is funded by the UC Lab Fees Research Fund). We are conducting interviews and reviewing historic episodes in order to trace the roots of investigative errors. Contextual bias is emerging as an important theme in this research. I think there is much to be learned from a comparison of how National Laboratories and crime laboratories view and address this issue.

Second, I am collaborating with researchers from several countries on an international study of how crime laboratories view and are addressing the issue of contextual bias. We are seeking NIJ funding for this research. We think a close examination of actual laboratory practices will help address questions about the practicality of various methods for addressing contextual bias.

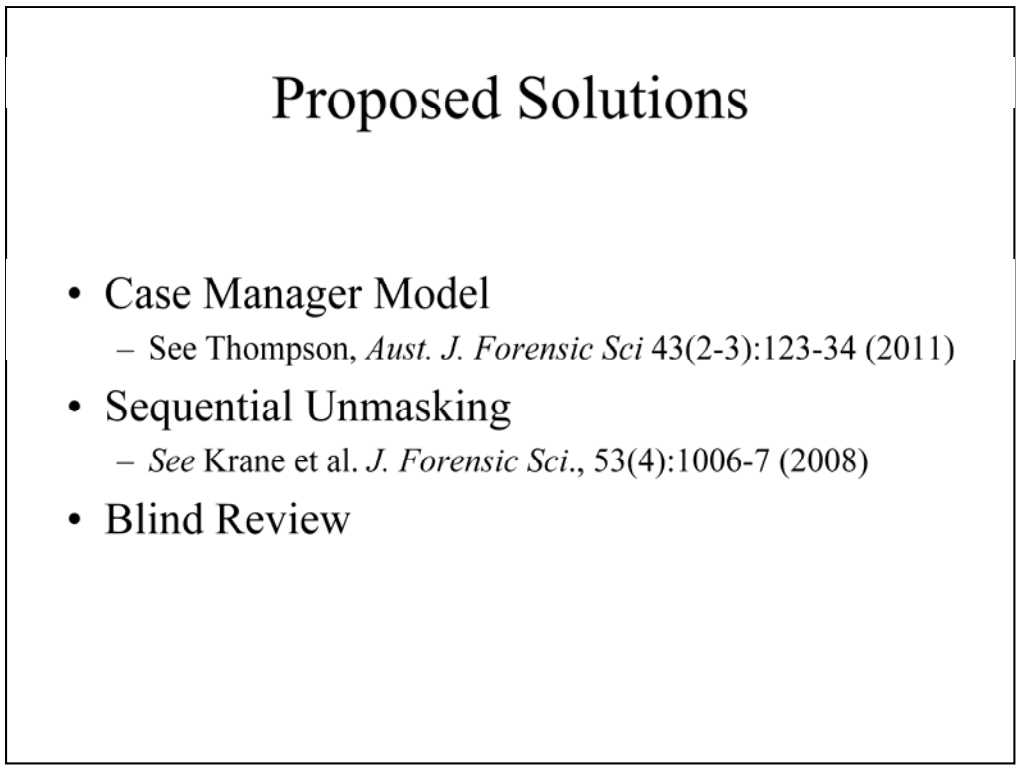
Third, we have an active program of research that looks at how lay people (such as jurors) respond to forensic science evidence as a function of how it is presented and explained.



In order to talk about contextual bias, we need to discuss which aspects of the surrounding context a forensic scientist should and should not consider when making a forensic assessment. *Bias*, as I use that term here, arises when the forensic scientist is influenced by contextual information that *should not be considered* because it is irrelevant to the scientific task.

Bias can occur without conscious awareness and may arise from both motivational and cognitive mechanisms. It is a well-known human tendency to interpret data in a manner consistent with one's expectations and desires.

Contextual bias is less likely to be a factor when the data being examined are clear-cut or where standards exist that allow a single possible interpretation in each instance. It is more likely to be important when the data to be interpreted are potentially ambiguous or subject to more than one possible interpretation, and where analysts must rely more heavily on subjective judgment based on general knowledge, training and experience.



