

Understanding DNA Evidence

Beaver County Courthouse
March, 2016
Beaver, PA

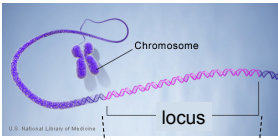
Mark W Perlin, PhD, MD, PhD
Cybergenetics, Pittsburgh, PA



Cybergenetics

Cybergenetics © 2003-2016

DNA genotype



mother allele

ACGT repeated word

father allele

A genetic locus has two DNA sentences, one from each parent.

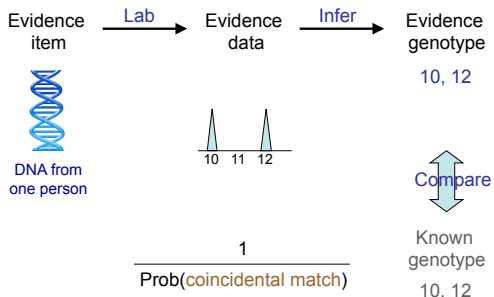
An **allele** is the number of repeated words.

A **genotype** at a locus is a pair of alleles.

10, 12

Many alleles allow for many many allele pairs. A person's genotype is relatively unique.

DNA match statistic



National Academy of Sciences



"Strengthening Forensic Science: A Path Forward" (2009)

- Human examination bias
- Statistics & reporting
- Underlying scientific basis

Among existing forensic methods, only nuclear DNA analysis has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between an evidentiary sample and a specific individual or source.

National Academy of Sciences

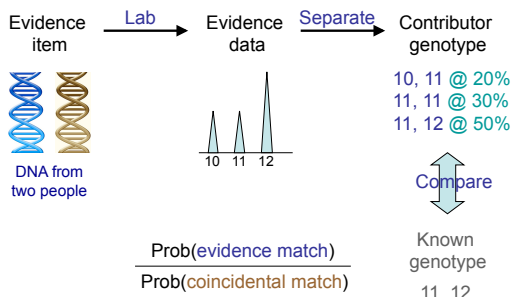


"Strengthening Forensic Science: A Path Forward" (2009)

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However, ... there may be problems ... with how the DNA was ... interpreted, such as when there are mixed samples

DNA match statistic



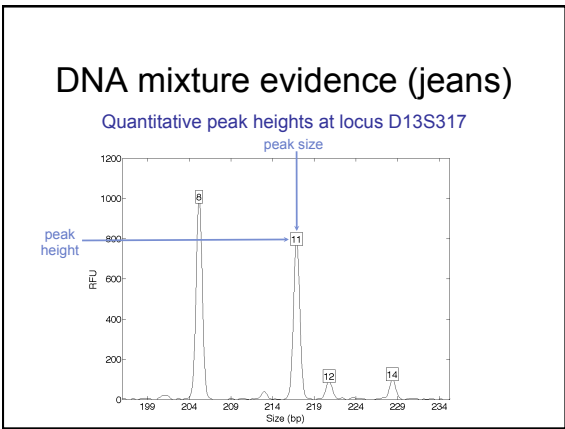
Pennsylvania v Ralph Skundrich

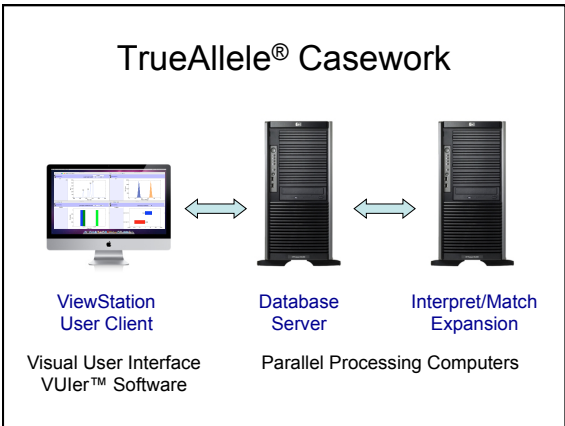
On July 25, 2002, a Pittsburgh college student, 18, was threatened with a gun and sexually assaulted in her Shadyside apartment.

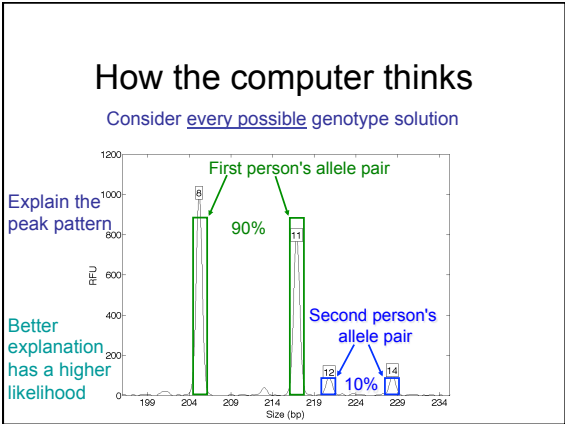
The victim's jeans and T-shirt contained biological evidence.

