

# Cracking the DNA mixture code – computer analysis of UK crime cases

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Cybergenetics, Pittsburgh, PA



Cybergenetics

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## Leicestershire bank robbery



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## Black balaclava



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Brown parka



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Black shoes



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Helicopter view



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Brown parka



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Black balaclava



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Black shoes



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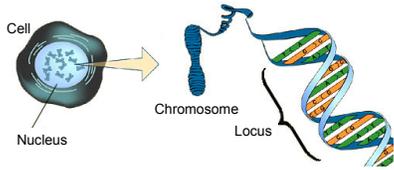
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## DNA biology




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## 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,  
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

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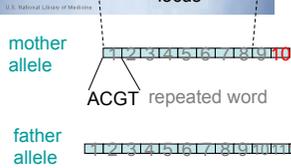
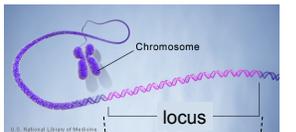
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## DNA genotype



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.

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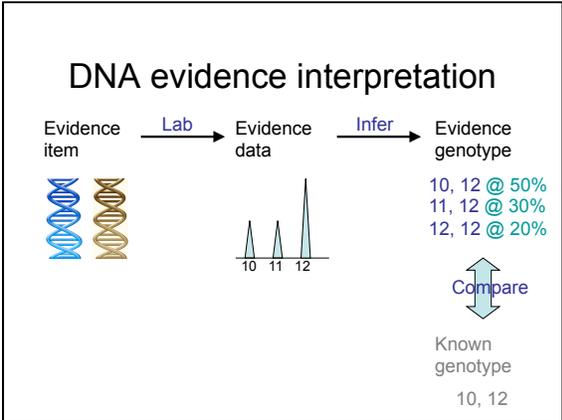
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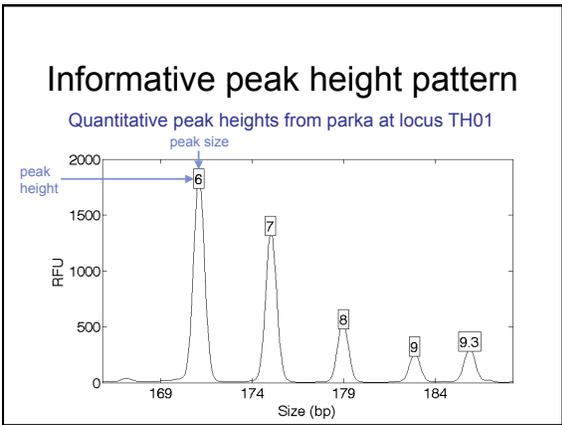
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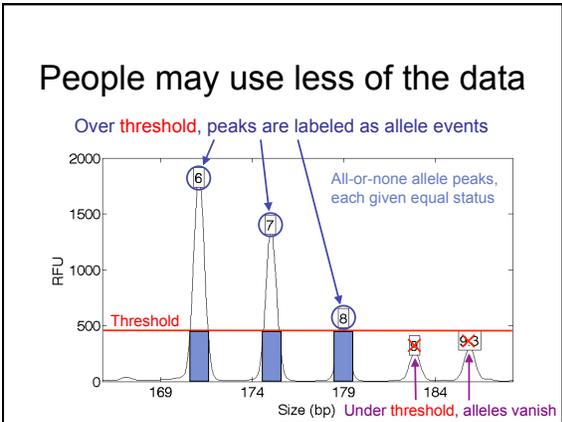
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## DNA lab report: **Balaclava**

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.**

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## 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.**

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## 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.**

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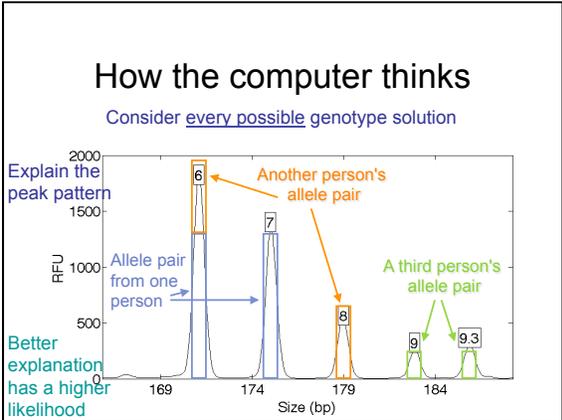
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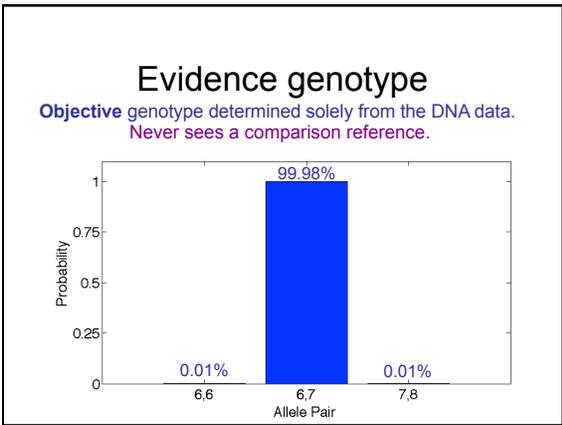
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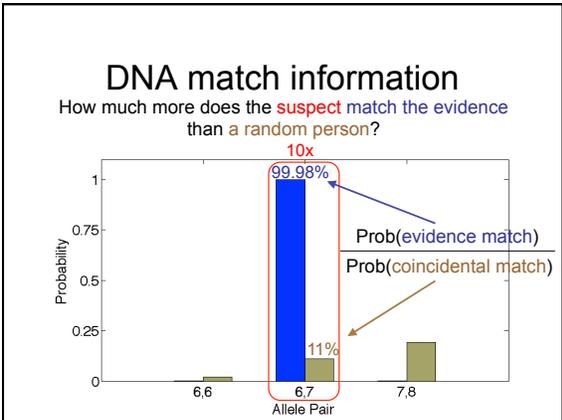
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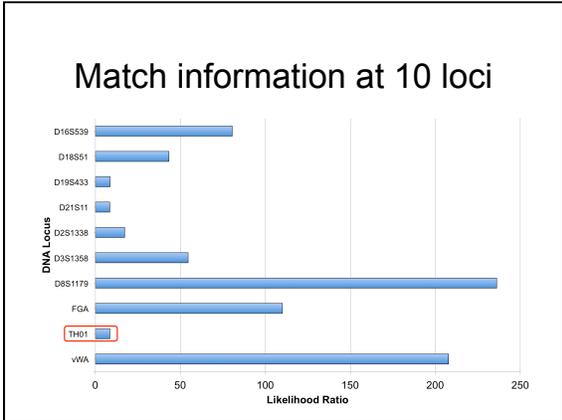
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### Is the suspect in the evidence?

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

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**NEWS LEICESTER**

29 November 2013 Last updated at 13:51 ET

#### 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'

Leroy Williams admitted he was not a good role model to his seven children.

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## 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.

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## 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.

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## 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

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## 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)

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## 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

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## 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

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## More TrueAllele information

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



- Courses
- Newsletters
- Newsroom
- Presentations
- Publications

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



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