

Revolutionising DNA analysis in major crime investigations

The Investigator Conferences
Green Park Conference Centre
May, 2014
Aylesbury, Buckinghamshire

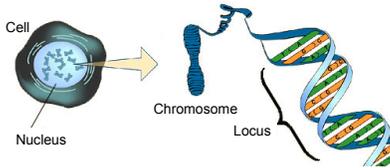
Mark W Perlin, PhD, MD, PhD
Cybergenetics, Pittsburgh, PA



Cybergenetics

Cybergenetics © 2003-2014

DNA biology



Short tandem repeat



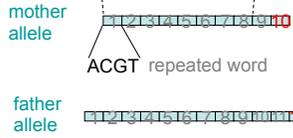
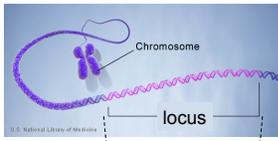
23 volumes in cell's
DNA encyclopedia

DNA locus paragraph

It was the best of times, it was the worst of times,
it was the age of wisdom, it was the age of foolishness,
it was the epoch of belief, it was the epoch of incredulity,
it was the season of Light, it was the season of Darkness,
it was the spring of hope, it was the winter of despair,
we had everything before us, we had nothing before us,
we were all going direct to Heaven,
we were all going direct the other way -- in
short short short short short short short short short short,
the period was so far like the present period, that some of its
noisiest authorities insisted on its being received, for good or
for evil, in the superlative degree of comparison only.

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

DNA genotype



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

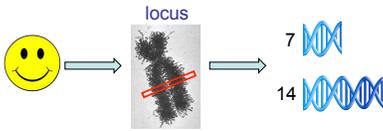
An **allele** is the number of repeated words.

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

10, 12

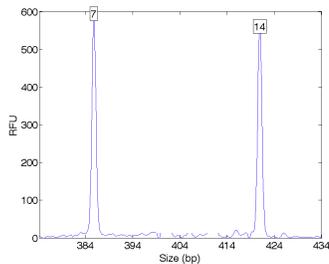
Many alleles allow for many many allele pairs. A person's genotype is relatively unique.