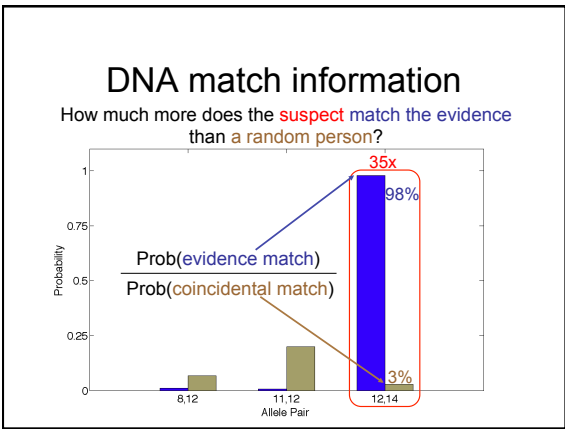
The Allegheny County crime lab developed DNA data from the two evidence items.

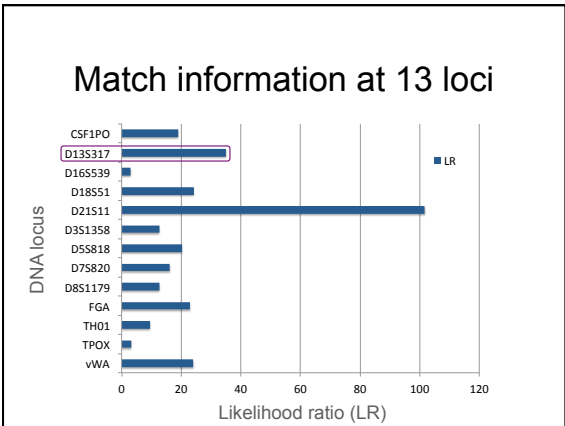
Skundrich was identified as a suspect after a DNA match was made in the national database in 2009.











Is the suspect in the evidence?

A match between the jeans and Ralph Skundrich is:

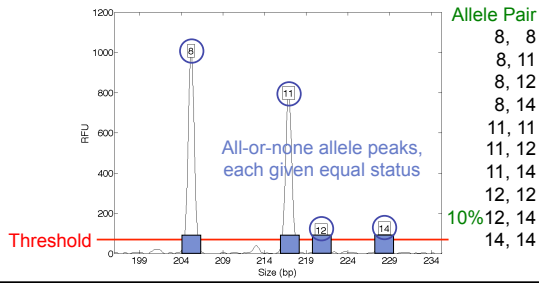
2.1 quadrillion times more probable than coincidence

A match between the T-shirt and Ralph Skundrich is:

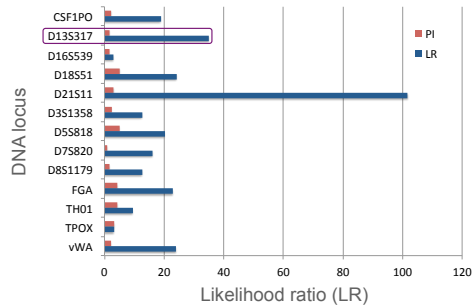
4.04 quadrillion times more probable than coincidence

Crime lab data summary

Over threshold, peaks are labeled as allele events



Match statistic comparison



Information comparison

Method	Jeans	T-shirt
Combined PI	280 thousand (5)	630 thousand (5)
TrueAllele	2 quadrillion (15)	4 quadrillion (15)

Reliability (PA Rule 702)

Testimony by Expert Witness

A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

- (a) the expert's scientific, technical, or other specialized knowledge is beyond that possessed by the average layperson;
- (b) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue; and
- (c) the expert's methodology is generally accepted in the relevant field.

TrueAllele validation papers

Perlin MW, Sinelnikov A. An information gap in DNA evidence interpretation. *PLoS ONE*. 2009;4(12):e8327.

Ballantyne J, Hanson EK, Perlin MW. DNA mixture genotyping by probabilistic computer interpretation of binomially-sampled laser captured cell populations: Combining quantitative data for greater identification information. *Science & Justice*. 2013;53(2):103-14.

Perlin MW, Hornyak J, Sugimoto G, Miller K. TrueAllele® genotype identification on DNA mixtures containing up to five unknown contributors. *Journal of Forensic Sciences*. 2015;on-line.

Greenspoon SA, Schiermeier-Wood L, Jenkins BC. Establishing the limits of TrueAllele® Casework: a validation study. *Journal of Forensic Sciences*. 2015;in press.

