2012 Mixture Interpretation Workshop:

Mixtures **U**sing *SOUND* **S**tatistics, **I**nterpretation, & **C**onclusions

Mixtures and Court

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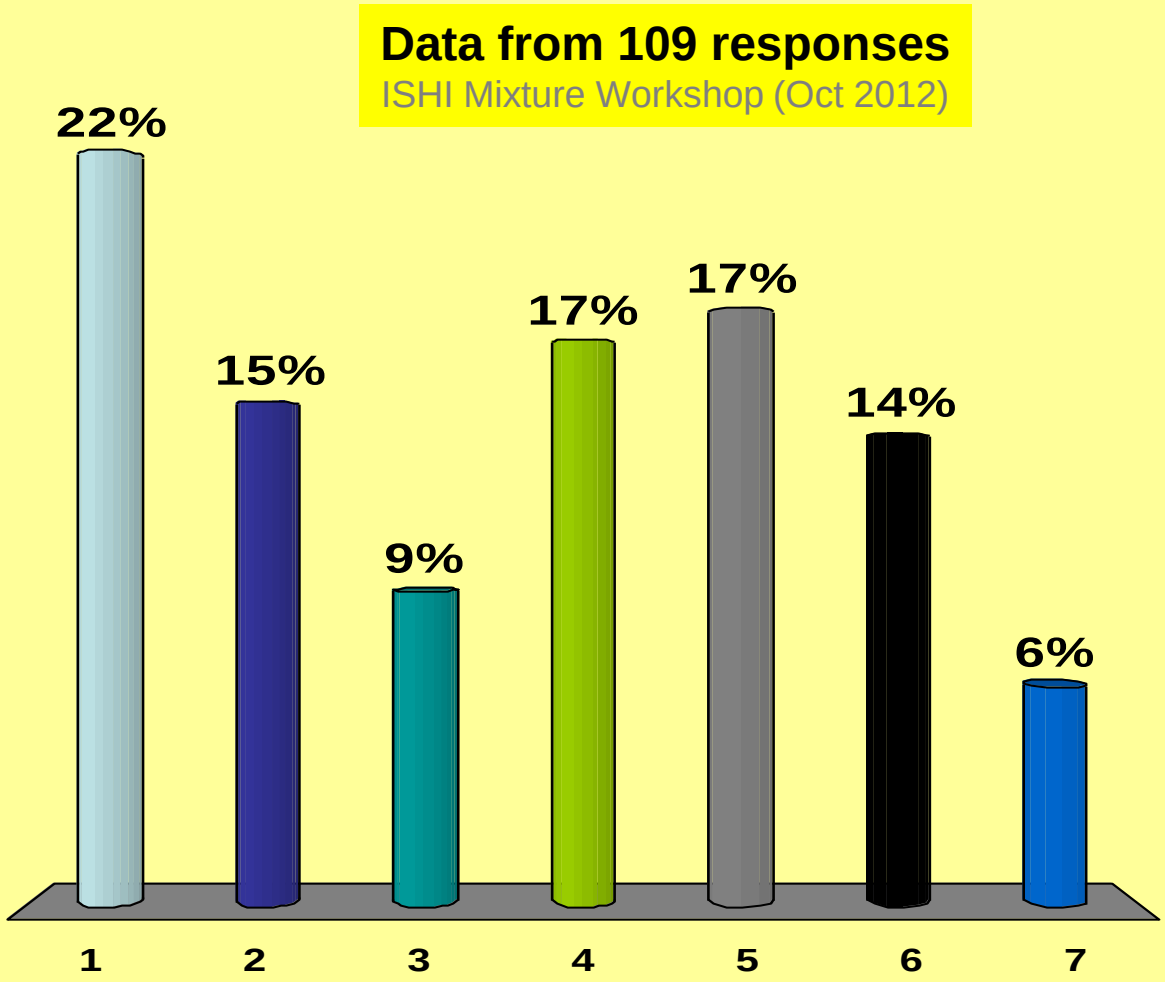
NIST

I have testified in court ____ times:

1. None
2. 1-5
3. 6-10
4. 11-20
5. 21-50
6. 51-100
7. >100



Outline for Session

- General court testimony
  - Credibility
  - Why is testimony hard
  - What makes you nervous
  - How to prepare yourself and the attorney
- Topics
  - Mixtures
  - Statistics
  - Inconclusive results
- Questions & discussion

