

Unleashing Forensic DNA through Computer Intelligence

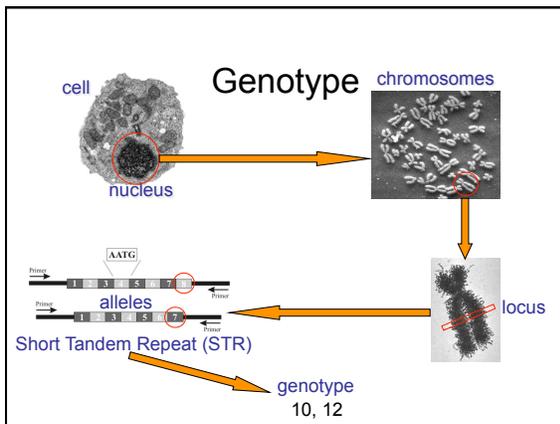
Forensics Europe Expo
Forensic Innovation Conference
April, 2013
London, UK

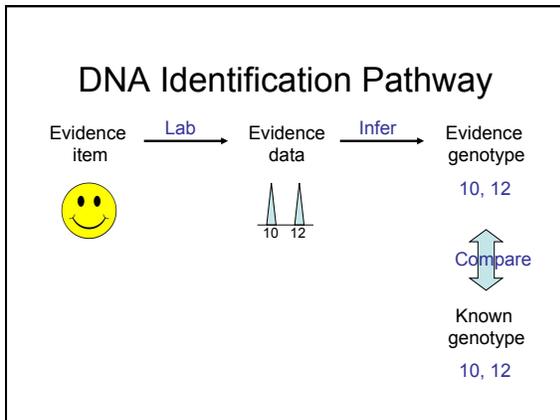
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Cybergenetics, Pittsburgh, PA



Cybergenetics

Cybergenetics © 2003-2013





Match Information

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

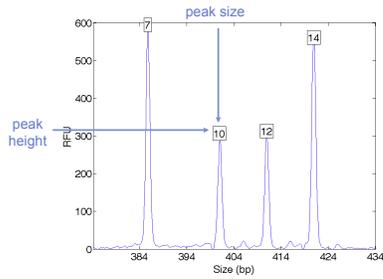
$$\frac{\text{Prob}(\text{evidence matches suspect})}{\text{Prob}(\text{coincidental match})} = \frac{100\%}{5\%} = 20$$

↑ data

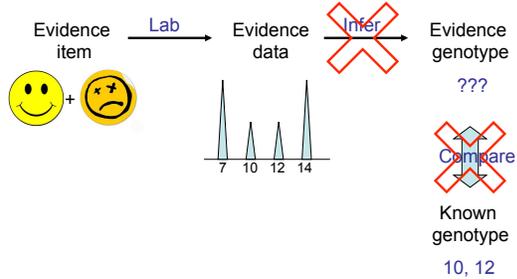
after (evidence) / before (population)

DNA Mixture Data

Quantitative peak heights at a locus



DNA Pathway Broken



Human Interpretation Issues

Evidence

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

Database

- hit by association, not by match
- comparison: make false hits
- restrict upload: lose true hits

TrueAllele® Casework

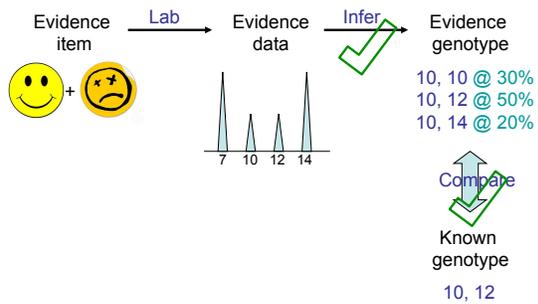
Evidence

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

Database

- hit based on LR match statistic
- sensitive: find true hits
- specific: only true hits