Case manager (a *trained forensic scientist*)

- Communicates with police
- Participates in decisions about collection, testing
- Manages work flow to Analyst

Analyst (*another* trained forensic scientist)

- Performs analytic tests and comparisons
- While blind to any information *unnecessary to the analysis*
- Prepares a written report

The same individual can perform both roles, but *not in the same case.*

Sequential Unmasking

See Krane et al. *J. Forensic Sci*., 53(4):1006-7 (2008), and subsequent commentary

Analysis/interpretations of evidentiary samples is performed *and documented*, as far as possible, before analyst is made aware of characteristics of reference samples

Information about reference samples is *unmasked* only when needed to complete the comparison

Blind Case Review

Critical judgments are replicated by a second analyst

Who is blind to unnecessary contextual information

Who has no expectations regarding outcome

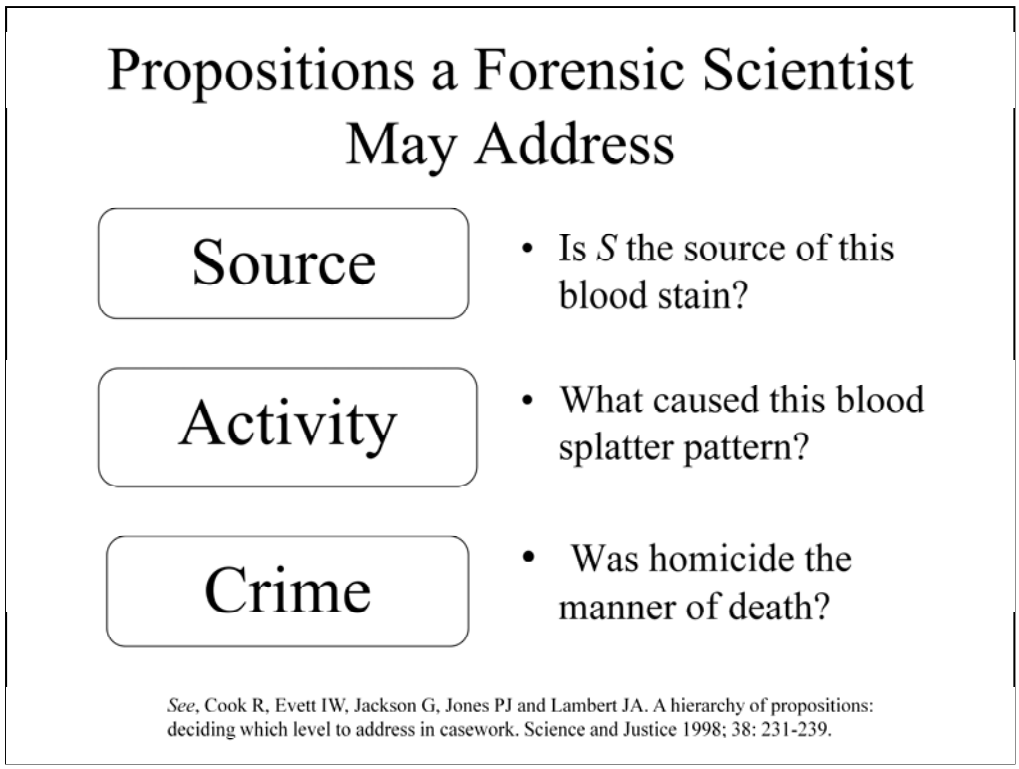
"I called this a match, what do you think Joe?" is probably not good enough

But how do we decide what is *task-relevant*?

Will efforts to shield analysts from potentially biasing contextual information deprive them of information they need to do their jobs?

Is it possible to draw a sharp analytic distinction between information that is *task-relevant* and *task-irrelevant* in forensic science?

If we cannot draw a sharp analytic distinction between task-relevant and task-irrelevant information, then efforts to reduce the influence of task-irrelevant information are likely to founder.