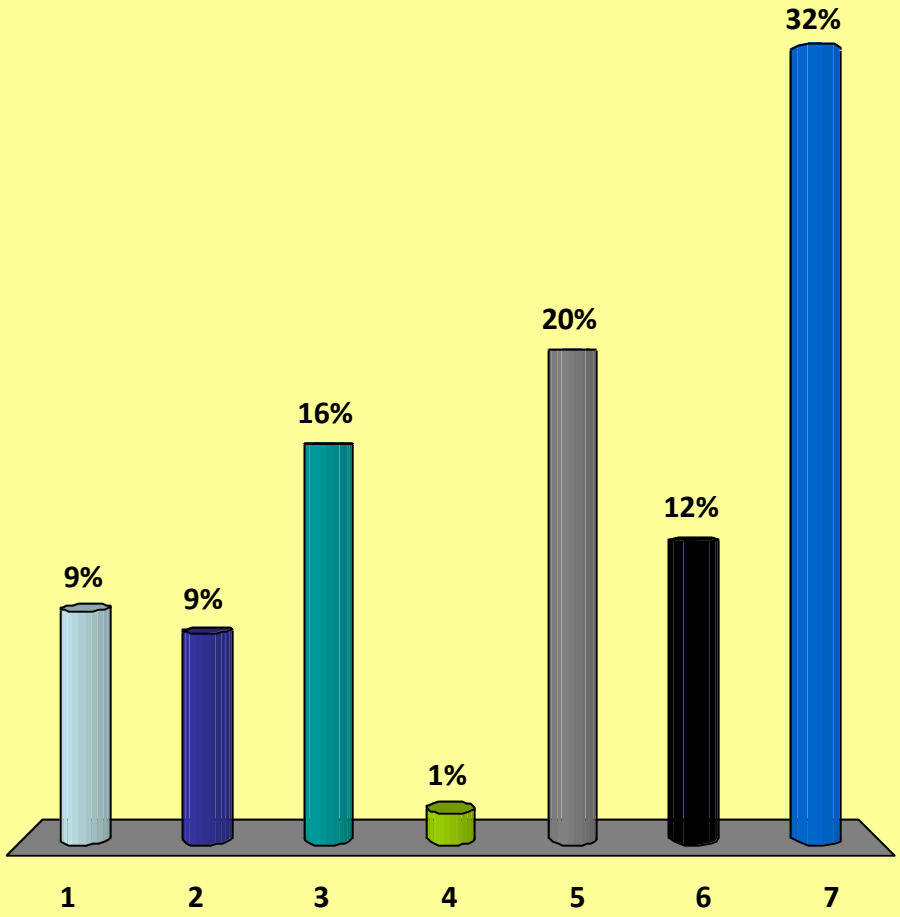
Role of an Expert Witness

- Educate the jury regarding the testing conducted and the results and conclusions of that testing.
- Answer all questions asked by the attorneys or the judge that you have the expertise to answer.
- Maintain position as a neutral participant.

Which would you rank as the **three** most important contributions to making your testimony credible?

1. Appearance & demeanor "your blue suit"
2. Educational background
3. Years of forensic DNA experience
4. Number of times qualified as an expert witness
5. Your level of confidence
6. Your use & understanding of scientific terminology
7. Your answers to questions using simple understandable language

Data from 306 total responses
ISHI Mixture Workshop (Oct 2012)



Let's consider a recent publication in the journal: Behavioral Sciences and the Law from 2010

- The Witness Credibility Scale: an Outcome Measure for Expert Witness Research by S.L. Brodsky, M.P. Griffin, and R.J. Cramer
  - 264 study participants rated simulated expert testimony (direct and cross) using 41 items
  - Each item consisted of 1 to 10 rating scale of paired adjectives such as "uninformed" - "informed"
  - From their original data they developed a 20 item Witness Credibility Scale using the same format

Brodsky, S.L., Griffin, M. P., Cramer, R.J. 2010 The Witness Credibility Scale: an Outcome Measure for Expert Witness Research, Behavioral Sciences and the Law, **28:** 892-907

- The variance observed in the 264 participants' ratings of expert witness credibility is best explained by 4 features of the testimony

  These 4 features of an expert witness taken together explain approximately 70% of the variance in ratings of the expert from the test participants.

Characteristic	% Variance explained
Confident	50%
Likable	9%
Trustworthy	7%
Knowledgeable	5%

Brodsky, S.L., Griffin, M. P., Cramer, R.J. 2010 The Witness Credibility Scale: an Outcome Measure for Expert Witness Research, Behavioral Sciences and the Law, **28:** 892-907

“Confident” was described as & contrasted with the following characteristics:

