## F29 Overcoming Bias in DNA Mixture Interpretation

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After attending this presentation, attendees will understand some principles of objective genotyping that help overcome cognitive and contextual bias in DNA mixture interpretation in order to provide unbiased match results.

This presentation will impact the forensic science community by showing how computer technology can resolve forensic questions in ways that remove unwanted bias.

Mixtures arise when two or more people contribute their DNA to an item of biological evidence. Unlike single source DNA data, there may be multiple possible genotype solutions for each contributor to the mixture. An inferred genotype (for a contributor at a locus) is therefore a list of allele pair possibilities, each with an associated probability.

Bias occurs when extraneous context or prejudice influence decisions. With DNA mixtures, bias shifts genotype probability away from the data-derived distribution toward a more preconceived outcome. This can happen in at least three ways. First, at the *data* level, some DNA interpretation methods modify the observed data. For example, a human analyst may initially code some data peaks as "real" and others as "artifact," while also scrubbing peak height quantities. This human filtering can be inaccurate, since uncertainty is best resolved by assigning probability to multiple outcomes, not by making arbitrary choices. Worse, if the analyst has some knowledge of a desired outcome (e.g., knows the suspect's genotype), then contextual bias may impair his/her classification decisions. Next, at the *genotype* level, some deconvolution methods strive for perfect mixture separation without genotype ambiguity. Here again probabilistic assignments would be a more scientific way to address uncertainty. If the analyst knows a desired solution, that knowledge can skew their conclusions. Finally, at the *match* level, there are statistical approaches that are inherently biased by knowledge of a suspect's genotype. With Combined Probability of Inclusion (CPI), the suspect's genotype is required to determine whether or not to use a locus statistically. With some Likelihood Ratio (LR) methods, the suspect's genotype must be considered when assessing the evidence.

Cross-examination can uncover such bias, thereby undermining the credibility of an expert and their conclusions. "Did you know the defendant's genotype during your analysis of the evidence?" "Doesn't knowing your customer's desired answer bias your decisions?" "Have any scientific studies demonstrated otherwise?"

The admissibility of biased DNA evidence can be legitimately challenged. Federal Rules of Evidence (FRE) 403 balances unfair prejudice against probative value. Assuming the genotype of a defendant when analyzing mixture evidence data is manifestly unfair and prejudicial to the defendant and may artificially inflate probative value. A judge may decide that a biased match statistic should not be admitted into evidence.

Cognitive science can help limit human bias in DNA interpretation. Approaches such as "sequential unmasking" intentionally restrict an analyst's access to case context and defendant information. But, in the computer age, why are people even involved in critical steps that can potentially introduce bias and why develop "expert" software that mimics biased human behavior? An unbiased approach would have a computer thoroughly examine DNA mixture data without knowing the defendant's genotype. This examination can be done by separating out the (probabilistic) genotypes of each contributor to a mixture. Only once that separation has been completed, and after the evidence genotypes have been recorded, should a comparison be made between two genotypes to calculate their match statistic.

There are practical ways to eliminate cognitive bias in forensic science. One is to replace subjective human methods with objective computing. Another is to avoid computer programs that examine evidence data alongside a suspect exemplar. Sophisticated Bayesian modeling offers a more neutral computing alternative.

Sources of bias that can be introduced when examining DNA mixture evidence will be presented. Understanding objective computer solutions will help the analyst present more neutral results in court. Additionally, recognizing bias will help trial attorneys better challenge skewed evidence.

**DNA Mixture, Objective Genotyping, Cognitive Bias**





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