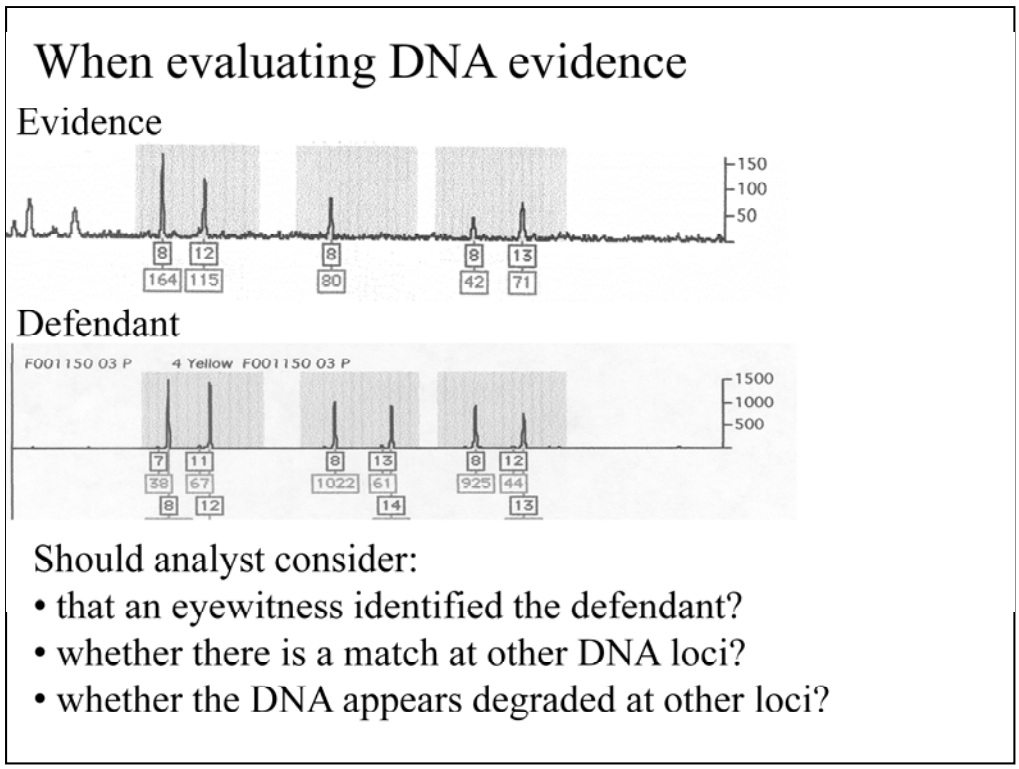
Most forensic scientists confine themselves to opining on source level propositions. The issue of whether a crime occurred, and what crime it was, is a matter for the legal system (judge or jury) rather than a forensic scientist. An exception is the medical examiner who is sometimes asked to make an independent determination of both cause and manner of death.

Criterion for Task-Relevance

Information is *task-relevant* if (and only if) it affects the conditional probability (under the relevant propositions) of the data the expert will evaluate.

Information that affects the probability that a relevant proposition is true, but not the conditional probability of the data under that proposition, is *task-irrelevant*.

I believe this definition of task-relevance is vitally important, but it is a bit technical an abstract. So I will explain it through some examples.



Here are DNA profiles from an evidentiary sample in a sexual assault case and from a criminal defendant. Could the defendant be the source of the evidentiary sample? Notice that one of the defendant's alleles was not detected in the evidentiary profile. Is this a true genetic difference (indicating the defendant was not the source)? Or did the discrepancy arise from "allelic dropout" (which can occur when the underlying DNA is degraded or insufficient in quantity)?

The analyst must make a subjective judgment based on data that are somewhat ambiguous (in that reasonable experts have differed in their interpretations).

A DNA analyst from a major laboratory recently told me that disagreements among analysts about issues of interpretation arise in about 10 percent of their cases (typically in cases involving mixed samples or samples with limited or degraded DNA). Thus, even with the best validated form of forensic science evidence, there can be ambiguities that analysts must resolve through the use of subjective judgment. This is the very situation in which we expect the effects of contextual bias to be most influential.

But what types of information are task-irrelevant and therefore potentially biasing? And which types constitute task-relevant information that the analyst may properly consider?

