Issues with DNA Evidence, Past and Future

Washington County Bar Association
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Washington, PA

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Cybergenetics

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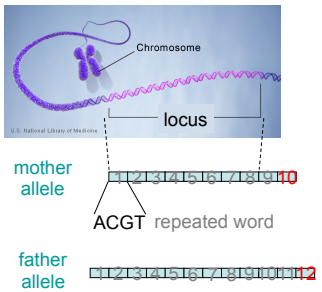
National Academy of Sciences

"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.

DNA genotype



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

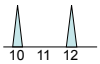
Many alleles allow for many many allele pairs. A person's genotype is relatively unique.

DNA match statistic

Evidence item → Lab → Evidence data → Infer → Evidence genotype

10, 12

DNA from one person



Compare

Known genotype
10, 12

$$\frac{1}{\text{Prob(coincidental match)}}$$

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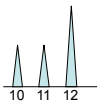
However, ... there may be problems ... with how the DNA was ... interpreted, such as when there are mixed samples

DNA match statistic

Evidence item → Lab → Evidence data → Separate → Contributor genotype

DNA from two people



10, 11 @ 20%
11, 11 @ 30%
11, 12 @ 50%

Compare

Known genotype
11, 12

$$\frac{\text{Prob(evidence match)}}{\text{Prob(coincidental match)}}$$

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.

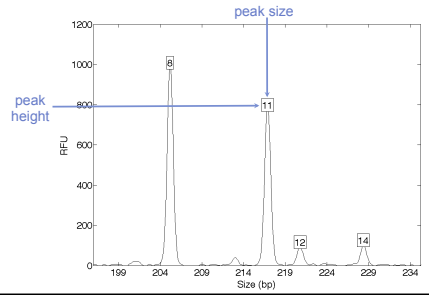
The victim's jeans and T-shirt contained biological evidence.

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.

DNA mixture evidence (jeans)

Quantitative peak heights at locus D13S317



TrueAllele® Casework

ViewStation User Client

Database Server

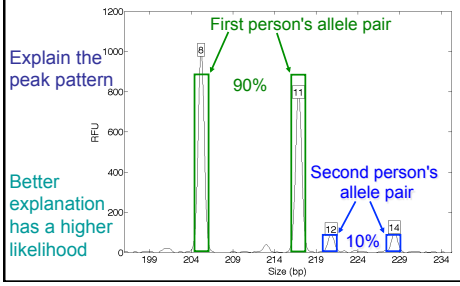
Interpret/Match Expansion

Visual User Interface VUIer™ Software

Parallel Processing Computers

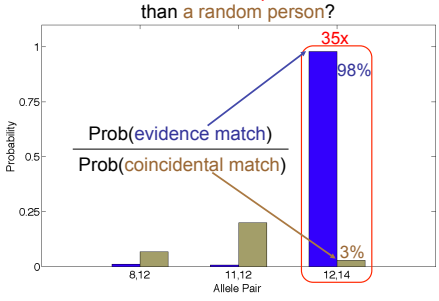
How the computer thinks

Consider every possible genotype solution

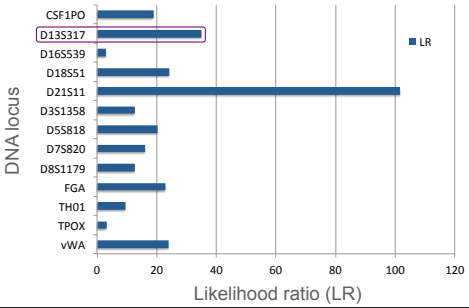


DNA match information

How much more does the suspect match the evidence than a random person?



Match information at 13 loci



Is the suspect in the evidence?

A match between the jeans and Ralph Skundrich is:

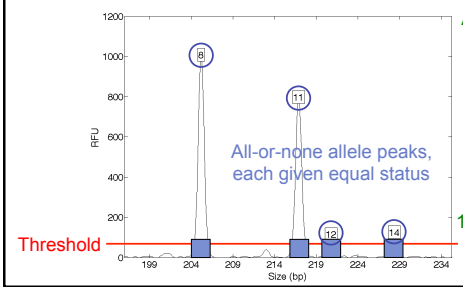
2.1 quadrillion times more probable than coincidence

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

4.04 quadrillion times more probable than coincidence

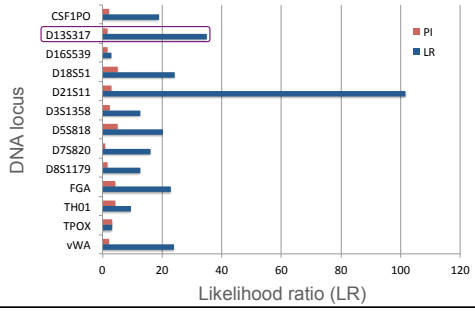
Crime lab data summary

Over threshold, peaks are labeled as allele events



Allele Pair
8, 8
8, 11
8, 12
8, 14
11, 11
11, 12
11, 14
12, 12
12, 14
14, 14

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.