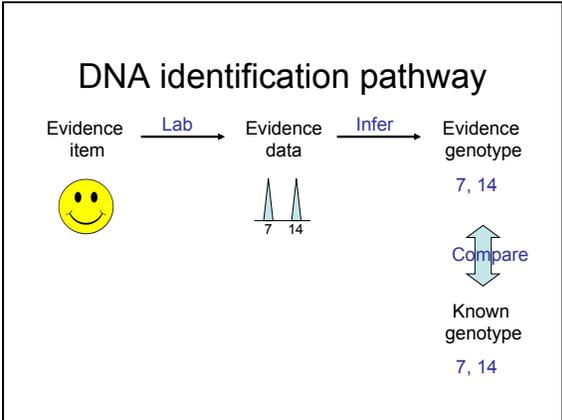
One person, one genotype

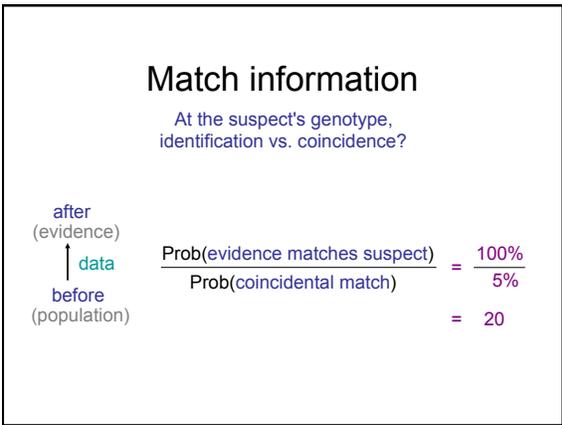


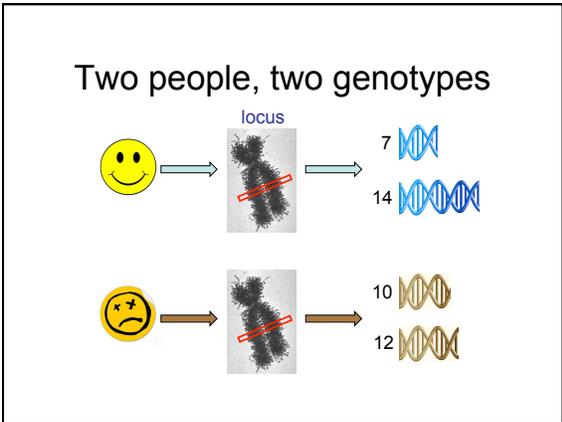
DNA data

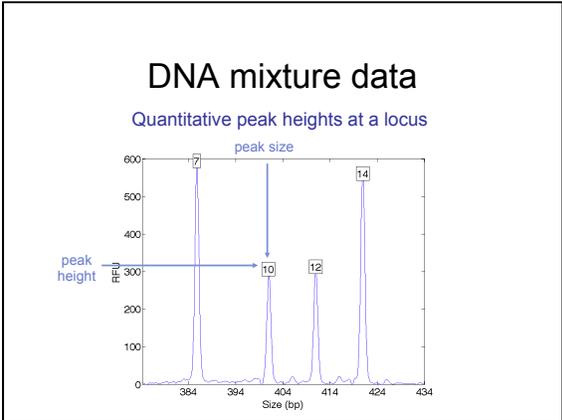
One or two allele peaks at a locus

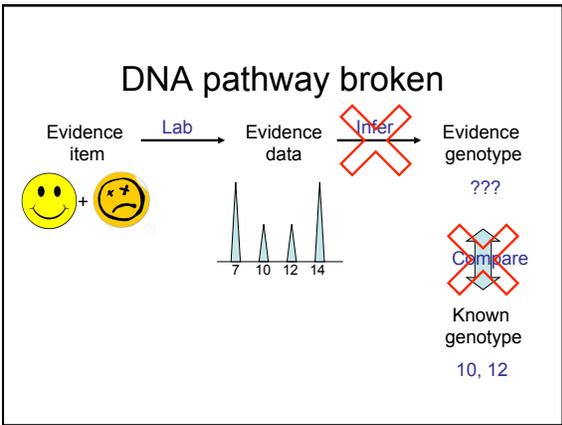












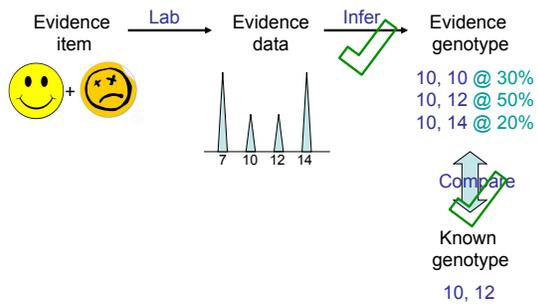
Human interpretation issues

- 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?

$$\frac{\text{Prob}(\text{evidence matches suspect})}{\text{Prob}(\text{coincidental match})} = \frac{50\%}{5\%} = 10$$

after (evidence) ↑ data before (population)

Leicestershire bank robbery



Black balaclava



Brown parka



Black shoes



Helicopter view



Brown parka



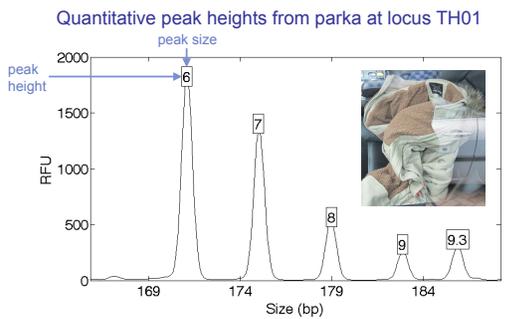
Black balaclava



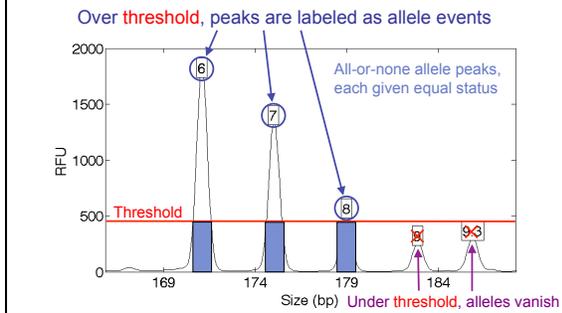
Black shoes



Informative peak height pattern



How people use less of the data



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;

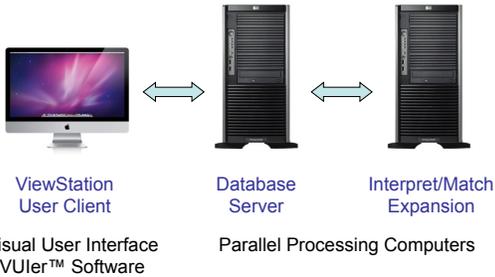
however, due to the overall complexity of the results and the number of contributors to them, a statistical evaluation is not possible.

DNA lab report: Parka

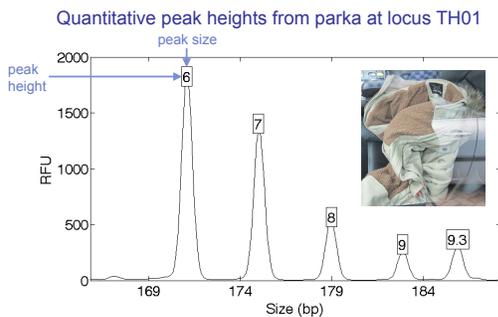
The left and right cuff areas of the brown parka (item CEG/2) were submitted separately for DNA profiling tests. A complex mixed DNA results which appeared to have originated from at least four people was obtained from biological material on the right cuff. In my opinion, this result is not suitable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

