Detecting and Denying DNA Evidence: A History of Forensic Identification

Pioneers of Forensic Science
Duquesne University
June, 2017
Pittsburgh, PA

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Cybergenetics

JUSTICE THROUGH SCIENCE

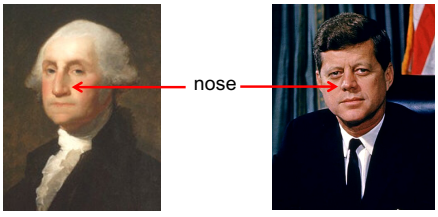
Cybergenetics © 2003-2017

Identification

Everyone has a nose

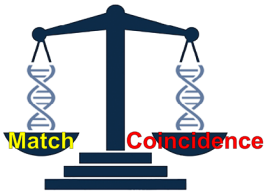
Match

Same person?
Or coincidence?



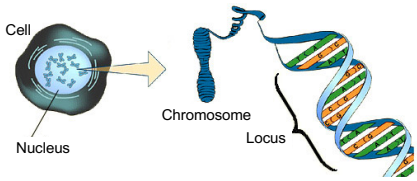
Information

A balance of probability



match statistic
weighs probability

DNA biology



Short tandem repeat

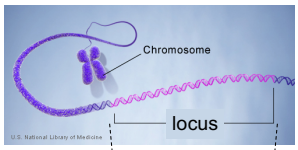
23 volumes in
cell's
DNA encyclopedia

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 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



mother allele

1 2 3 4 5 6 7 8 9 10

ACGT repeated word

father allele

1 2 3 4 5 6 7 8 9 10 11 12

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.

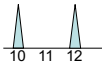
10, 12

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

Simple DNA interpretation

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

DNA from one person



10, 12

Compare

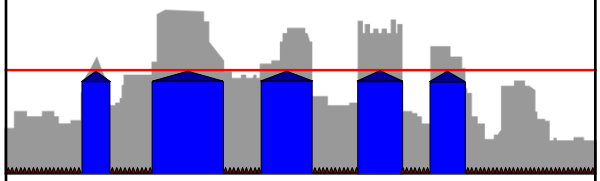
Known genotype

10, 12

Pittsburgh skyline

Draw a threshold

Same heights & vacant lots



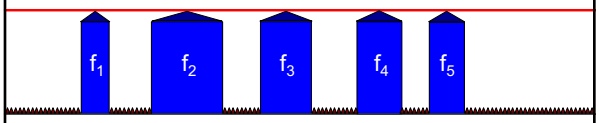
DNA mixture

eye of newt

toe of frog

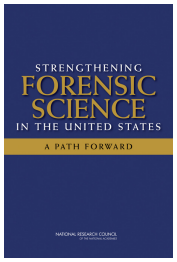
Double, double toil and trouble

Simplify data to interpret mixture



1. Apply threshold to find "alleles"
2. Add allele frequencies ($f_1 + f_2 + \ldots$)
3. Square sum, take reciprocal
4. Locus "probability of inclusion" (PI)
5. Multiply locus PI values
6. Combined (CPI) **match statistic**

National Academy of Sciences



Trouble in River City
2009

Where's the "science" in Forensic Science?

Unreliable DNA mixture statistics

NIST (Commerce Department) study in 2005
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	7.80E+08	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	47,900	1,350,000
16	ProPlus/Cofiler	434,600	31,710	399,100

Remember that these labs are interpreting the same MIX05 electropherograms

When not "inconclusive":

213 trillion (14)

31 thousand (4)

Forensic DNA labs put on notice ten years ago

Biased DNA workflow

Choose data | Person decides | Calculate statistic

- Put people in the process
- To overcome software limits
- And introduce human bias

Falsely identify innocent people

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**

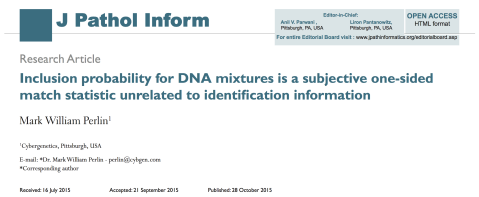
Mixture statistic shuts down labs

"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

Statistics lack scientific basis

Misled courts for 15 years on countless DNA mixtures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Research Article