Confident

- Self assured
- Well-spoken
- Poised
- Relaxed

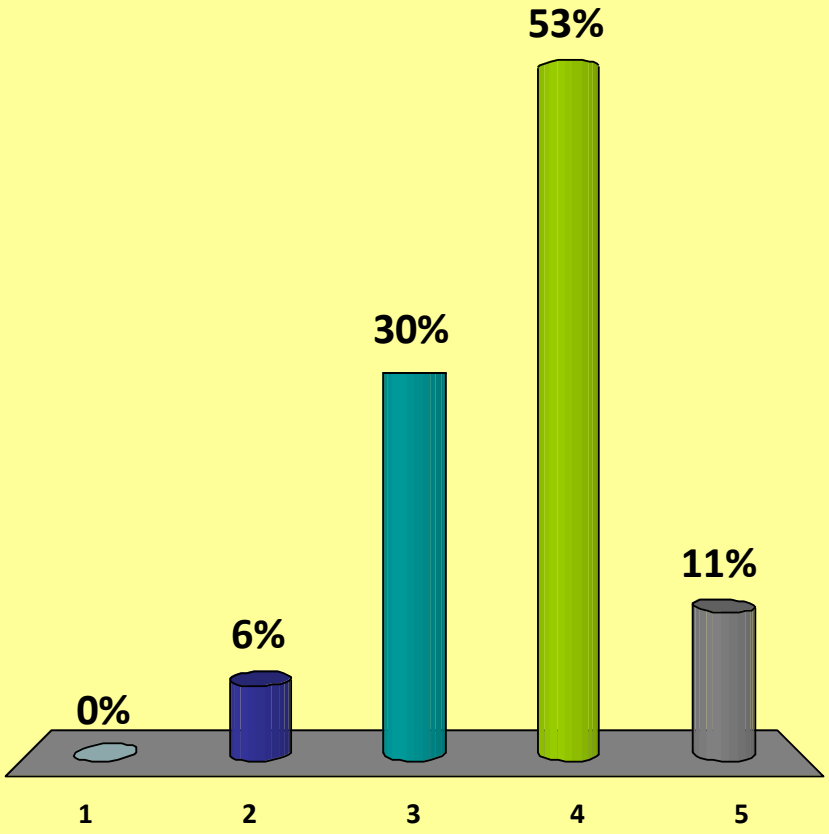
Not Confident

- Not self-assured
- Inarticulate
- Shaken
- Tense

How would you rate your own level of confidence?

Data from 105 responses
ISHI Mixture Workshop (Oct 2012)

1. I am never confident.
2. I have a low level of confidence.
3. I have a medium level of confidence.
4. I am mostly confident
5. I am always confident.



Confidence in yourself and effective testimony comes from:

- What you know
  - Molecular biology, genetics, statistics applied to evaluate or provide weight to the data
  - Scientific literature
  - Validation data
  - Case results and conclusions
- Training and experience
- Your ability to communicate your answers effectively (i.e., in understandable language).

Confidence and effective testimony do *NOT* come from:

- Your SOP
- Your Technical Leader
- Your QA system
- Other lab policy
- You lab accreditation

- The jury can only see *you*. These other people or entities are not present for them to evaluate.

What is the effect of answering a question by referring to the SOP, technical leader, lab policy, etc.?

- Have you demonstrated true familiarity with the topic?
- Have you demonstrated you know the underlying answer?
- Do you sound well informed?

- The answer is likely to be NO to each of these questions

What is different about testimony related to a mixture? IT'S HARDER!

- The results are likely to be more complicated than for a single source profile
- You may need to explain one or more of the following
  - How you *know* a profile is a mixture
  - Why you cannot be certain of the number of contributors
  - How are you able to deduce the profile of a second contributor by assuming the presence of a known person
  - Why is the inclusion not an identification
  - Why are some results inconclusive
  - What is the Combined Probability of Inclusion
  - What is a likelihood ratio
  - What is a threshold: analytical, stochastic
  - What is a major contributor
  - What is an indistinguishable mixture
  - What does "polymorphism" mean

Consider the following question and possible answers:

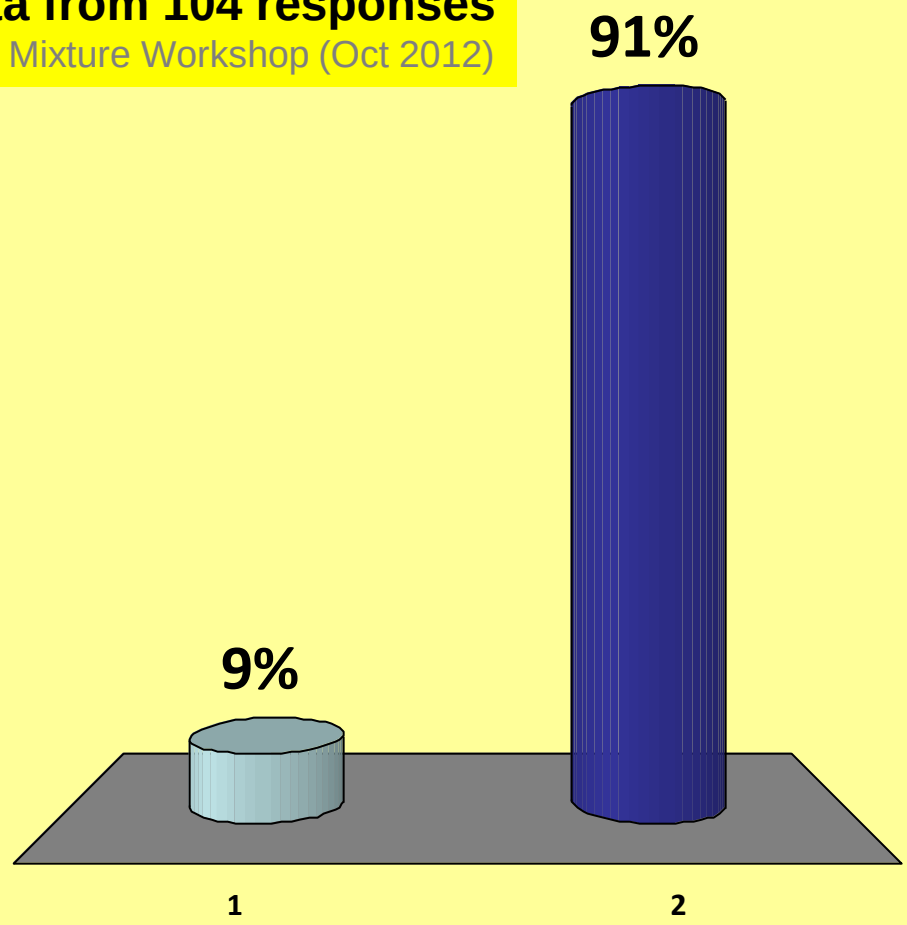
- How do you *know* the profile contains a mixture?

1. There are more than two alleles per locus
2. Many peak height ratios are < 50%
3. Peak heights at amelogenin indicate a mixture

Would the jury understand any of those statements as is?

1. Yes
2. No

Data from 104 responses
ISHI Mixture Workshop (Oct 2012)



How do you bridge the gap between what you know and what you can say that is *understandable* to a juror?

or

Are You Smarter than a 5th Grader?

and

Can you explain DNA testing to a 5th grader?

The GAP is bridged by:

*A very careful translation which you can construct and practice for **any question** you may be uncertain about.*

1. Consider what is the ***minimum*** number of concepts that are needed to answer the question
   - Make the list and be ruthless in removing unnecessary information
2. In what order would you present these concepts to make the most sense
   - Order the list
3. What is the simplest translation from how you would explain these concepts to a colleague to how would you say them to a 5th Grader?
   - Write out the language in plain English
4. Fill in any knowledge gap that you have which you may have discovered during this process.

For allele drop out explanation: Remove any unnecessary concepts

- ~~Human genome has 46 chromosomes~~
- Cells are diploid
- STR loci show length variation
- Results are observed as quantitative peak heights
- Generally see both alleles of a heterozygous pair in single source samples with > 0.25 ng in amplification

Continue removing unnecessary concepts:

- May have insufficient signal when sample mass < 0.25ng
- ~~Must have validated the analytical threshold (AT)~~
- Either or both of the alleles of a heterozygous pair may have signal below the AT as template mass is reduced
- Allele dropout has occurred when only one peak of a heterozygous pair is observed above the AT

Explaining allele drop out: *Convert* remaining concepts into easily understandable language

- We get ½ of our DNA from each parent. Therefore we have 2 copies of each segment of DNA
- The sections of DNA which we are testing are different in their lengths.
- We see the different lengths of DNA as peaks (signal) from the instrument, where each peak represents one of the 2 copies of the DNA.
- We will always see both copies, 2 peaks, when we have sufficient starting sample.

Explaining allele drop out: *Convert* remaining concepts into easily understandable language

- Instrument has a sensitivity baseline (threshold) below which we cannot be confident of the signal. Therefore the signal can be too low to detect.
- There are 3 possibilities
  1. Signal is good enough so both copies are seen.
  2. Signal is low (below the baseline) and neither copy is seen
  3. Signal is low and one but not both copies is seen
     a. See copy 1 but not copy 2
     b. See copy 2 but not copy 1
- Observing one but not both copies is called allele drop out.

