

Computer interpretation of touch DNA mixtures

Seminar for Chiefs of Police
in Western Pennsylvania
May, 2014
Allegheny County, PA

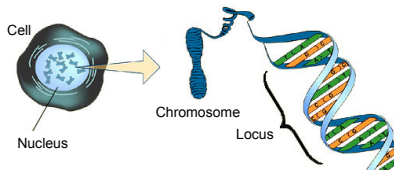
Mark W Perlin, PhD, MD, PhD
Cybergenetics, Pittsburgh, PA



Cybergenetics

Cybergenetics © 2003-2014

DNA biology



Short tandem repeat



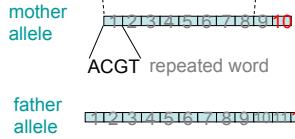
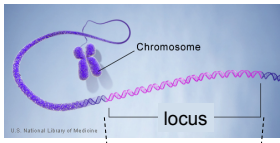
23 volumes in cell's
DNA encyclopedia

DNA locus paragraph

Take me out to the ball game
take me out with the crowd
buy me some peanuts and Cracker Jack
I don't care if I never get back
let me
root root root root root root root root root
for the home team,
if they don't win, it's a shame
for it's one, two, three strikes, you're out
at the old ball game

"root" repeated 10 times, so
allele length is 10 repeats

DNA genotype



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

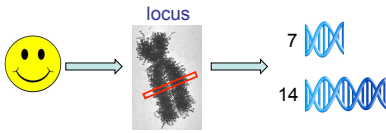
An **allele** is the number of repeated words.

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

10, 12

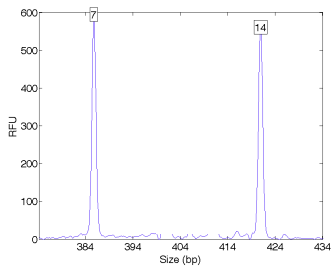
Many alleles allow for many many allele pairs. A person's genotype is relatively unique.

