

TrueAllele® Modeling of DNA Mixture Genotypes

California Association of
Crime Laboratory Directors
October, 2014
San Francisco, CA

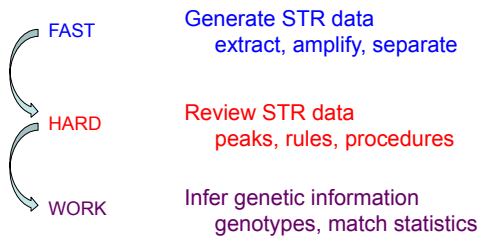
Mark W Perlin, PhD, MD, PhD
Cybergenetics, Pittsburgh, PA



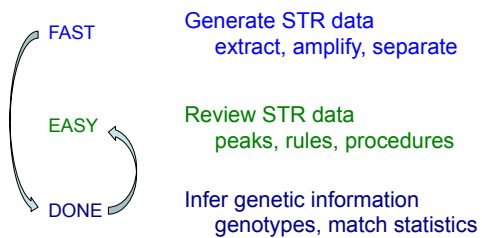
Cybergenetics

Cybergenetics © 2003-2014

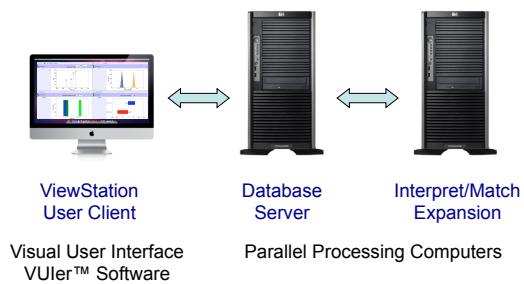
Data review bottleneck



Pre-analyze by computer



TrueAllele® Casework



TrueAllele-first workflow

- Full plate of EPG data files



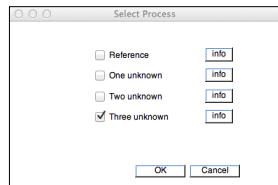
TrueAllele-first workflow

- Full plate of EPG data files
- TrueAllele peak analysis and upload



TrueAllele-first workflow

- Full plate of EPG data files
- TrueAllele peak analysis and upload
- Analyst asks computer all questions

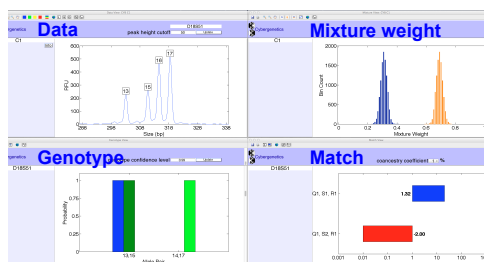


TrueAllele-first workflow

- Full plate of EPG data files
- TrueAllele peak analysis and upload
- Analyst asks computer all questions
- Computer solves, provides answers

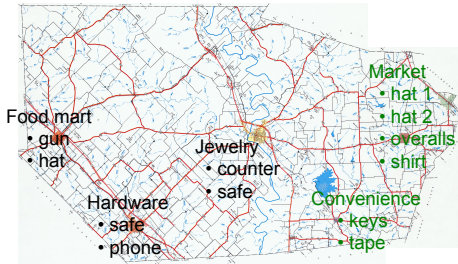
Separated genotypes
Mixture weights
Likelihood ratios

