

Open Access DNA Database

Whose DNA is it Anyway?

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March, 2013
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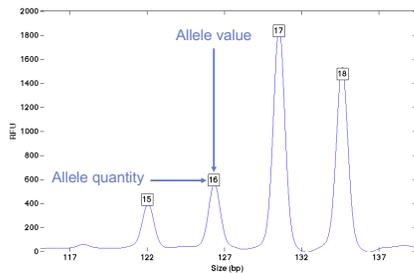


Cybergenetics

Cybergenetics © 2003-2013

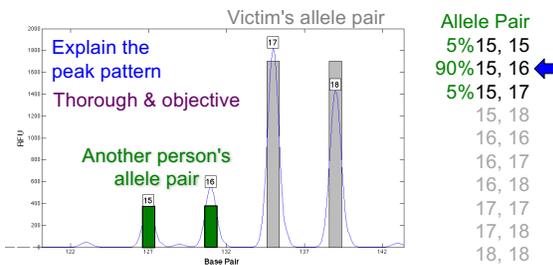
DNA Mixture Data

Quantitative peak heights at a locus



Genotype Inference

Computer-based probabilistic genotyping



Identification Information

Likelihood Ratio

Explaining all the data under two competing hypotheses

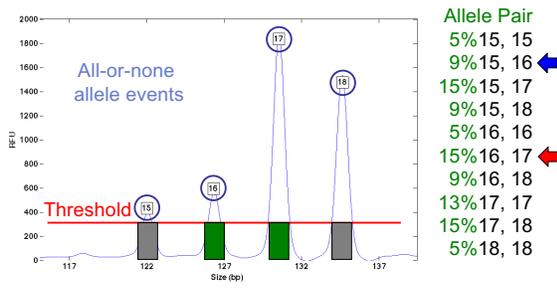
Matching genotype probability

Evidence	90%	→	$LR = \frac{90\%}{9\%} = 10$
Coincidence	9%		

$\log(LR) = \log(10) = 1 \text{ ban}$

Data Summary for CPI

Over threshold, peaks are labeled as allele events



Information Loss

Combined probability of inclusion

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

Matching genotype probability

Evidence	9%	→	$LR = \frac{9\%}{9\%} = 1$
Coincidence	9%		

$\log(LR) = \log(1) = 0 \text{ ban}$

Mixture Information Study

2 & 3 person DNA mixtures

16 cases

31 evidence items

41 genotype matches

Crime

homicide (7)

sexual assault (5)

assault (2)

death investigation (1)

robbery (1)

Item

clothing (12)

weapon (6)

vehicle (5)

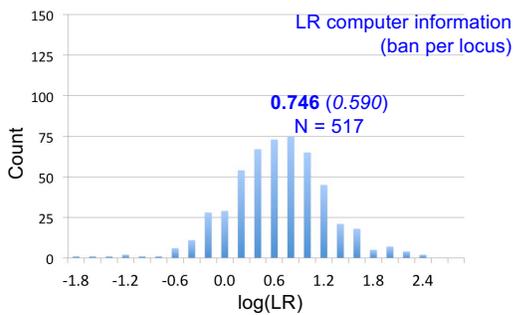
skin swab (3)

vaginal swab (3)

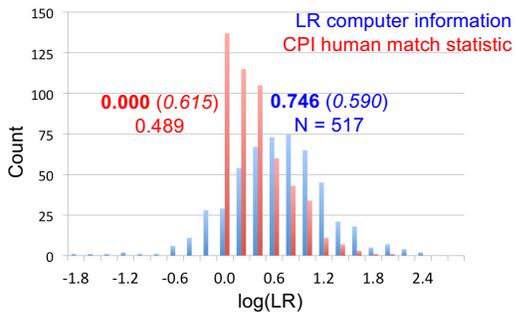
fingernail (1)