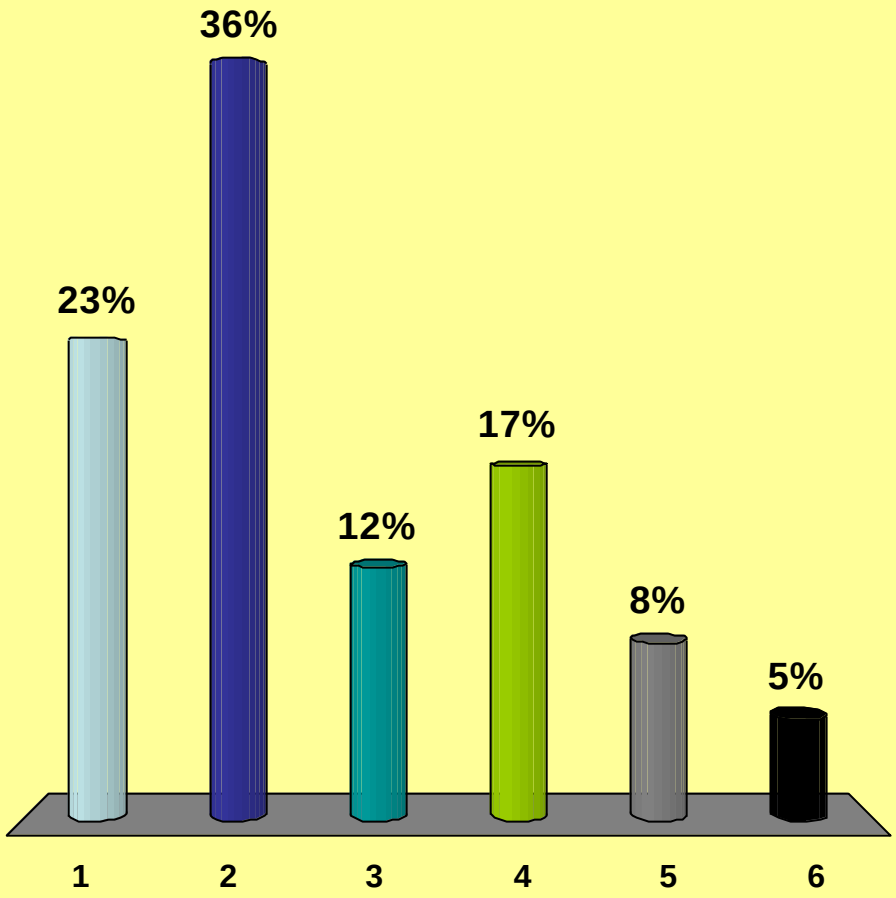
In summary:

- What would you say scientifically?
- What parts of the description are *essential* to the trier-of-fact?
- Eliminate the unnecessary concepts
- Substitute common words for scientific terms
- Practice and practice again!

For me, testifying in court…

1. Is generally rewarding.
2. Is a tolerable necessity, but an important part of my job.
3. Is intellectually challenging.
4. Is OK, but I am always scared.
5. Makes me physically ill.
6. I hope to never go again!

Data from 84 responses
ISHI Mixture Workshop (Oct 2012)



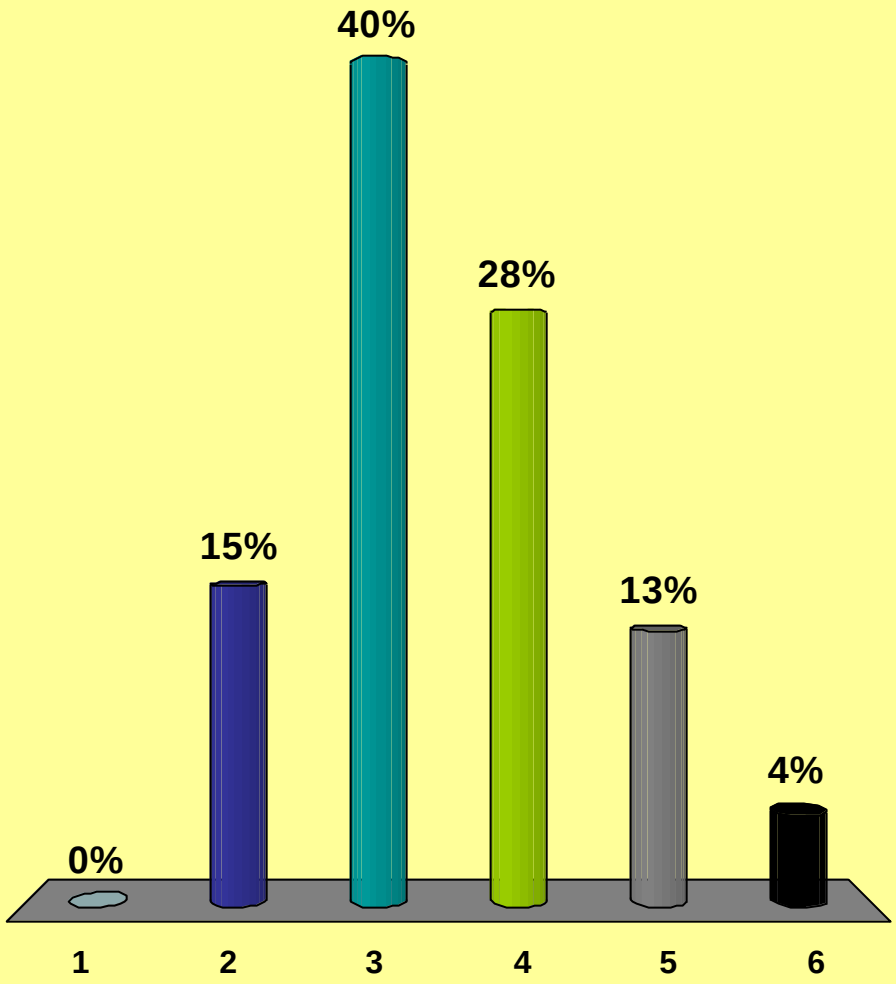
BE PREPARED!!