Visual user interface



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

Evidence from multiple scenes



Laboratory DNA processing

3 to 4 person mixtures

12 evidence items

Scene 1

• gun

• hat

Scene 2

• safe

• phone

Scene 3

• counter

• safe

Scene 4

• keys

• tape

Scene 5

• hat 1

• hat 2

• overalls

• shirt

10 reference items

5 victims

• V1

• V2

• V3

• V4

• V5

5 suspects

• S1

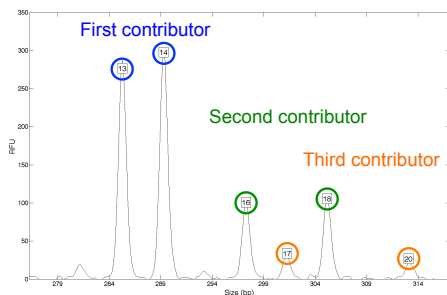
• S2

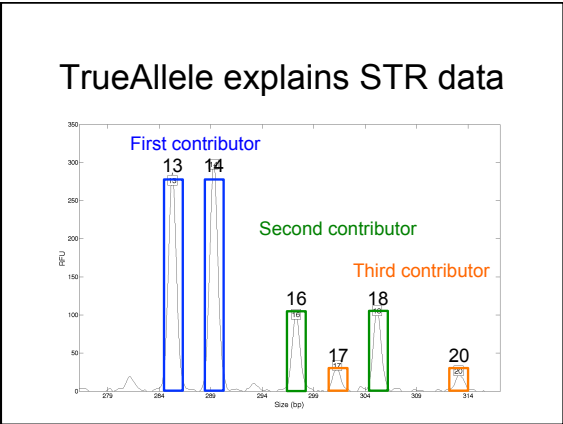
• S3

• S4

• S5

Kern lab develops STR data





TrueAllele separates 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%

Objective analysis, computer never sees suspect profile

TrueAllele matches genotypes

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. Overall					11
5. Shirt					3

Review data, prepare report

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

Separated genotypes for each contributor

- TrueAllele does the heavy lifting
- single-source simplicity & language
- evidentiary & investigative use

Admissibility, trial, conviction

"By one touch, Mr. Langston when he put his hand down to go over the counter at the Delano store, the Delano P.D. was able to swab that and find low level DNA ... and match to Mr. Langston. It's the first time that method has ever been done in California," said Cynthia Zimmer, Deputy District Attorney.



Sentenced to 73 years in prison

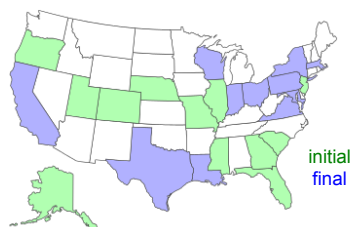
Admissibility challenge

- California
- Louisiana
- Maryland
- New York
- Ohio
- Pennsylvania
- Virginia
- United Kingdom
- Australia

Appellate precedent in Pennsylvania

TrueAllele in the United States

Laboratory systems or case reports in 23 states

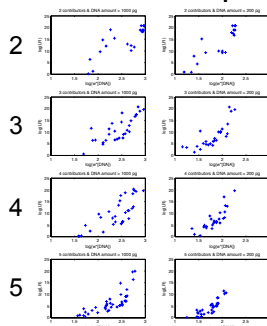


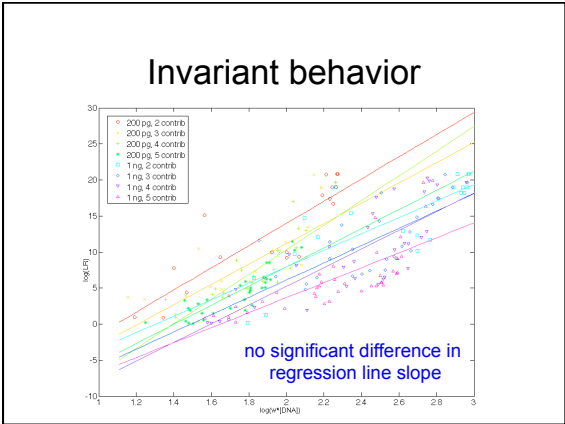
TrueAllele® genotype identification on DNA mixtures containing up to five unknown contributors.
 Perlín MW, Hornyak J, Sugimoto G, Miller K
Journal of Forensic Sciences. 2015;in press.