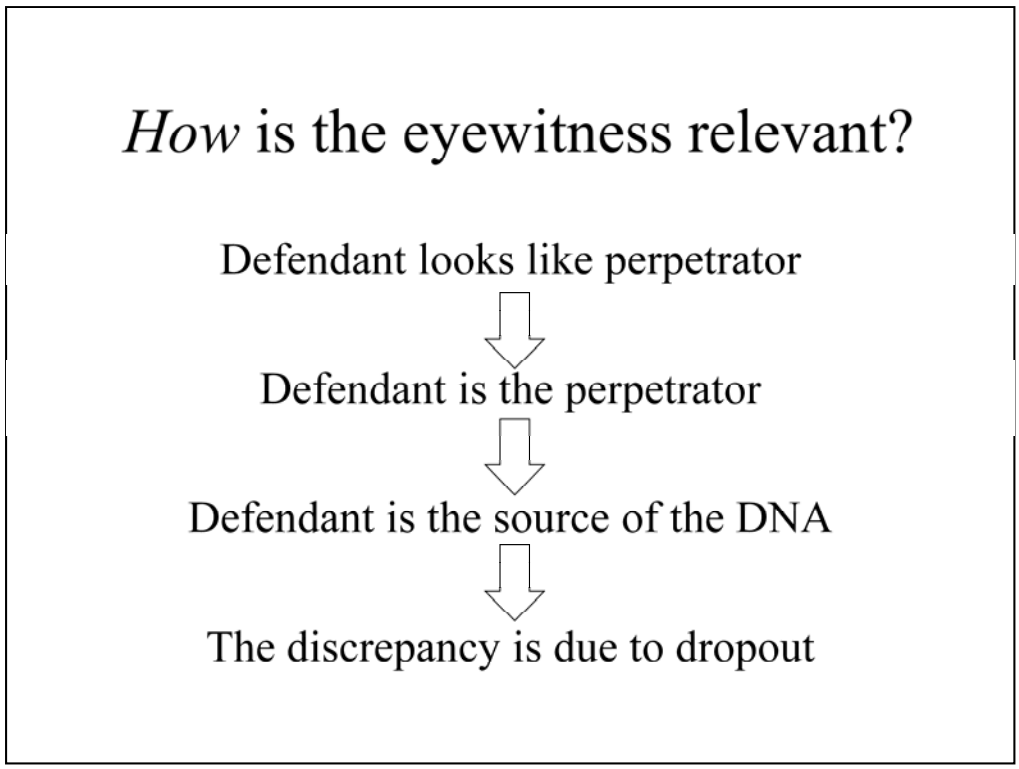
Rule 401 (Federal Rules of Evidence)

Evidence is relevant if:

(a) it has any tendency to make a fact more or less probable than it would be without the evidence; and

(b) the fact is of consequence in determining the action.

All of the information mention would be relevant to a juror under the Federal Rules. We must distinguish what is relevant for the jury from what is task-relevant for the analyst. One might think of this as distinguishing legal relevance from scientific relevance.

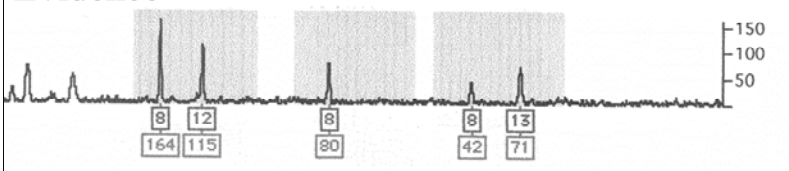


Consider the line of reasoning that links the eyewitness evidence to the assessment of the DNA evidence. Notice that it requires the DNA analyst to reason "backward" from an assessment of the defendant's guilt to an assessment of the DNA evidence. This kind of reasoning might well be reasonable for a juror who is trying to make sense of the entire case. But I will argue that it is entirely inappropriate for a forensic scientist who purports to perform an independent scientific assessment of the evidence.

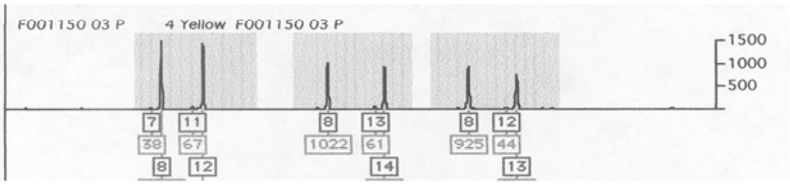
The forensic scientist is not in a good position to assess the other evidence in the case and has no business doing so. Moreover, the legal system expects that the forensic scientist's conclusions will stem from an assessment of the scientific evidence, not from consideration of other evidence in the case. The jurors may not realize that the expert is basing his or her conclusions in part on evidence the jury has already considered, which creates the potential for double-counting. More importantly, it allows the forensic assessment to be influenced (tainted) by other evidence, undermining its independence.