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

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Received: 16 July 2015 Accepted: 21 September 2015 Published: 28 October 2015

Human mixture interpretation

- Inaccurate. Disagrees with true information
- Subjective. Workflow introduces human bias
- Widespread. Hundreds of thousands of cases
- Opaque. Choices use only some of the data
- Biased. Can only include – or give no answer

Inconclusive

TrueAllele® computer technology

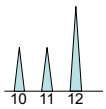
- Accurate. 34 validation studies, 7 published
- Objective. Workflow removes human bias
- Accepted. Reported in 37 states, used by labs
- Transparent. Give math, software (4GB DVD)
- Neutral. Can statistically include or exclude

Informative

DNA mixture interpretation

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

DNA from two people



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

Compare

Known genotype
11, 12

Pennsylvania v. Kevin Foley

Apr 2006: Blairsville Dentist John Yelenic murdered

Nov 2007: Trooper Kevin Foley charged with crime

February 2008: Defense questions 13,000 DNA match score

March 2009: Jury hears 189,000,000,000 TrueAllele statistic

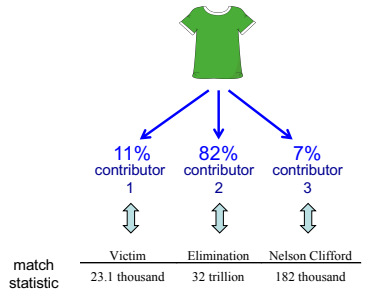
Pennsylvania v. Joshua Huber

Item	Description	Melissa Zuk	Derek Schindler	Joshua Huber
13E	Living room wall bloodstain	1 in 160 million	1 in 36 thousand	11.6 quintillion
29A	Schindler's right hand fingernails		1.37 quintillion	53.8 thousand
1603461-13A	Left hand fingernails of Melissa Zuk	17.4 billion		3.35 thousand

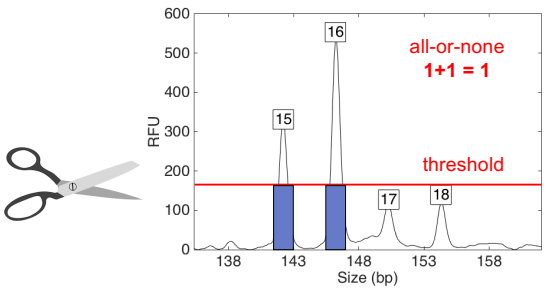
Virginia v. David Black

Item	Description	David Black	Bonnie Black	BettyAnn Armstrong	Craig Black	Eleanora Black
08	Baseball hat velcro strap	32.5 quintillion	16.1 billion		1/1.83 thousand	1/62.6
94	Master bedroom light switch	364 million	8.14 million			
95	Master bathroom light switch	1/19.5	554 million			3.63 million

Maryland v. Nelson Clifford



Crime labs don't use all DNA data

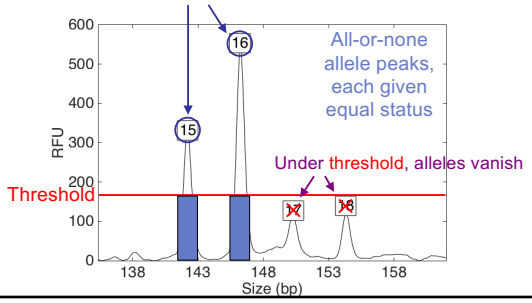


Wolfe sisters homicide

On February 6, 2014, Susan Wolfe (44)
and her younger sister Sarah (38, left)
were killed in their East Liberty home in Pittsburgh.