Perlin MW, Legler MM, Spencer CE, Smith JL, Allan WP, Belrose JL, Duceman BW. Validating TrueAllele® DNA mixture interpretation. *Journal of Forensic Sciences*. 2011;56(6):1430-47.

Perlin MW, Belrose JL, Duceman BW. New York State TrueAllele® Casework validation study. *Journal of Forensic Sciences*. 2013;58(6):1458-66.

Perlin MW, Dormer K, Hornyak J, Schiermeier-Wood L, Greenspoon S. TrueAllele® Casework on Virginia DNA mixture evidence: computer and manual interpretation in 72 reported criminal cases. *PLoS ONE*. 2014;(9)3:e92837.

Validation axes

Sensitivity. The extent to which interpretation identifies the correct person.
Truly include, don't falsely exclude.

Specificity. The extent to which interpretation does not misidentify the wrong person.
Truly exclude, don't falsely include.

Reproducibility. The extent to which interpretation gives the same answer to the same question.
Concordant independent computer runs.

Widespread acceptance

Admitted after Frye or Daubert challenge in:
California, Louisiana, New York, Ohio, Pennsylvania,
South Carolina, Virginia, Australia & United Kingdom

Crime labs use TrueAllele® system in
California, Maryland, South Carolina & Virginia

Used in five hundred criminal cases in most of the
United States, for both prosecution and defense

Seventy criminal cases in Pennsylvania
Adams, Allegheny, Beaver, Berks, Butler, Cambria, Columbia, Delaware, Indiana,
Luzerne, Lycoming, Mercer, Mifflin, Pike, Washington, Westmoreland, York

Pennsylvania appellate court

J-A-1000B-11
2012 PA Super 31
COMMONWEALTH OF PENNSYLVANIA, Appellee
v.
KEVIN JAMES FOLEY, Appellant
No. 2009 WDA 2009
Appeal from the Judgment of Sentence of June 1, 2009
in the Court of Common Pleas of Indiana County
Criminal Division at No(s): CP-32-CR-0001170-2007
BEFORE: PANELLA, SHOGAN, and COUVILLE, JJ.
OPINION BY PANELLA, J. FILED: FEBRUARY 15, 2012
Appellant, Kevin James Foley, appeals from the judgment of sentence entered on June 1, 2009, by the Honorable William J. Martin, Resident Judge of the Court of Common Pleas of Indiana County, Criminal Division. After careful review, we affirm.
* * *
Because Foley has failed to establish the existence of a legitimate dispute over Dr. Perlin's methodology, he has failed to show that Dr. Perlin's testimony constituted "novel" scientific evidence. See *Wertz*, 998 A.2d at 972. Therefore, we find that the trial court's decision to admit the testimony was not an abuse of discretion. Absent a legitimate dispute, there is no reason to "impede admissibility of evidence that will aid the trier of fact in the search for truth." *Id.*

Relevance (PA Rule 403)

Excluding relevant evidence for prejudice, confusion, waste of time, or other reasons



The court may exclude relevant evidence if its probative value is outweighed by a danger of one or more of the following:

- unfair prejudice,
- confusing the issues,
- misleading the jury,
- undue delay,
- wasting time, or
- needlessly presenting cumulative evidence.

DNA statistic shuts down labs

“National accreditation board suspends all DNA testing at D.C. crime lab”

The Washington Post April 27, 2015
Did not comply with FBI standards

“New protocol leads to reviews of ‘mixed DNA’ evidence”

The Texas Tribune September 12, 2015
24,468 lab tests affected

MIX05: NIST mixture interpretation interlaboratory study.
Butler JM, Kline MC, National Institute of Standards and Technology
Promega’s Sixteenth International Symposium on Human Identification, 2005

MIX05: Statistics not reproducible

National Institute of Standards and Technology
Two Contributor Mixture Data, Known Victim

Some Differences in Reporting Statistics

LabID	Kits Used	Caucasians	African-Americans	Hispanics
30	ProPlus/Collier	1.0E+15	2.13E+14	3.00E+15
34	ProPlus/Collier	2.40E+11	7.50E+10	9.80E+10
33	ProPlus/Collier	2.94E+08	1.13E+08	1.74E+09
6	ProPlus/Collier	42,000,000	3,500,000	280,000,000
9	ProPlus/Collier	1.14E+07	1.97E+07	1.54E+08
79	ProPlus/Collier	93,000	47,906	1,350,000
16	ProPlus/Collier	434,600	31,710	359,100

213 trillion (14)

31 thousand (4)

Remember that these labs are interpreting the same MIX05 electropherograms

MIX13: An interlaboratory study on the present state of DNA mixture interpretation in the U.S.
 Coble M, National Institute of Standards and Technology
 5th Annual Prescription for Criminal Justice Forensics, Fordham University School of Law, 2014.