When evaluating consistency of DNA profiles

Evidence

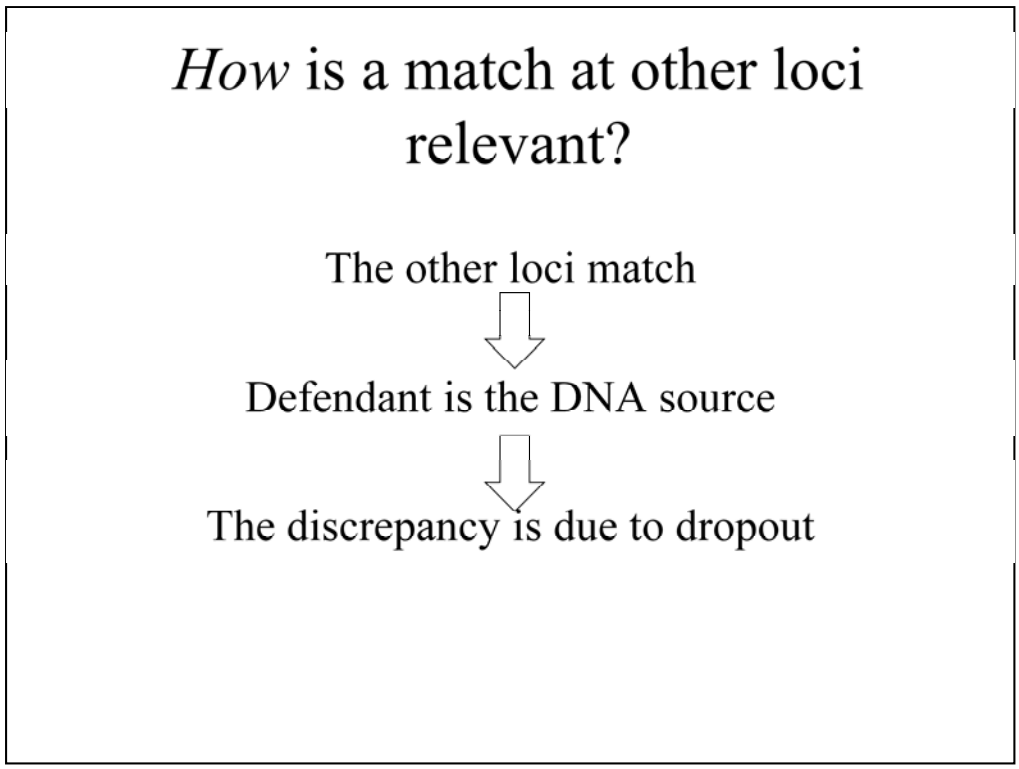


Defendant



Should analyst consider:

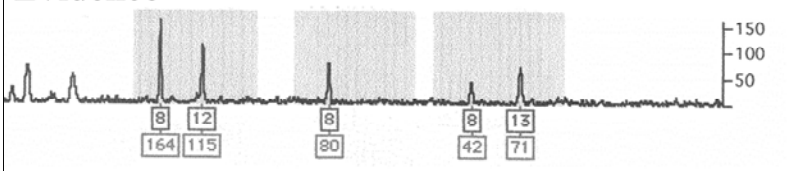
- that an eyewitness identified the defendant?
- whether there is a match at other DNA loci?
- whether the DNA appears degraded at other loci?



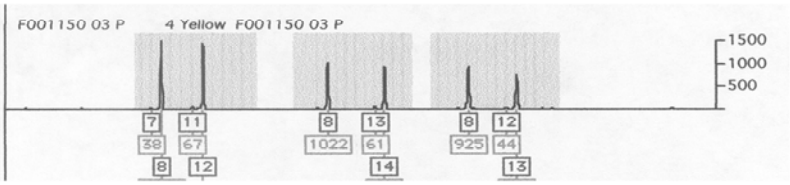
The same kind of backward reasoning is invoked when the analyst's judgments about the discrepancy between the profiles is influenced by whether the defendant matches at the other loci.