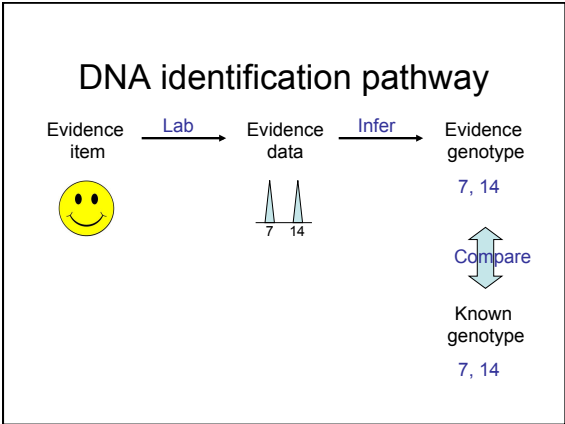
One person, one genotype

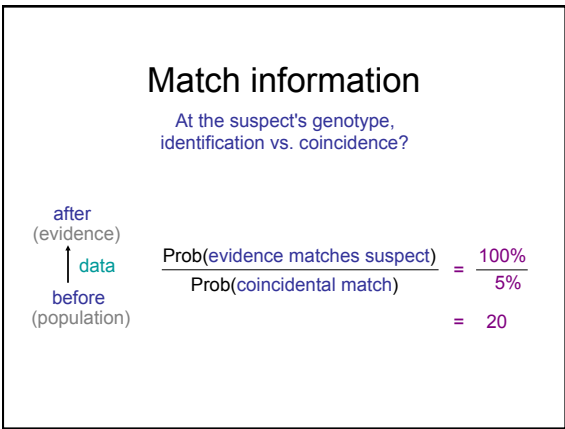


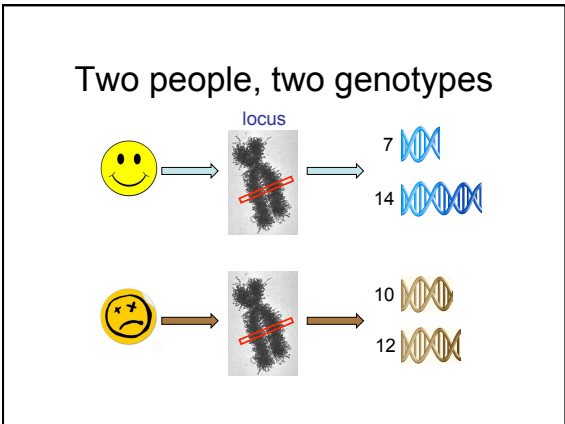
DNA data

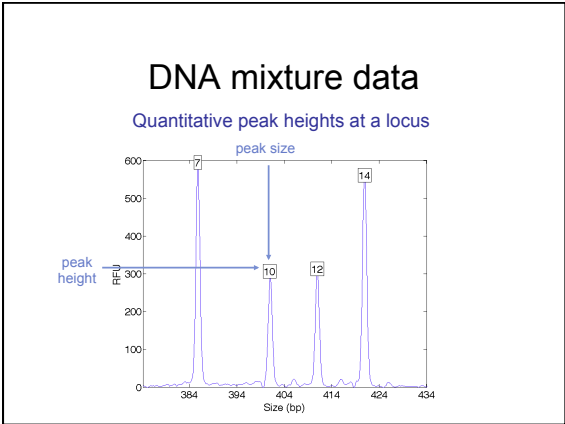
One or two allele peaks at a locus

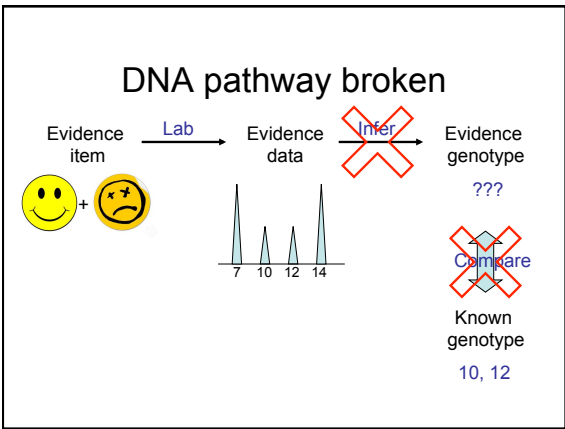












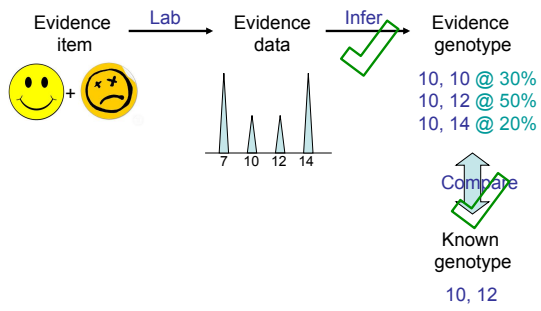
Human interpretation issues

- call good data inconclusive
- peaks are too low for them
- too many contributors to handle
- potential examination bias

TrueAllele® Casework

- preserve data information
- use all peaks, high or low
- any number of contributors
- entirely objective, no bias

DNA pathway restored



Match information preserved

At the suspect's genotype,
identification vs. coincidence?

$$\frac{\text{Prob}(\text{evidence matches suspect})}{\text{Prob}(\text{coincidental match})} = \frac{50\%}{5\%}$$

after (evidence) = 10
↑ data
before (population)



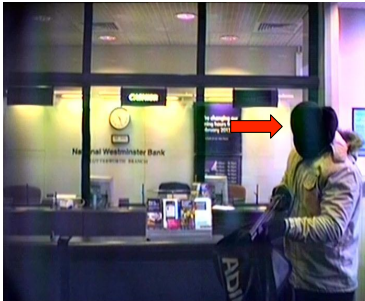
Leicestershire bank robbery



England

The complex block contains a title "Leicestershire bank robbery", a small map of England with a red dot in the Leicestershire region, and a photograph of a brick building with a "NatWest" sign and a police car parked in front.

Black balaclava



NatWest

The complex block contains a title "Black balaclava" and a photograph of a person wearing a black balaclava in a bank lobby. A red arrow points to the balaclava. The background shows a "NatWest" bank sign.