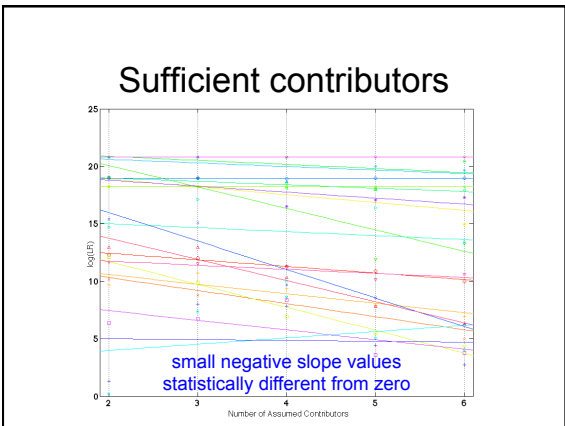
Kern County validation study

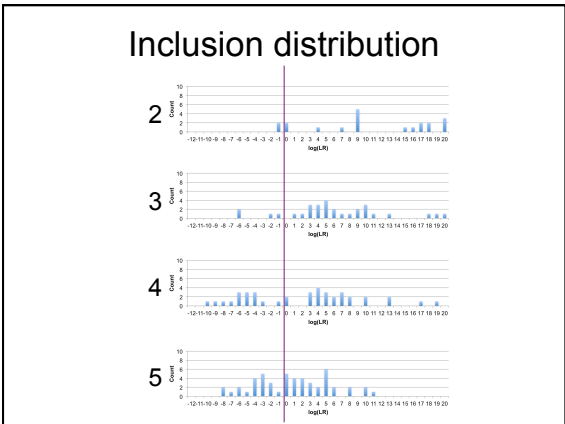


Information response

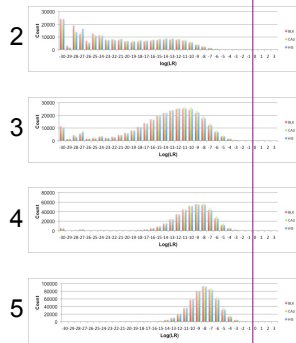




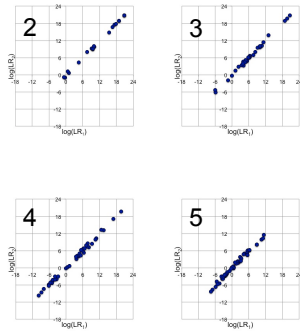




Exclusion distribution



Reproducibility comparison



Peer-reviewed validation papers

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

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.

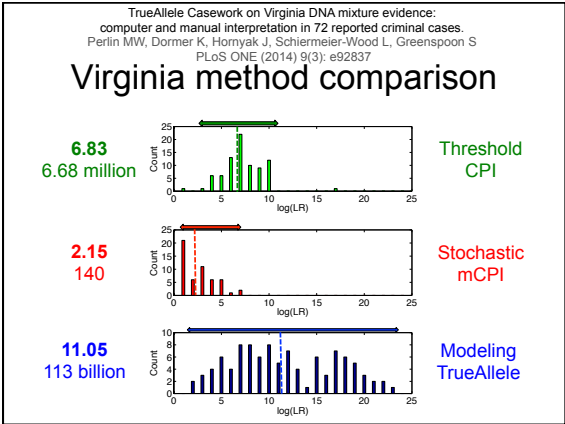
Perlin MW, Hornyak J, Sugimoto G, Miller K. TrueAllele® genotype identification on DNA mixtures containing up to five unknown contributors. *Journal of Forensic Sciences*. 2015;in press.

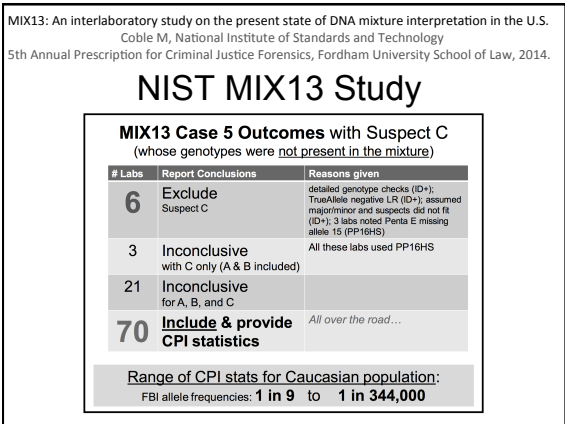
Greenspoon SA, Schiermeier-Wood L, Jenkins BC. Establishing the limits of TrueAllele® Casework: a validation study. *Journal of Forensic Sciences*. 2015;in press.