- Good PREPARATION is KEY to good testimony
  - Your preparation
  - Preparation of the attorney asking the questions

Time I routinely spend preparing for my testimony is:

1. I do not prepare
2. <1 hour
3. 1-2 hours
4. 2-4 hours
5. 5-10 hours
6. >10 hours

Data from 93 responses
ISHI Mixture Workshop (Oct 2012)



Your Preparation

- Review case carefully
  - "New" technical review
  - Know all paperwork
  - Critique your own case
    - What are strengths? Weaknesses?
    - What would you address/challenge if consulting for opposing counsel?
  - Be aware of all potential issues and how to address them
  - How can the information in case be best presented

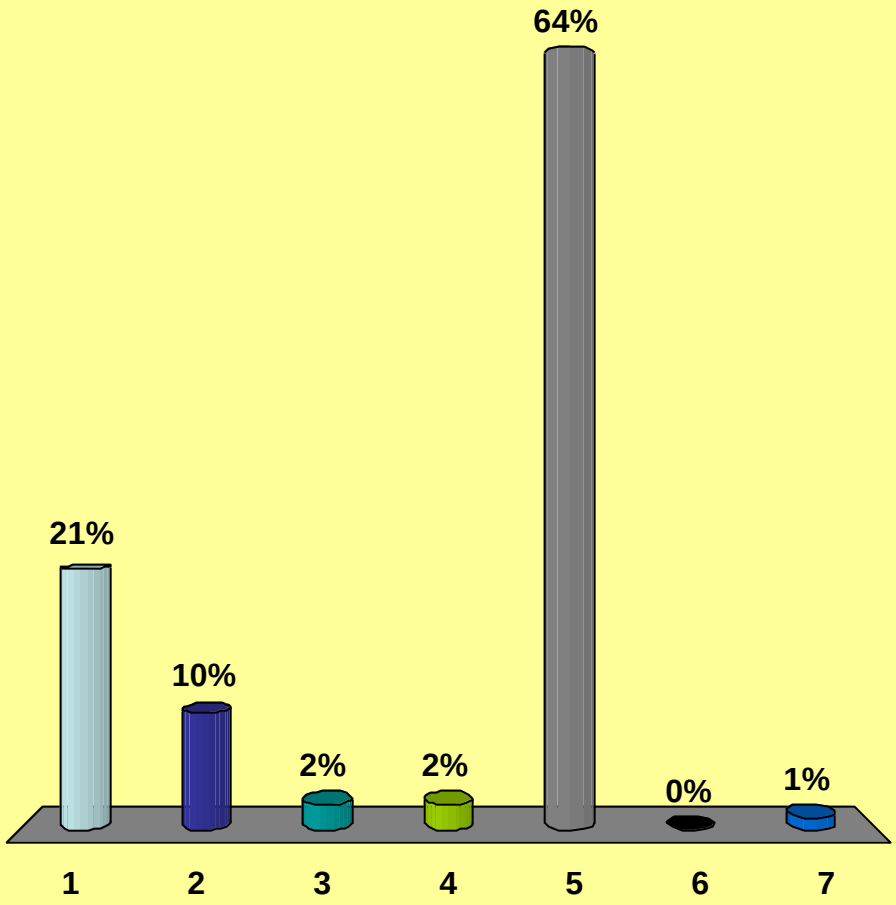
Preparation with Attorney

- Provide all discovery & discuss with attorney
- Explain what results and conclusions you can present in court
  - Be sure that the attorney understands what you can and cannot say
  - Does your testimony fit with what the attorney thought you were going to say?
- Explain limitations of your testimony
  - Expertise
  - Case, data, report, conclusions

If I find a mistake in the case, I tell:

1. Supervisor
2. Technical leader/QC manager
3. Lab director
4. Attorney
5. At least 2 of the above
6. No one and hope it doesn't come out in court
7. I never make mistakes!