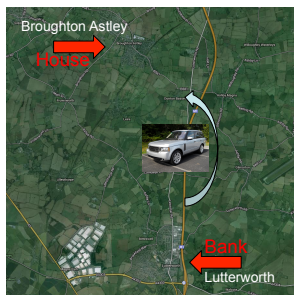
Brown parka



Black shoes



Helicopter view



Brown parka

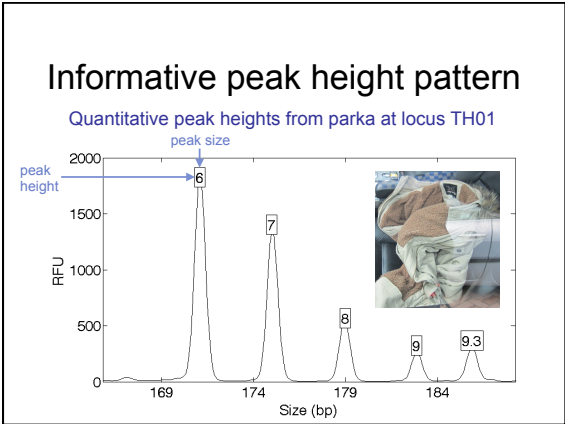


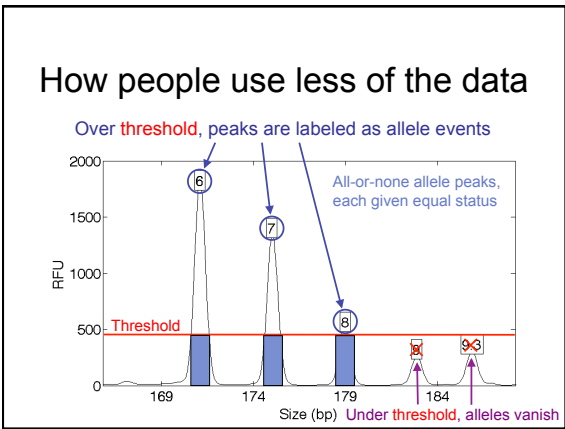
Black balaclava



Black shoes







DNA lab report: **Balaclava**

A sample from the **inside crown area** of the balaclava (item JAS/3) was submitted for DNA profiling tests.

A **complex mixed DNA** results which appeared to have originated **from at least four people** was obtained from biological material on the crown.

In my opinion, this result is not suitable for meaningful comparison.

DNA lab report: Shoes

The **inside heel area and the toe area** of the left shoe (item PAC/2) were submitted separately for DNA profiling tests.

Mixed DNA results which appeared to have originated from **at least three people** were obtained from biological material on each of the sampled areas. In my opinion, **Leroy Williams could have contributed DNA** to these results in that all of the components that make up his DNA profile are represented in the result;

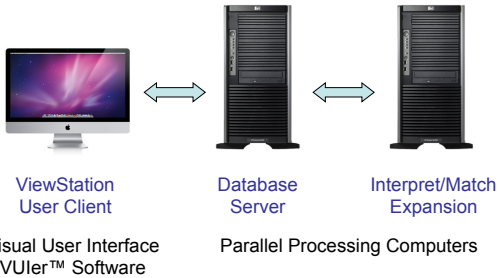
however, due to the overall complexity of the results and the number of contributors to them, a statistical evaluation is not possible.

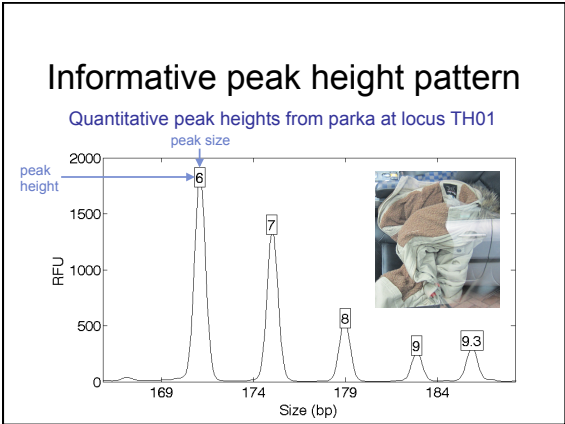
DNA lab report: Parka

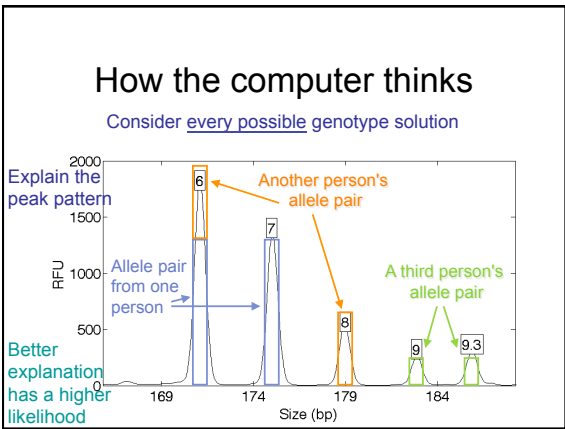
The **left and right cuff areas** of the brown parka (item CEG/2) were submitted separately for DNA profiling tests. A **complex mixed DNA** results which appeared to have originated from **at least four people** was obtained from biological material on the right cuff. **In my opinion, this result is not suitable for meaningful comparison.**