DNA Pathway Restored



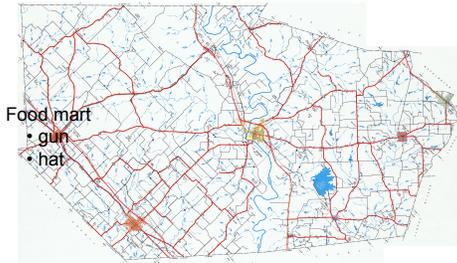
Match Information Preserved

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

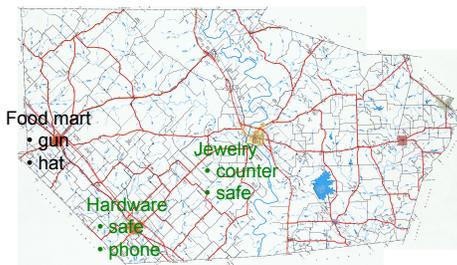
$$\begin{array}{l} \text{after} \\ \text{(evidence)} \\ \uparrow \text{data} \\ \text{before} \\ \text{(population)} \end{array} \quad \frac{\text{Prob}(\text{evidence matches suspect})}{\text{Prob}(\text{coincidental match})} = \frac{50\%}{5\%} = 10$$

Perlin MW. DNA mapping the crime scene: do computers dream of electric peaks?
Promega's Twenty Third International Symposium on Human Identification, 2012; Nashville, TN.

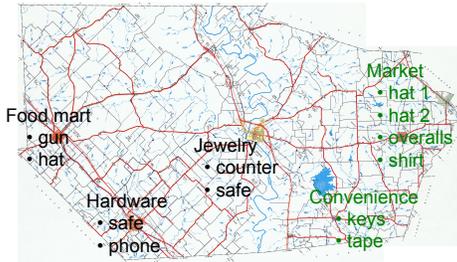
Gang crime in Kern County



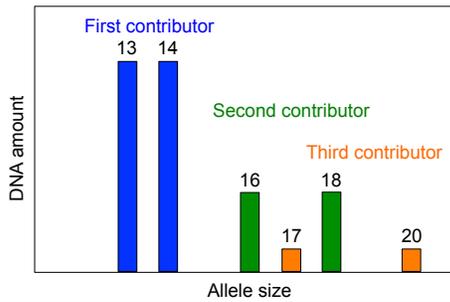
Escalation



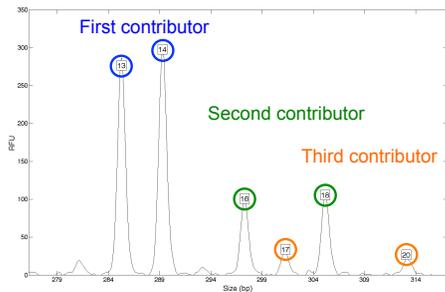
Evidence from multiple scenes



DNA evidence: genotypes



Develop STR data



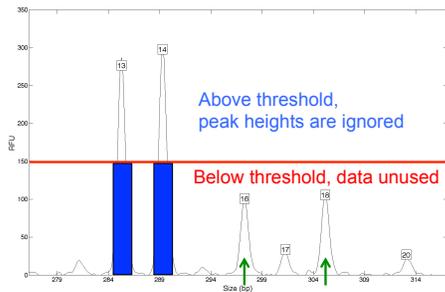
Laboratory processing

- | | | |
|-------------------|--------------------|------------|
| 12 evidence items | 10 reference items | |
| Scene 1 | • gun | 5 victims |
| | • hat | • V1 |
| Scene 2 | • safe | • V2 |
| | • phone | • V3 |
| Scene 3 | • counter | • V4 |
| | • safe | • V5 |
| Scene 4 | • keys | 5 suspects |
| | • tape | • S1 |
| Scene 5 | • hat 1 | • S2 |
| | • hat 2 | • S3 |
| | • overalls | • S4 |
| | • shirt | • S5 |

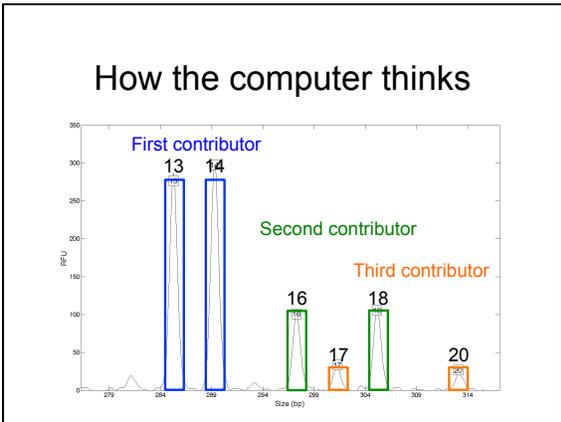
DNA match questions

log(LR)	Suspect 1	Suspect 2	Suspect 3	Suspect 4	Suspect 5
1. Gun					
1. Hat					
2. Safe					
2. Phone					
3. Counter					
3. Safe					
4. Keys					
4. Tape					
5. Hat 1					
5. Hat 2					
5. Overalls					
5. Shirt					