Crime lab didn't use all DNA data

Over threshold, peaks are labeled as allele events



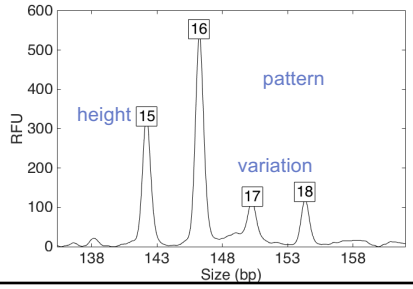
Pennsylvania v. Allen Wade

Thresholds failed to interpret most DNA mixtures

Hat	No conclusions
Cup	Insufficient data
Fingernails	Contamination, insufficient data
Gear shift	Insufficient data
Seat lever	Cannot be excluded
Knit hat	Insufficient data
Sock	Too complex, no conclusions

Computers can use all the data

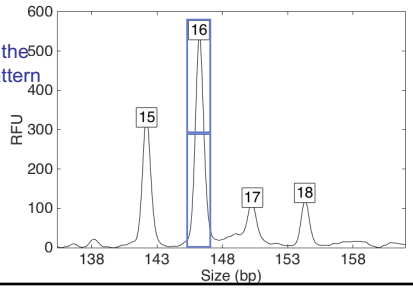
Quantitative peaks at locus vWA



How the computer thinks

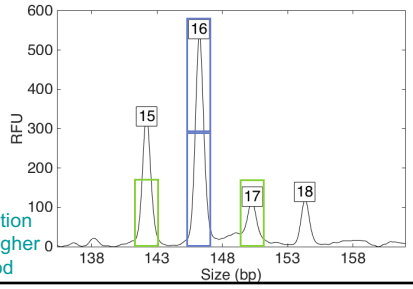
Propose genotype solutions

Explain the peak pattern



How the computer thinks

Add together contributor genotypes



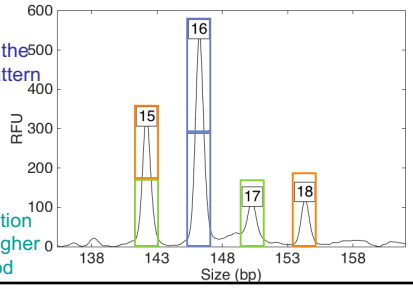
Better explanation has a higher likelihood

How the computer thinks

Consider every possible genotype solution

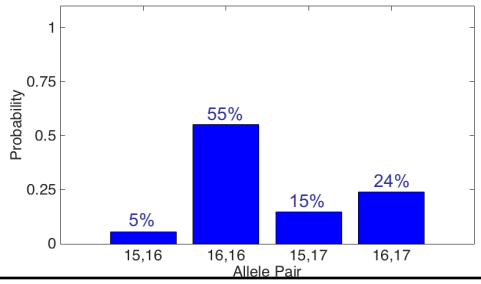
Explain the peak pattern

Better explanation has a higher likelihood



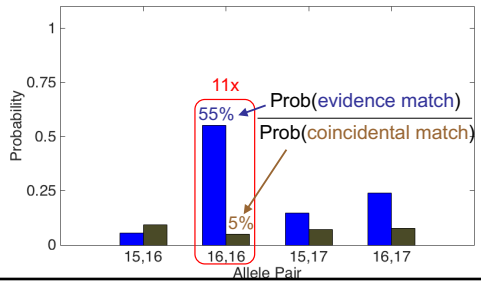
Evidence genotype

Objective genotype determined solely from the DNA data.
Never sees a comparison reference.

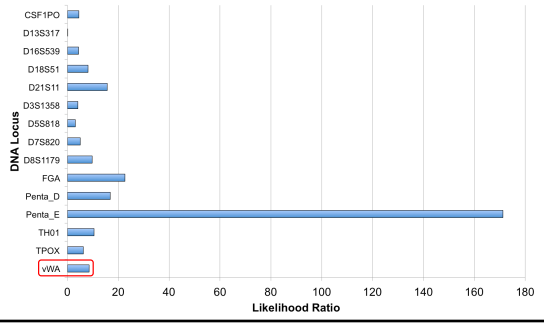


DNA match information

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



Match information at 15 loci



Is the suspect in the evidence?

