How Inclusion Interpretation of DNA Mixture Evidence Reduces Identification Information

American Academy of Forensic Sciences
February, 2013
Washington, DC

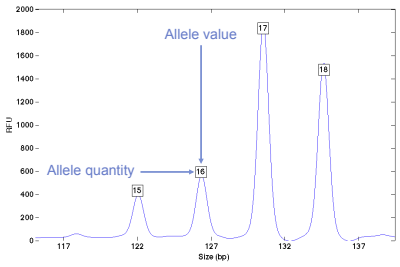
Mark W Perlin, PhD, MD, PhD
Kiersten Dormer, MS and Jennifer Hornyak, MS
Cybergenetics, Pittsburgh, PA
Thomas Meyers, MS and Walter Lorenz
Allegheny County Medical Examiner's Office, Pittsburgh, PA

Cybergenetics

Cybergenetics © 2003-2013

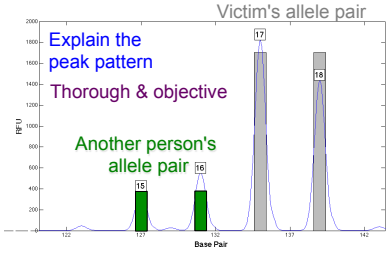
DNA Mixture Data

Quantitative peak heights at a locus



Genotype Inference

Computer-based probabilistic genotyping



Allele Pair
5%15, 15
90%15, 16
5%15, 17
15, 18
16, 16
16, 17
16, 18
17, 17
17, 18
18, 18

Identification Information

Likelihood Ratio

Explaining all the data under two competing hypotheses

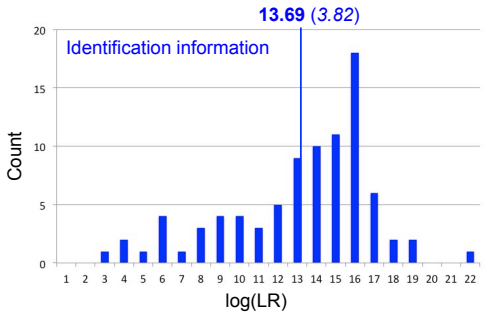
	Matching genotype probability
Evidence	90%
Coincidence	9%

$$LR = \frac{90\%}{9\%} = 10$$

log(LR) = log(10) = 1 ban

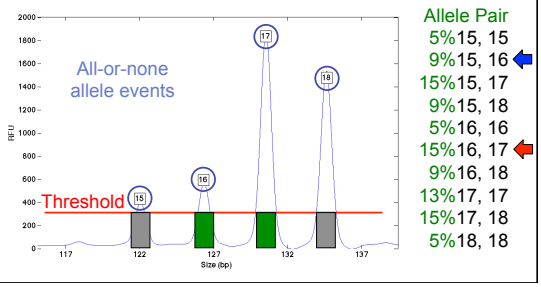
Perlin MW, Belrose JL, Duceman BW. New York State TrueAllele® Casework Validation Study. Journal of Forensic Sciences. 2013;58(6):in press.

Evidence Information



Data Summary for CPI

Over threshold, peaks are labeled as allele events



Allele Pair	
5%	15, 15
9%	15, 16
15%	15, 17
9%	15, 18
5%	16, 16
15%	16, 17
9%	16, 18
13%	17, 17
15%	17, 18
5%	18, 18

Information Loss

Combined probability of inclusion

CPI explains less of the data (no peak heights or model)

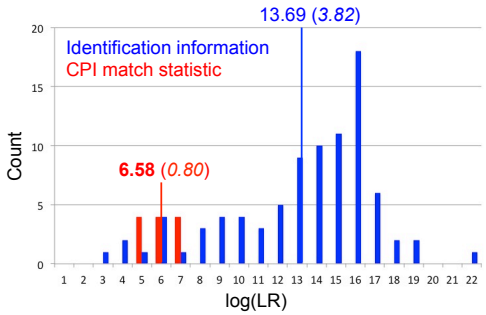
	Matching genotype probability
Evidence	9%
Coincidence	9%

$$LR = \frac{9\%}{9\%} = 1$$

log(LR) = log(1) = 0 ban

Perlin MW, Belrose JL, Duceman BW. New York State TrueAllele® Casework Validation Study. Journal of Forensic Sciences. 2013;58(6):in press.