Human review: no results



How the computer thinks



TrueAllele: objective genotypes

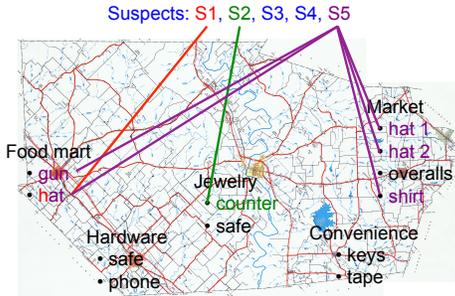
For each contributor, at every locus

Allele pair	Probability
16, 18	65%
14, 18	12%
13, 18	10%
18, 20	8%
17, 18	4%

TrueAllele: match answers

log(LR)	Suspect 1	Suspect 2	Suspect 3	Suspect 4	Suspect 5
1. Gun					4
1. Hat	3				4
2. Safe					
2. Phone					
3. Counter		6			
3. Safe					
4. Keys					
4. Tape					
5. Hat 1					6
5. Hat 2					
5. Overalls					11
5. Shirt					3

DNA mapping the crime scene



Report results in court



A match between the evidence and the suspect is 553 million times more probable than a coincidental match to an unrelated Black person

M. W. Perlin, "Easy reporting of hard DNA: computer comfort in the courtroom," *Forensic Magazine*, vol. 9, pp. 32-37, 2012.



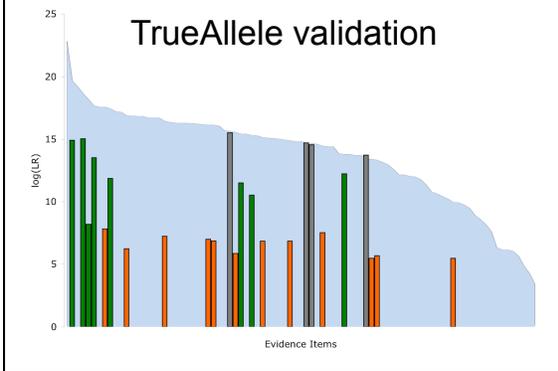
TrueAllele reliability

Perlin MW, Sinelnikov 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.

Perlin MW, Belrose JL, Duceman BW. [New York State TrueAllele® Casework validation study](#). *Journal of Forensic Sciences*. 2013;58(6):in press.

Perlin MW, Belrose JL, Duceman BW. [New York State TrueAllele® Casework validation study](#). *Journal of Forensic Sciences*. 2013;58(6):in press.



TrueAllele in criminal trials

Over 100 case reports filed on DNA evidence

Court testimony:

- state
- federal
- military
- foreign

Crimes:

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

TrueAllele in the United States



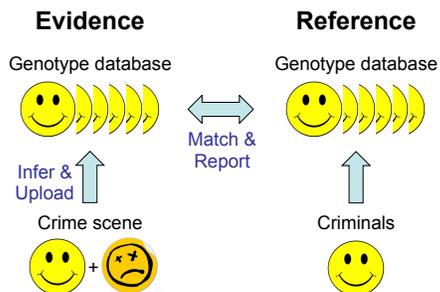
Casework system
Interpretation services

TrueAllele in the United Kingdom

- 2000: FSS & TrueAllele Databank
- first fully automated DNA expert system
 - for reference samples only
 - *faster*: eliminated 350,000 item backlog
 - *better*: eliminated human error of 0.05%
 - *cheaper*: eliminated 100 jobs

- 2010: PSNI & TrueAllele Casework
- match stats for complex DNA evidence
 - 3-4 person DNA mixtures
 - low-template & degraded DNA
 - Massereene Barracks attack

Real Information, Real Time



TrueAllele computer age

Objective, reliable truth-seeking tool

- solves the DNA mixture problem
- handles low-copy and degraded DNA
- provides accurate DNA match statistics
- automates DNA evidence interpretation

Currently used to:

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

More information

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

- Courses
- Newsletters
- Newsroom
- Presentations
- Publications

http://www.cybgen.com/support/sending_data.shtml



Cybergenetics

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