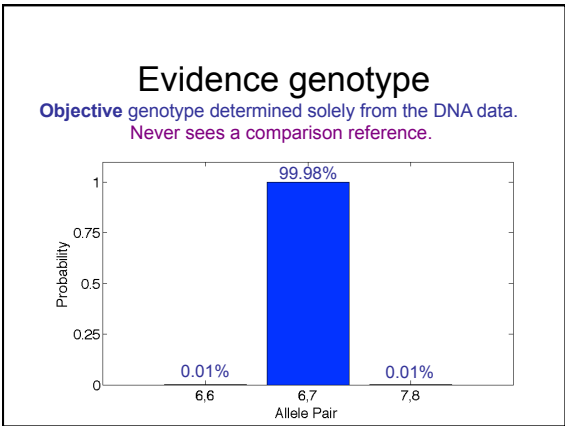
A **mixed DNA result**, which appeared to have originated from **at least three people** was obtained from biological material recovered from the left cuff of the brown parka (CEG/2). **In my opinion Leroy Williams could have contributed DNA to this result; however, the finding is not suitable for statistical evaluation.**

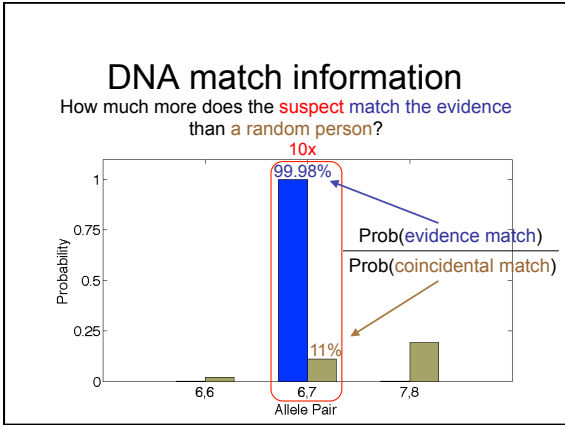
TrueAllele® Technology

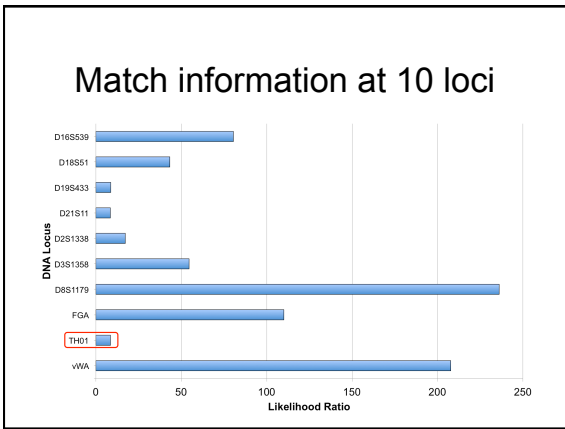












10,000,000,000,000,000

Is the suspect in the evidence?

A match between the **parka** and Leroy Williams is:
10.2 quadrillion times more probable than
a coincidental match to an unrelated **Black** person

A match between the **shoe** and Leroy Williams is:
13.9 quadrillion times more probable than
a coincidental match to an unrelated **Black** person

A match between the **balaclava** and Leroy Williams is:
15.7 quadrillion times more probable than
a coincidental match to an unrelated **Black** person

TrueAllele in criminal trials

About 200 case reports filed on DNA evidence

Court testimony:

- state
- federal
- military
- international

Crimes:

- armed robbery
- child abduction
- child molestation
- murder
- rape
- terrorism
- weapons

Blairsville, PA Dentist Dr. John Yelenic



State Trooper Arrested



November 2007: Kevin Foley charged with crime

Fingernail DNA Evidence



93.3% victim + 6.7% DNA component

Three DNA Match Statistics

Score	Method
13 thousand	inclusion
23 million	with victim
189 billion	TrueAllele

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Jury convicts trooper of dentist slaying

Published: Thursday, March 19, 2009 12:46 AM EDT
An Indiana County Court jury this evening convicted state trooper Kevin Foley of first degree murder in the April 13, 2006, slashing death of Blairsville dentist John Yelenic.