Data from 94 responses
ISHI Mixture Workshop (Oct 2012)



Preparation with Attorney

- Explain all issues, problem areas, mistakes related to case, lab or yourself
  - Contamination, loss of evidence, etc.
  - Proficiency Tests
  - Audits, deficiencies
  - Errors
  - Media coverage
- Do NOT blindside attorney
- Plan for cross exam questions AND re-direct

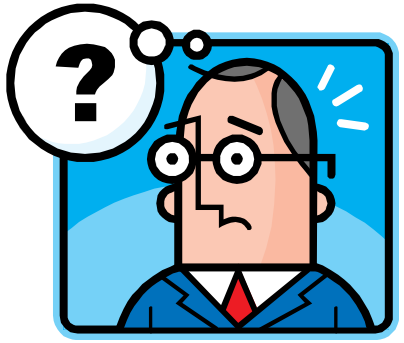
Preparation with Attorney

- Plan how to address any problems with case
  - Prior to court
    - Re-test?
    - Test other items?
    - Provide discovery
  - During testimony
    - Discuss in direct?
    - Other witnesses needed?

Your Preparation

- Have CV up-to-date
- Be knowledgeable on:
  - Molecular Biology/Technology in lay terms
  - Know relevant literature – foundational *and* current
  - Training
  - Proficiency tests
  - Validation
  - QA/QC
  - Audits
  - Any areas that you need refresher on

Scenario 1



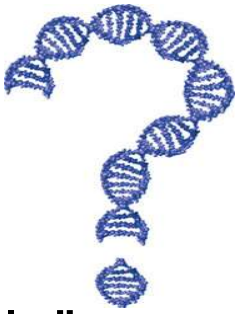
- You are fairly early in your testimony with only some basic information provided about DNA testing and profiles, when…
- All of a sudden the attorney asks you "What is a stochastic threshold used for?"

- What do you do?

Attorney Uses New Scientific Words

- Explain what it means in lay terms
- May need to provide additional background to answer questions
- Ok to do that – but let the court know that you are providing some background
- Take all the time you need to think through answer and to present the answer
- Short answer whenever possible – attorney will ask for more if needed

Uncertainty

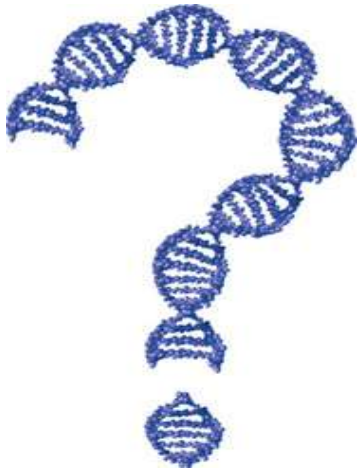


- Ok to admit there is some uncertainty
  - In science, there are exceptions to almost every “rule”
  - Uncertainty not a “bad thing”
- Explain why it is not possible to know the TRUE answer
  - Admit other possibilities exist and state/quantitate likelihood
  - Exceptions become important when more likely/probable
  - Don’t get caught up in the exceptions when highly unlikely
- Explain how you deal with the uncertainty
  - Just need to know limitations and degree of possible error (how wrong could you be?)

Uncertainty – Scenario 2

- Question:

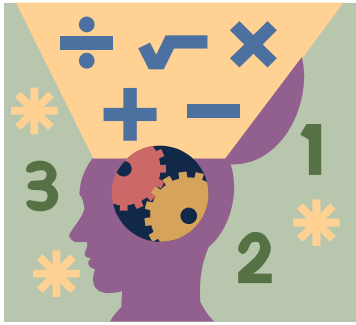
  How do you *know* that a DNA mixture has only two contributors?