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.

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.

WTC DNA data reanalysis

18,000
victim remains

match

2,700
missing people

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 five 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-A10008-11

2012 PA Super 31

COMMONWEALTH OF PENNSYLVANIA, Appellee	IN THE SUPERIOR COURT OF PENNSYLVANIA
v.	
KEVIN JAMES FOLEY, Appellant	No. 2039 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 COLVILLE*, 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, President 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 Betz***, 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.

Commonwealth v Booher

IN THE COURT OF COMMON PLEAS OF BUTLER COUNTY, PENNSYLVANIA

COMMONWEALTH	:	CRIMINAL DIVISION
vs	:	CP-10-CR-1385-2010
Benjamin Booher	:	

ORDER OF COURT

AND NOW, this 10th day of October, 2012, the Court's grants the defendant's Motion to preclude the introduction of DNA evidence. The Commonwealth will not be permitted to present the testimony of Ashley Mangan which indicates that spermatozoa were identified in the crotch and in front of the crotch of M.L.'s underwear. Timothy Gavel will not be permitted to testify of the results as set forth in conclusion seven of the report of July 31, 2010.

By the court,

Timothy F. McCune
Judge

10-11-12

The Defendant argues and the Court accepts said argument that the evidence itself and the Commonwealth's presentation of it would be misleading and confusing to the jury. A jury will likely hear DNA and assume it links the Defendant to the alleged crime even though it does not. The statistics are misleading and give a false impression to a jury that the Commonwealth's DNA evidence proves that the Defendant committed the offense. Expert testimony of this nature will lead the jury to inexplicably conclude that this test proves that Benjamin Booher is the perpetrator, despite the fact that the results of the test only show that he cannot be excluded as a contributor of non-sperm DNA in any of M.L.'s clothing.

It would be extremely prejudicial to the Defendant if forensic scientist

DNA excluded as misleading, confusing & prejudicial

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

		Case1		
LabID	Kits Used	Caucasians	African Americans	Hispanics
90	ProPlus/Cofiler	1.18E+15	2.13E+14	3.09E+15
34	ProPlus/Cofiler	2.40E+11	7.90E+09	9.80E+10
33	ProPlus/Cofiler	2.94E+08	1.12E+08	1.74E+09
6	ProPlus/Cofiler	40,000,000	3,500,000	280,000,000
9	ProPlus/Cofiler	1.14E+07	1.97E+07	1.54E+08
79	ProPlus/Cofiler	930,000	47,000	1,350,000
16	ProPlus/Cofiler	434,600	31,710	399,100

Remember that these labs are interpreting the same MIX05 electropherograms

213 trillion (14)

31 thousand (4)

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 (ID+); TrueAllele negative LR (ID+); assumed major/minor and suspects did not fit (ID+); 3 labs noted Penta 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**	*All over the road…*

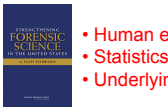
Range of CPI stats for Caucasian population:
FBI allele frequencies: **1 in 9** to **1 in 344,000**

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

J Pathol Inform

Research Article

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

Mark William Perlin[1]

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

PA Rule 401
"evidence makes a fact more or less probable"

Probative value
none

PA Rule 403
"outweighed by a danger of:"

Unfair prejudice
Confusing the issues
Misleading the jury
Cumulative evidence

Method comparison

Capability	Human review	TrueAllele
Data choice	Selection bias	Use all data
Uncertainty	Threshold	Statistical
Neutral	Include only	Include/Exclude
Statistic	Counts tests	Probative
Objective	No	Yes
Validated	No	Yes
Accurate	No	Yes
Frye challenge	No	Yes
Item-to-item	No	Yes
Database	10%	100%

Inconclusive mixture

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

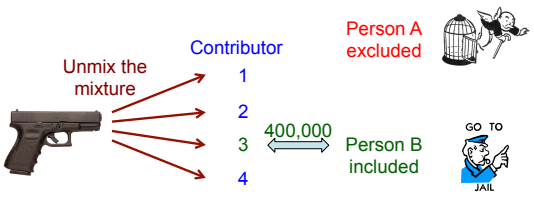
Conclusions:

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



44 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

Post-conviction relief

Title 42, Chapter 95, Subchapter B

§ 9543(a)(2). Eligibility for PCR
(ii) Ineffective assistance of counsel
(vi) The unavailability … of exculpatory evidence that has subsequently become available and would have changed the outcome …

§ 9543.1. Post-conviction DNA testing
TrueAllele reanalysis of "inconclusive" DNA or inaccurate DNA match statistics

Han Tak Lee v. Monroe County (PA Innocence)
US Court of Appeals for the Third Circuit (2012)
"fire expert testimony at trial fundamentally unreliable, so entitled to federal habeas relief on due process claim"

More DNA 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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