When evaluating consistency of DNA profiles

Evidence

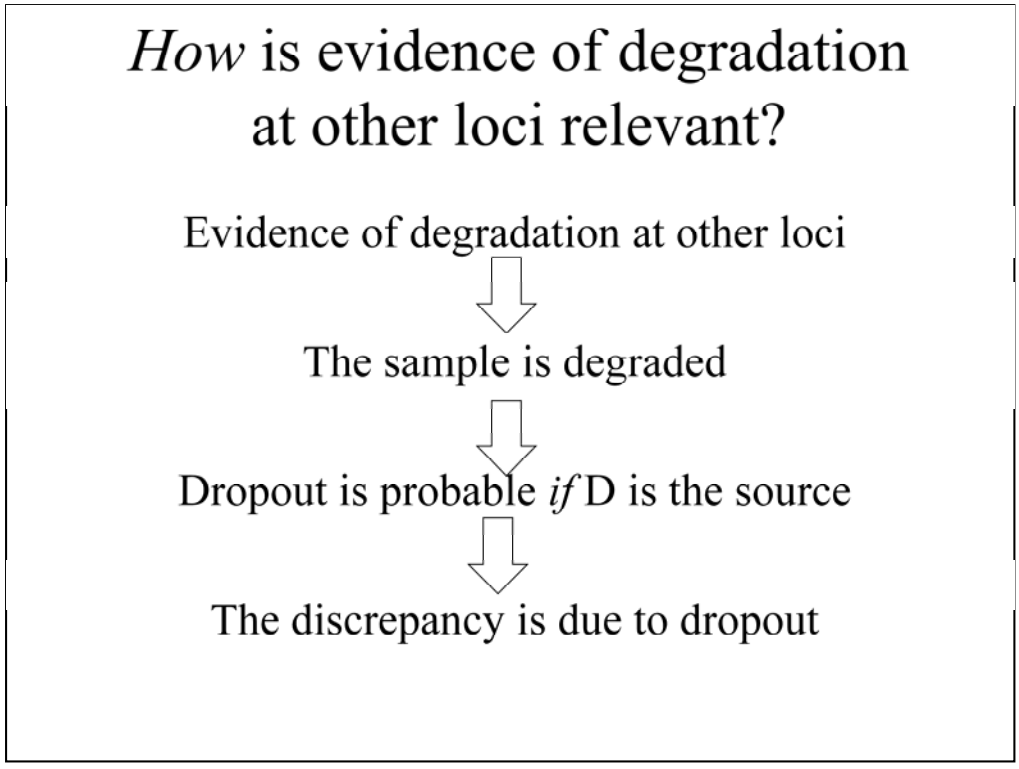


Defendant

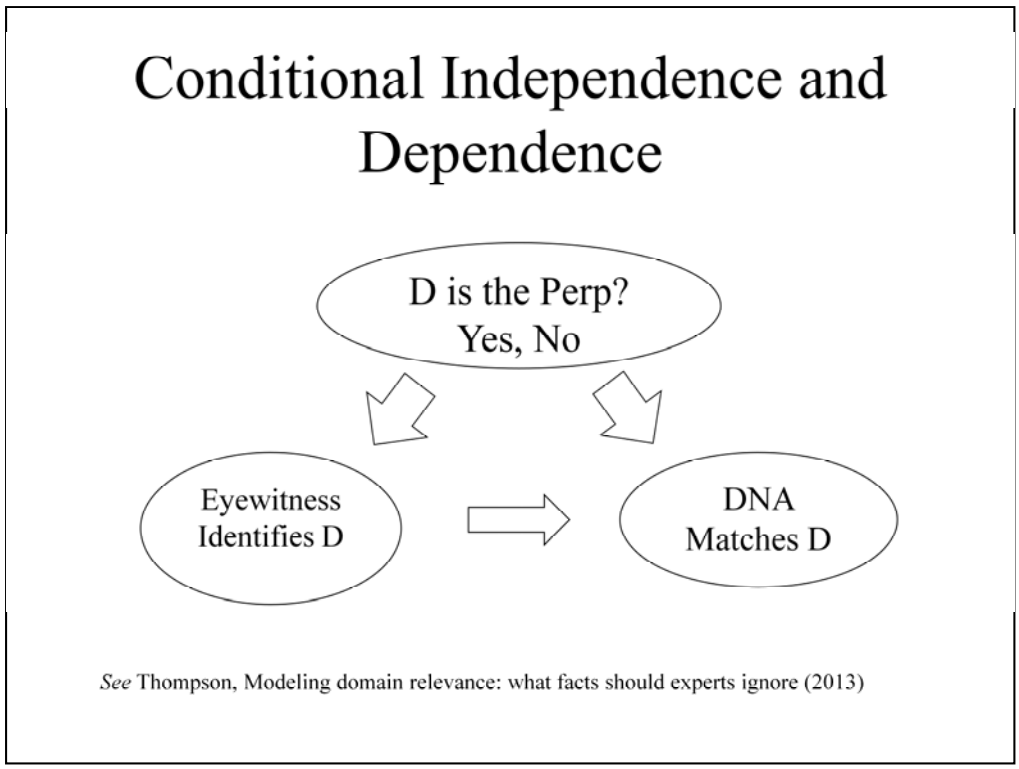


Should analyst consider:

- that an eyewitness identified the defendant?
- whether there is a match at other DNA loci?
- whether the DNA appears degraded at other loci?