Uncertainty – Scenario 2

- How do you *know* a DNA profile is from only two contributors?
  - You don't, but most probable explanation for the data that you see
    - # of alleles, PHR, intra and interlocus balance, peak heights
  - Could this profile have resulted from DNA from >two people?
    - Highly unlikely, but…
    - Would need right mixture ratio, right combination of alleles
- May use analogy
- Answer may vary depending on quality of the data

Statistics

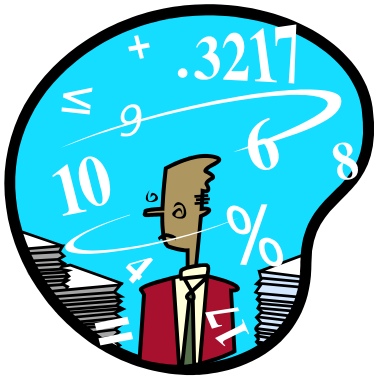


- Understand what statistics were used in the case and why those stats were used
- Be able to explain basic principles of the stats used
- Know what question was being answered with the stats
- Consider other relevant questions that could/should be asked statistically

Statistics

- Focus on the “commonness” or “rareness” of the profile rather than the perceived differences in the numbers
- Acknowledge that the numbers are rough estimates (based on population samples and Hardy-Weinberg assumptions)

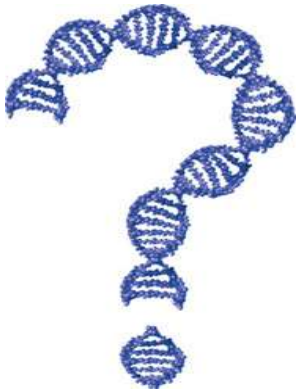
Scenario 3



- You presented statistics of 1 in 10 quadrillion unrelated individuals using your laboratory SOP.
- You are confident in the statistics you presented.
- The opposing attorney states “My expert says the “real statistics” are 1 in 100. What do you have to say to that?”

Different Experts
Different Opinions or Statistics –

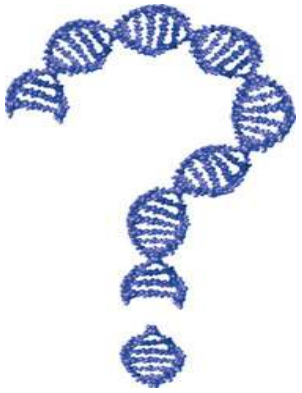
- Different ways to calculate (equations, methods)
- Different assumptions
- Different questions may be asked
- Different databases + θ correction + different minimum allele frequency, etc. (generally fairly minor difference)
- Lowest frequency observed



Different Experts Different Opinions or Statistics –

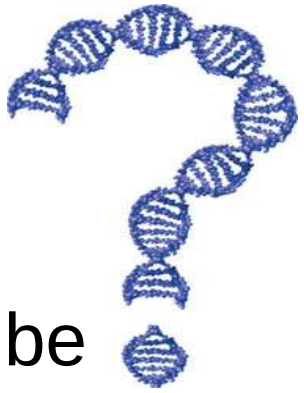
- It is OK for different experts to have different opinions
  - You may agree to the opinions based on different assumptions (often framed as “hypotheticals”) from what you used
  - Need to put limitations on your assumptions vs. the assumptions used
  - Ok to state that other opinion is valid under those assumptions but why those assumptions may or may not be valid ones to use

Inconclusive



- Inability/failure to include or exclude
- Why were the results deemed uninterpretable or inconclusive? What information used to declare inconclusive?
  - No DNA
  - Too little DNA; insufficient data to make determination (below ST, missing alleles?)
  - Too many contributors
  - QC problem, contamination, error

Inconclusive Reported



- Because known individual's *alleles* cannot be excluded (i.e., is included) but no available appropriate statistical model for profile
  - Cannot do CPI
  - Not major:minor mixture
  - Possible incomplete profile
  - **Cannot distinguish genotypes**
- Need to stress importance that a statistical frequency is needed to provide meaning or parameters to an "inclusion"
- Misleading to include without statistical frequency

Important Points to Remember

- If you don’t know – say you don’t know
- NEVER guess
- Don’t change your answer because you keep getting asked the same question
- Don’t go outside your area of expertise – state your limitations (KNOW your limitations!)

Important Points to Remember

- Answer the question asked as briefly as possible to communicate the answer. Do not elaborate.
- Answer “yes” and “no” questions with “yes” or “no”. Add “with exceptions” or “with qualification” as needed.
- Stay NEUTRAL.
- Answer in same manner to both attorneys.
- Not your job to “win” case.

Important Points to Remember

- Answer the question the same way regardless of who is asking the question.
- Stay true to the science.
- REVIEW ALL exhibits prior to testimony.

Possible Court Stressors

- Feeling unprepared, uninformed
- Adversarial environment in court
- Public speaking
- Interactions different from usual social communication norms
  - Looking at jury to answer question asked of someone else
  - Only answering; cannot ask if jury is understanding or fill in missing information easily

What to do to Alleviate Stress

Do Self-Assessment of Stressors

- Determine what part of court is most difficult, uncomfortable, stressful for you
- How can you best deal with it?
  - Better preparation
  - Advice from other experts, resources available
  - Practice

Questions?
Comments?
Discussion
Advice from your experience