Evidence CPI Statistic



Mixture Information Study

2 & 3 person DNA mixtures

16 cases
31 evidence items
41 genotype matches

Crime	Item
homicide (7)	clothing (12)
sexual assault (5)	weapon (6)
assault (2)	vehicle (5)
death investigation (1)	skin swab (3)
robbery (1)	vaginal swab (3)
	fingernail (1)
	rectal swab (1)

Match Information vs. Statistic

Computer-inferred genotype information (LR)
Human review data summary statistic (CPI)

41 genotypes x 15 loci
615 locus experiments

human review?

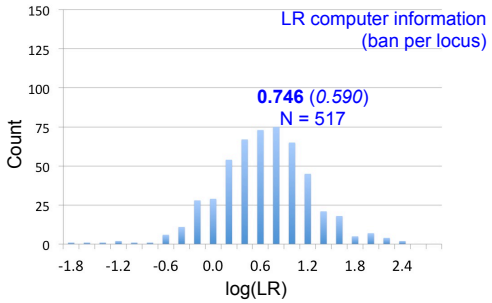
YES → 517
Computer & CPI

NO → drop out or imbalance?

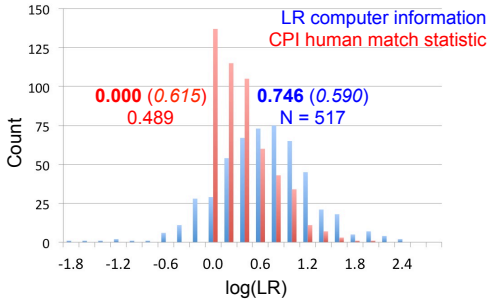
YES → 29

NO → 68
Computer-only results

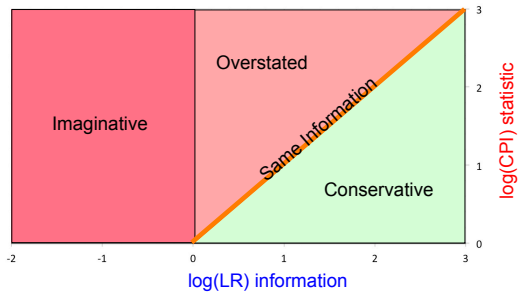
Information (per locus)



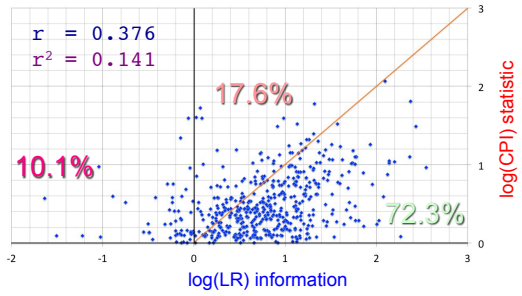
CPI Statistic (per locus)



Joint Statistic Distribution

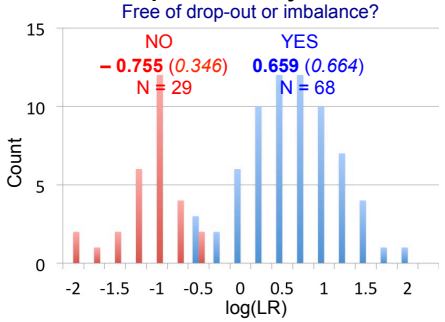


Joint Statistic Distribution



Computer-only Results

Free of drop-out or imbalance?



Conclusions

CPI locus statistic relative to true information

- CPI does not correlate well with identification information
- CPI acts like a random positive number generator
- more loci give a higher statistic; not more information

- 28% of the time CPI overstates actual information
- lower error with the major of a two person mixture

- time to move on … probabilistic genotyping and LR

More information

http://www.cybgen.com/information

- Courses
- Newsletters
- Newsroom
- Presentations
- Publications

Cybergenetics

perlin@cybgen.com