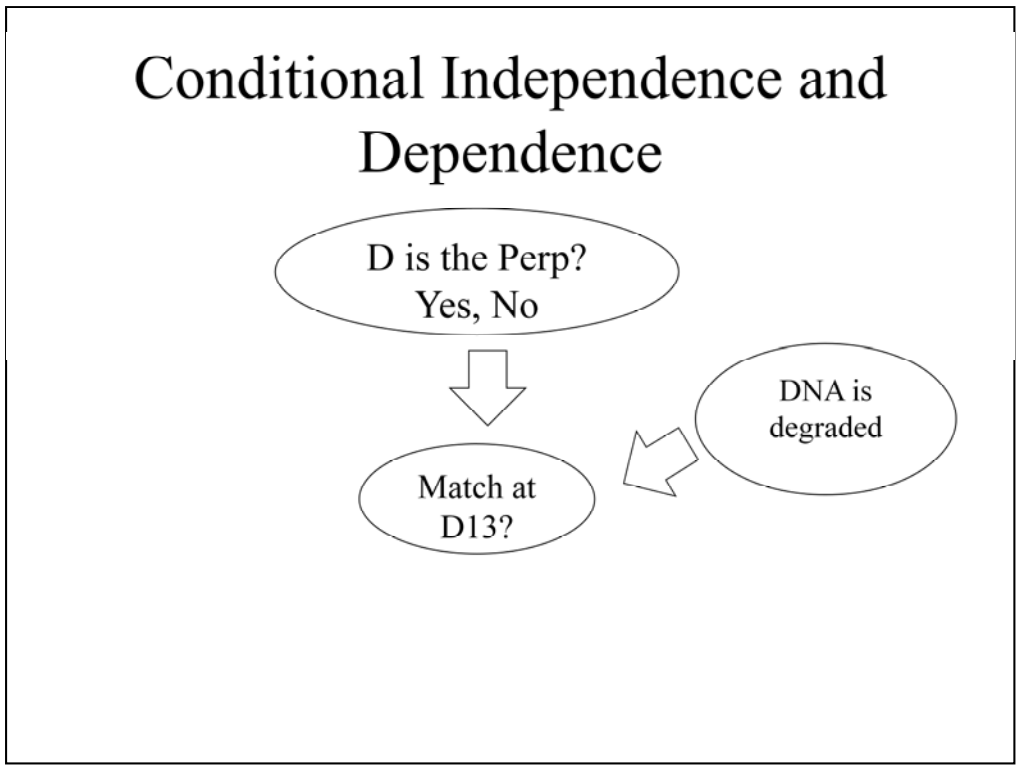
But this line of inference is different. It does not require the analyst to draw conclusions about the probability the defendant is the source. The analyst's judgment rests solely on information within the scientific domain (DNA degradation) and does not depend on the analyst's assessment of the overall likelihood the defendant is the source.



People who study human inference often use diagrams called Bayes nets to illustrate the logical connections between various propositions under consideration. The basic proposition under consideration by the jury is whether the defendant is the perpetrator of the crime. The arrow from this proposition to the eyewitness identification indicates that the eyewitness evidence is probative—we expect an eyewitness identification to be more likely if the defendant is the perpetrator. Similarly, we expect a DNA match to be more likely if the defendant is the perpetrator. But notice there is no arrow from the eyewitness to the DNA match. The two pieced of evidence are said to be conditionally independent.

But when the analyst takes the eyewitness identification into account when evaluating the DNA, that independence is destroyed. The two pieces of evidence are now conditionally dependent.

In a conference paper in the background readings, I use Bayes nets to model the effects of a DNA analyst taking account of eyewitness evidence in a case like this one. The models paint a compelling picture of what happens to the probative value of the forensic evidence when the analyst is influenced by information that would otherwise be conditionally independent. Under all reasonable assumptions about how the influence would work, the probative value of the forensic evidence is reduced, lessening its value for the jury, when the analyst is influenced by the eyewitness.



By contrast, the value of the forensic evidence for the jury is always enhanced, never diminished, when the analyst considers domain-relevant information like the degradation of the DNA.

The Criminalist's Paradox

- By considering "task-irrelevant" information the analyst becomes more likely to reach the correct conclusion
- But undermines the probative value of the conclusion reached
- By helping themselves be "right," analysts may increase chances the justice system will go wrong.

Possible Solution

- How can analysts consider whether the DNA is degraded at other loci (task-relevant) without knowing whether the DNA matches at other loci (task-irrelevant)?
  - See, Krane et al., (2008) Sequential unmasking: a means of minimizing observer effects in forensic DNA interpretation. J Forensic Sci;53(4):1006–7.