A match between the right fingernails
and Allen Wade is:

6.06 trillion times more probable than
a coincidental match to an unrelated Black person

32.5 trillion times more probable than
a coincidental match to an unrelated Caucasian person

8 trillion times more probable than
a coincidental match to an unrelated Hispanic person

Pennsylvania v. Allen Wade

The crime lab reported 5 DNA mixture matches
TrueAllele found 17 matches on the same data

Hat	65.3 thousand	Allen Wade
Cup	20.5 thousand	Susan Wolfe
Fingernails	6.06 trillion	Allen Wade
Gear shift	9.37 million	Sarah Wolfe
Seat lever	385 billion	Sarah Wolfe
Knit hat	25.7 thousand	Allen Wade
Sock	300	Sarah Wolfe

Allen Wade Found Guilty On All Counts In East Liberty Sisters' Slaying

CBS News, May 23, 2016

PITTSBURGH (KDKA/AP)

- A man accused of killing two sisters who lived next door to him in East Liberty has been found guilty on all counts.
- Allen Wade was accused of shooting Sarah and Susan Wolfe after they returned from work on Feb. 6, 2014, apparently to steal a bank card.
- On Monday morning, a jury found Wade guilty of first-degree murder, robbery, burglary and theft by unlawful taking.

Pennsylvania v. Allen Wade

Thresholds failed to interpret DNA mixture
TrueAllele succeeded on the same data

A hat left from a burglary of the Wolfe sister's home six weeks before the murder matched Allen Wade with a 65.3 thousand statistic

Preventable Crime

No information from mixture

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

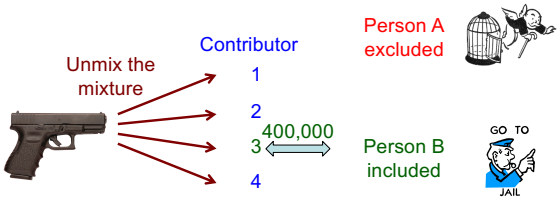
Conclusions:

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



Allegheny County: 59 cases, 13 trials, 4 exonerations

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	fingernail, clothing	Allen Wade	guilty	life
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	Zachary Blair	guilty plea	15 years
weapons	gun	Delmingo Williams	guilty plea	3 years
incest rape	clothing	Terry L.	guilty	40 years
bank robbery	hat	Robert Schatzman	guilty	1 1/2 years
weapons	gun	Rashawn Walker	guilty	1.5 years
robbery	hat	Lauren Peak	guilty plea	1 year
rape	body cavity	Freddie Cole	guilty plea	2 years
murder	gun	Chaz White	guilty plea	4 years
sex crime	clothing	Christopher Stavish	guilty plea	2 1/2 years
murder	gun	Jake Knight	guilty	life

Pursue the past

Pittsburgh Post-Gazette

Allegheny County crime lab vying to use more advanced DNA database

Technology developed by Cybergenetics gets conclusive results from DNA mixtures

February 28, 2014

Darryl Pinkins imprisoned

1989 – 5 men raped an Indiana woman
Darryl Pinkins and 2 others misidentified
1991 – wrongfully convicted, 65 year sentence

2001 – DNA mixture evidence
2 contributors found, not the accused
but 5 were needed, post-conviction relief denied

TrueAllele Pinkins findings

1. compared *evidence with evidence*
2. calculated *exclusionary match statistics*
3. revealed 5% *minor mixture contributor*
4. *jointly analyzed* DNA mixture data
5. showed three perpetrators were *brothers*

found 5 unidentified genotypes,
defendants not linked to the crime

Pinkins exonerated

Why government DNA fails

- Crime lab culture
  - Scientists vs. technicians
- Courtroom culture
  - Lawyers vs. experts
- Protecting the past
  - Fear of civil lawsuits
- Preserving the present
  - Tight federal control
- Funding the future
  - In government,
  - *the problem is the solution*

Non-governmental organization

JUSTICE THROUGH SCIENCE

1. Reanalyze forgotten DNA evidence

2. Educate lawyers, scientists & society

Education and service

	Education	Service
Lawyers	Trials & hearings	Open the past
Scientists	Teach juries	Find the truth
Journalists	DNA basics	Tell the stories

JUSTICE THROUGH SCIENCE

More information

http://www.cybgen.com/information

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