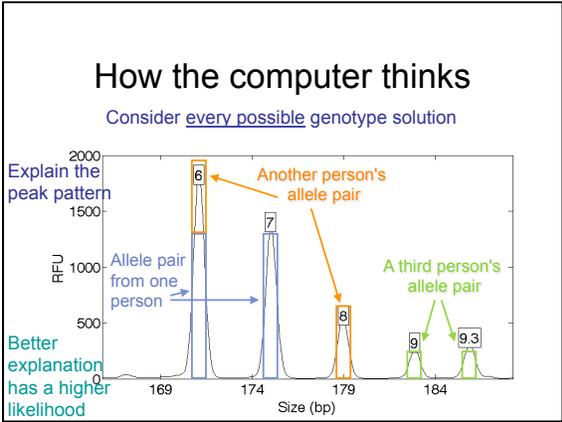
A mixed DNA result, which appeared to have originated from at least three people was obtained from biological material recovered from the left cuff of the brown parka (CEG/2). In my opinion Leroy Williams could have contributed DNA to this result; however, the finding is not suitable for statistical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

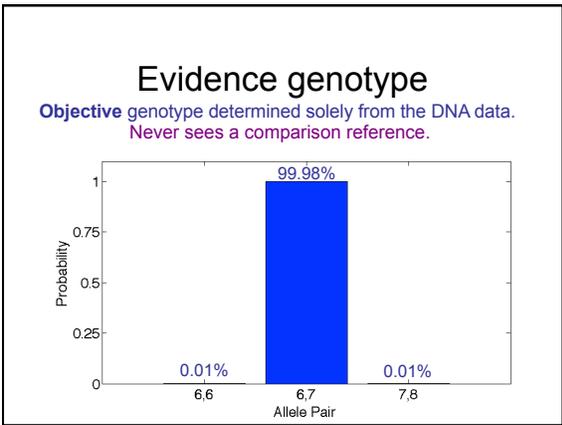
TrueAllele® Technology

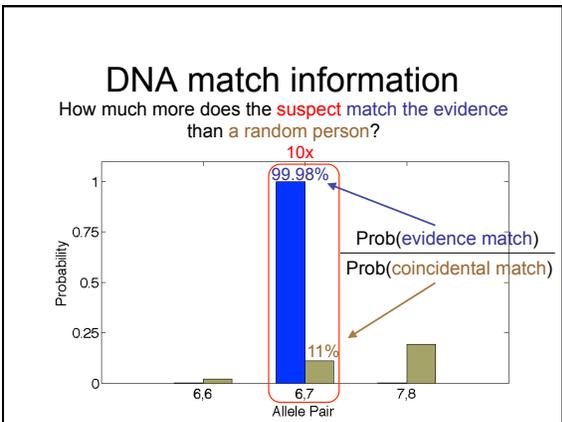


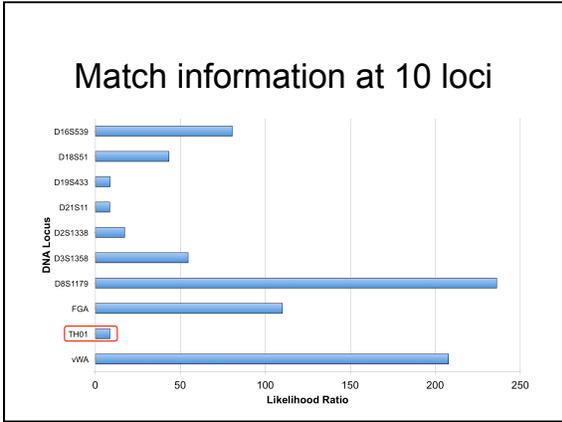
Informative peak height pattern











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

Leicester man Leroy Williams jailed for armed NatWest raid

A man has been jailed for 15 years for his part in a botched bank robbery.

Leroy Williams, 35, fled empty-handed from the NatWest branch in Lutterworth, Leicestershire, when staff managed to retreat to a secure room.

A shotgun and a handgun were wielded by the robbers, and the handgun was fired during January's attempted robbery.

Lincoln Crown Court heard one customer told police he feared for his life when he heard one of the robbers saying: "Put one in him."

Williams, of Hallam Crescent East, Leicester, was convicted of attempted robbery, possession of a firearm and an imitation firearm in August and sentenced earlier.

Three other men have already been jailed for their part in the raid.

Williams raided the bank with Richard Christopher, 33, of Tripp Close, Leicester.

Christopher, who pleaded guilty at an earlier hearing, was sentenced to 10 years for robbery, possession of a firearm and possession of an imitation firearm.

'Incompetency and violence'

The TrueAllele option

Objective, reliable truth-seeking tool

- solves the DNA mixture problem
- relatives & up to six contributors
- handles low-copy and degraded DNA
- provides accurate DNA match statistics
- easy to understand, easy to explain
- automates DNA evidence interpretation

When a report says "a meaningful comparison" or "a statistical evaluation" is not possible, TrueAllele is often highly effective.

Reliable: validation studies

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

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.

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, 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.

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

United Kingdom & Commonwealth countries

TrueAllele has analyzed 22 cases

Country	Crime
Australia (1)	Armed robbery (1)
Canada (3)	Identify theft (1)
England (8)	Murder (14)
Northern Ireland (10)	Rape (2)
	Terror (4)

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