The analyst must evaluate the evidentiary DNA sample, assess its level of degradation and the probability of allelic dropout, before knowing the defendant's DNA profile. That way the critical scientific determinations cannot be influenced by backward reasoning.

Blinding Regimes

WMD Forensics

- Efforts to insulate technical analysts from "task-irrelevant" information, including results of other forms of technical analysis
- Technical and investigative information integrated by "all source analysts."

Crime Laboratories

- Analysts often exposes to "task-irrelevant" information
  - Participation in investigations
  - Communications with investigators

Exposure to Task-Irrelevant Information

From crime lab notes:

- *"D. Aboto [prosecutor] left msg. stating this S. is suspected in other rapes but they cant find the V. Need this case to put S away."*
- *"Suspect-known crip gang member--keeps 'skating' on charges-never serves time. This robbery he gets hit in head with bar stool--left blood trail. Miller [deputy DA] wants to connect this guy to scene w/DNA …"*
- *"We need you to match [this latent print] to our crook right away because he is about to leave the country"*

Emotional involvement with cases

DNA Lab Notes (*Commonwealth v. Davis*)

- *"I asked how they got their suspect. He is a convicted rapist and the MO matches the former rape…The suspect was recently released from prison and works in the same building as the victim…She was afraid of him. Also his demeanor was suspicious when they brought him in for questioning…He also fits the general description of the man witnesses saw leaving the area on the night they think she died…So, I said, you basically have nothing to connect him directly with the murder (unless we find his DNA). He said yes."*

Use of task-irrelevant information

Testimony of David Senn in *NY v. Dean*, 2012, RT p. 87:

[After examining a bite mark] …[i]f I then found that DNA [evidence] came back as not excluding that same person, my confidence level would increase. I might be willing to upgrade my opinion from cannot exclude to probable….Now, many odontologists say you shouldn't have any awareness of the DNA results compared to the bite mark…but if I subsequently get them, then I reserve the right to write a revised opinion. And I have done that.

Can forensic scientists ignore task-irrelevant information (if they try)?

- I reject the insinuation that we do not have the wit or the intellectual capacity to deal with bias, of whatever sort. If we are unable to acknowledge and compensate for bias, we have no business in our profession to begin with, and certainly no legitimate plea to the indulgence of the legal system .
  – John Thornton, *J.Forensic Sciences* (2010).

Is the solution just to tell forensic scientists to ignore task-irrelevant information and trust that they are capable of doing so because they are professionals?

Response to Thornton

"Let us be clear. We are not ''insinuating'' that forensic scientists lack this intellectual capacity; we are asserting that it is a proven and well-accepted scientific fact that all human beings, including forensic scientists, lack this capacity."

(Thompson et al. Response to Thornton, *JFS* 2010)

The “bias blind spot” and “introspection illusion”

- People often believe they were influenced by factors that did not affect their judgments,
- and believe they were *not* influenced by factors that *did* affect their judgments.
- So they cannot reliably compensate for their own biases

Contextual bias is recognized and addressed in most areas of science

- Prevalence of blind and double-blind procedures *whenever an important determination rests on subjective judgment*
- Examples from Astronomy to Zoology
- Failure to address observer effects called a *hallmark of junk science*
  - Peter Huber, *Galileo's Revenge: Junk Science in the Courtroom* (1991)

Recommendations for the Commission

1. Issue a statement of principles on the issue of contextual bias

- Three suggested principles:
  - When drawing scientific conclusions, forensic scientists should rely solely on *task-relevant* information.
  - Forensic scientists should shield themselves from *task-irrelevant* information when making judgments that require subjective assessment of potentially ambiguous evidence.
  - When task-relevant information is potentially biasing, it should be disclosed to the analyst at a time and manner designed to minimize its biasing potential.

Recommendations for the Commission

2. Ask the Forensic Science Standards Board (of OSAC) to work with its Scientific Area Committees (with guidance form the Human Factors Committee) to implement the principles articulated by the Commission.

Tasks for OSAC

The Scientific Area Committees to (with advice of the Human Factors Committee) should:

- Determine what information is task-relevant and task-irrelevant for common tasks in each domain of forensic science
- Determine the best ways to shield analysts from task-irrelevant information when making critical judgments in each domain
- Develop standards and model protocols for addressing contextual bias

Thank you

Email:
william.thompson@uci.edu