MIX13: Statistics falsely include

MIX13 Case 5 Outcomes with Suspect C
 (whose genotypes were not present in the mixture)

# Labs	Report Conclusions	Reasons given
6	Exclude Suspect C	detailed genotype checks (D+); TrueAllele negative LR (D+); assumed major/minor and suspects did not fit (D+); 3 labs noted Penia E missing allele 15 (PP16HS)
3	Inconclusive with C only (A & B included)	All these labs used PP16HS
21	Inconclusive for A, B, and C	
70	Include & provide CPI statistics	<i>All over the road...</i>

Range of CPI stats for Caucasian population:
 FBI allele frequencies: **1 in 9** to **1 in 344,000**

Process is not objective science

- (1) Choose, alter, discard, edit, and manipulate the DNA data signals
- (2) Compare defendant's genotype to edited data & decide if he is in the DNA evidence
- (3) If he is "included", then calculate a DNA mixture statistic



- Human examination bias
- Statistics & reporting
- Underlying scientific basis

CPI lacks probative value



Research Article

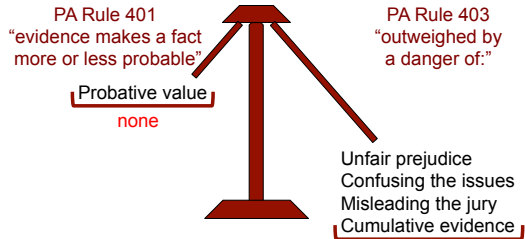
Inclusion probability for DNA mixtures is a subjective one-sided match statistic unrelated to identification information

Mark William Perlin¹

Forensic crime laboratories have generated CPI statistics on **hundreds of thousands of DNA mixture evidence items**. However, this commonly used match statistic behaves like a **random generator of inclusionary values**, following the LLN rather than measuring identification information. A quantitative CPI number **adds little meaningful information** beyond the analyst's initial qualitative assessment that a person's DNA is included in a mixture. **Statistical methods for reporting on DNA mixture evidence should be scientifically validated before they are relied upon by criminal justice.**

Relevance of CPI

Unvalidated DNA match statistic, unrelated to identification



Inconclusive mixture

Crime laboratory DNA report
Crime lab user fee: \$5,000

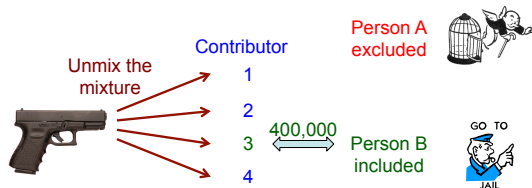
Conclusions:

Item 1 – Swab of textured areas from a handgun

The data indicates that DNA from four (4) or more contributors was obtained from the swab of the handgun. Due to the complexity of the data, **no conclusions can be made** regarding persons A and B as possible contributors to this mixture.

Computer reanalysis

Cybergenetics TrueAllele® report
Match statistics provide information



40 cases, 8 trials, 3 DNA exonerations
TrueAllele in Allegheny County

Crime	Evidence	Defendant	Outcome	Sentence
rape	clothing	Ralph Skundrich	guilty	75 years
murder	gun, hat	Leland Davis	guilty	23 years
rape	clothing	Akaninyene Akan	guilty	32 years
murder	shotgun shells	James Yeckel, Jr.	guilty plea	25 years
murder	fingernail	Anthony Morgan	guilty	life
weapons	gun	Thomas Doswell	guilty plea	1 year
bank robbery	clothing	Jesse Lumberger	guilty	10 years
drugs	gun	Derek McKissick	guilty plea	2 1/2 years
drugs	gun	Steve Morgan	guilty plea	2 1/2 years
murder	door, clothing	Calvin Kane	guilty plea	20 years
murder	gun	Jaykwaan Pinckney	guilty plea	10 years
child rape	clothing	Dhaque Jones	guilty plea	6 years
shooting	gun	Anthony Jefferson	guilty plea	4 years
weapons	gun	Delmingo Williams	guilty plea	3 years
incest rape	clothing	Terry L.	guilty	40 years
bank robbery	hat	Robert Schatzman	guilty	pending
weapons	gun	Rashawn Walker	guilty	1.5 years
robbery	hat	Lauren Peak	guilty plea	1 year
murder	gun	Chaz White	guilty plea	4 years

More DNA mixture information

- <http://www.cybgen.com/information>
- Courses
 - Newsletters
 - Newsroom
 - Presentations
 - Publications
 - Webinars



<http://www.youtube.com/user/TrueAllele>
 TrueAllele YouTube channel


Cybergenetics

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