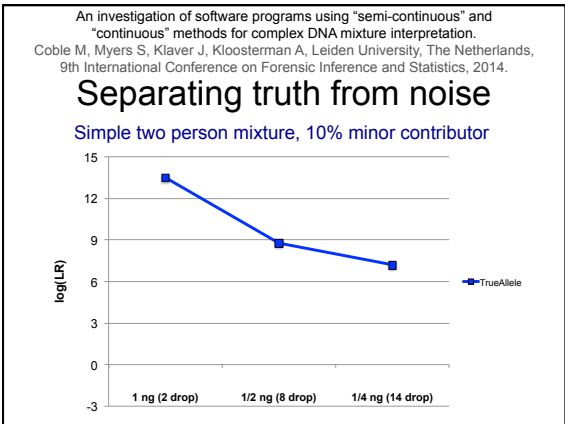
Perlin MW, Legler MM, Spencer CE, Smith JL, Allan WP, Belrose JL, Duceman BW. Validating TrueAllele® DNA mixture interpretation. *Journal of Forensic Sciences*. 2011;56(6):1430-47.

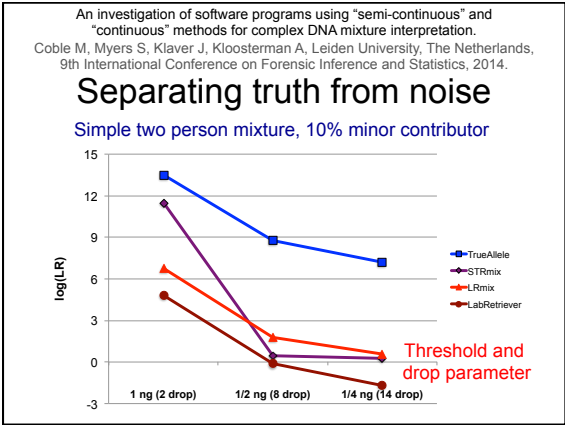
Perlin MW, Belrose JL, Duceman BW. New York State TrueAllele® Casework validation study. *Journal of Forensic Sciences*. 2013;58(6):1458-66.

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):e92837.









TrueAllele in California

Forensic MAGAZINE
SPECIAL ISSUE

Kern County Resolves the DNA Mixture Crisis
By W. F. Felt and Kevin W. Felt

TrueAllele in California
Resolving the DNA Mixture Crisis
Analysis of Mixed Profiles
by H. H. H. H.

VICOR
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Harvest database matches

Within case

Select	Case 1	Item 1	Case 2	Item 2	log(LR)
☐	11PED0795	88662A	11PED0795	88759X	21.955
☐	11PED0772	88657X	11PED0772	88784X	15.416
☐	11PED0761	88866M	11PED0761	88810X	15.165
☒	11PED0761	88866M	11PED0761	88815X	10.842
☒	11PED0761	88863M	11PED0761	88819X	09.143
☐	11PED0761	88863M	11PED0761	88815X	07.412
☐	11PED0772	88565X	11PED0772	88784X	07.029
☐	11PED0772	88732X	11PED0772	88784X	06.185

Between case

Select	Case 1	Item 1	Case 2	Item 2	log(LR)
☒	10PED0285	86931X	11PED0772	88657X	08.013
☒	10PED0285	86930X	11PED0772	88657X	07.543
☒	10PED0285	86990X	11PED0772	88657X	05.772
☐	10PED0285	86931X	11PED0772	88565X	04.779
☐	10PED0285	86931X	11PED0772	88732X	03.670
☐	10PED0285	86990X	11PED0772	88565X	03.206
☐	10PED0285	86990X	11PED0772	88732X	03.014

TrueAllele Cloud



Your cloud, or ours

Interpret and identify
anywhere, anytime

- Crime laboratory
 - Training
 - Validation
 - Spare capacity
 - Rent instead of buy
- Solve unreported cases
- Prosecutors & police
- Defense transparency
- Forensic education

More information

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



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



Cybergenetics



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