"John Yelenic provided the most eloquent and poignant evidence in this case," said the prosecutor, senior deputy attorney general Anthony Krastek. "He managed to reach out and scratch his assailant," capturing the murderer's DNA under his fingernails.



Pennsylvania Precedent

2012 PA Super 31
COMMONWEALTH OF PENNSYLVANIA, IN THE SUPERIOR COURT 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 NOVI. CP-22-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. Herli's methodology, he has failed to show that Dr. Herli's testimony constituted "novel" scientific evidence. *See Bantz*, 908 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.*

Pennsylvania Cases

- Allegheny
- Beaver
- Berks
- Butler
- Cambria
- Columbia
- Delaware
- Indiana
- Luzerne
- Mercer
- York

Allegheny County

19 cases, 15 reports
3 trials, 1 exoneration

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	finger nail	Anthony Morgan	stipulation	life
weapons	gun	Thomas Doswell	guilty plea	1 year
drugs	gun	Derek McKissick & Steve Morgan	2 guilty pleas	2 1/2 years
murder	door handle, shirt sleeves	Calvin Kane	guilty plea	20 years

TrueAllele today

Invented math & algorithms	20 years
Developed computer systems	15 years
Support users and workflow	10 laboratories
Used routinely in casework	3 labs
Validate system reliability	20 studies
Educate the community	50 talks
Train & certify analysts	200 students
Go to court for admissibility	5 hearings
Testify about LR results	20 trials
Educate lawyers and laymen	1,000 people
Make the ideas understandable	200 reports

All the DNA, all the time

TrueAllele applications:

- eliminate DNA backlogs
- reduce forensic costs
- solve crimes
- find criminals
- convict the guilty
- free the innocent
- create a safer society

More TrueAllele information

<http://www.cybgen.com/information>



- Courses
- Newsletters
- Newsroom
- Presentations
- Publications

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



TrueAllele Casework on Virginia DNA Mixture Evidence: Computer and Manual Interpretation in 72 Reported Criminal Cases

Mark W. Perlin¹, Kiersten Dormer¹, Jennifer Hornyak¹, Lisa Schliermeier-Wood², Susan Greenspoon²

¹ Cybergenetics, Pittsburgh, Pennsylvania, United States of America, ² Department of Forensic Science, Richmond, Virginia, United States of America

Abstract

Mixtures are a commonly encountered form of biological evidence that contain DNA from two or more contributors. Laboratory analysis of mixtures produces data signals that usually cannot be separated into distinct contributor genotypes. Computer modeling can resolve the genotypes up to probability, reflecting the uncertainty inherent in the data. Human analysts address the problem by simplifying the quantitative data in a threshold process that discards considerable identification information. Elevated stochastic threshold levels potentially discard more information. This study examines three different mixture interpretation methods, in 72 criminal cases, 111 genotype comparisons were made between 92 mixture items and relevant reference samples. TrueAllele computer modeling was done on all the evidence samples, and documented in DNA match reports that were provided as evidence for each case. Threshold-based Combined Probability of Inclusion (CPI) and stochastically modified CPI (mCPI) analyses were performed as well. TrueAllele's identification information in 101 positive matches was used to assess the reliability of its modeling approach. Comparison was made with 81 CPI and 53 mCPI DNA match statistics that were manually derived from the same data. There were statistically significant differences between the DNA interpretation methods. TrueAllele gave an average match statistic of 113 billion, CPI averaged 6.68 million, and mCPI averaged 140. The computer was highly specific, with a false positive rate under 0.005%. The modeling approach was indicated by having uniformly distributed match statistics over the data set. The computer could make genotype comparisons that were impossible or impractical using manual methods. TrueAllele computer interpretation of DNA mixture evidence is sensitive, specific, precise, accurate and more informative than manual interpretation alternatives. It can determine DNA match statistics when threshold-based methods cannot. Improved forensic science computation can affect criminal cases by providing reliable scientific evidence.