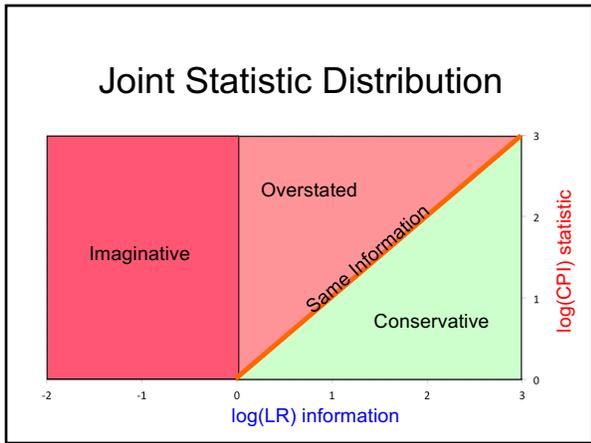
rectal swab (1)

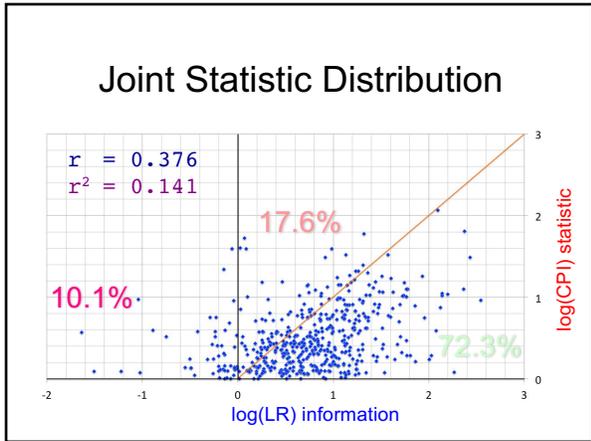
Information (per locus)

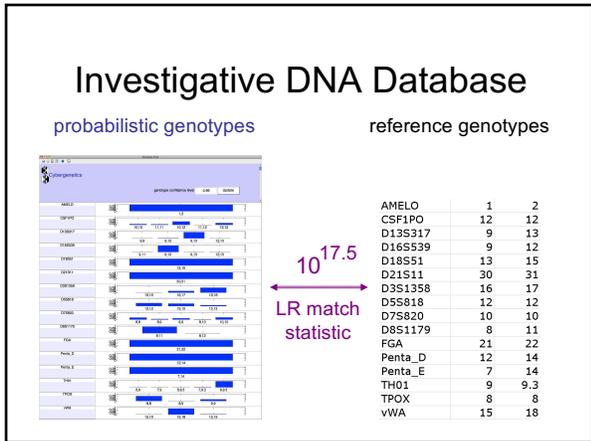


CPI Statistic (per locus)









Investigative Applications

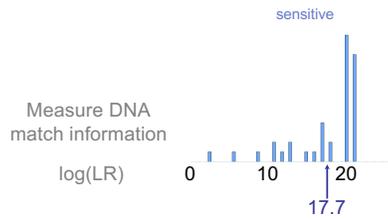
Information-preserving DNA database

- *evidence-to-suspect*, solve cold cases
- *evidence-to-evidence*, connect serial crime
- *evidence-to-kinship*, find missing people
- *kinship-to-reference*, conduct familial search
- *remains-to-missing*, identify disaster victims

Perlin MW. Identifying human remains using TrueAllele® technology. In: Okoye MI, Wecht CH, editors. Forensic Investigation and Management of Mass Disasters. Lawyers & Judges Publishing; 2007.

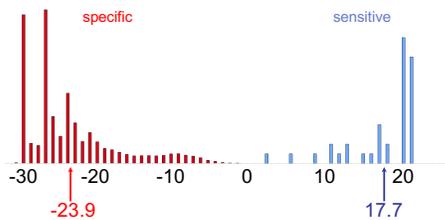
Sensitive

Two contributors, victim known
Infer one probabilistic genotype



Specific

Compare with 1,000 random genotypes



Allele List Database

uploadable allele lists

reference allele lists

CSF1PO	10	11	12							CSF1PO	12
D13S317	12	13								D13S317	9 13
D16S539	13									D16S539	9 12
D18S51	13	15	16	17						D18S51	13 15
D21S11	29	31.2								D21S11	30 31
D3S1358	18									D3S1358	16 17
D5S818	12	13								D5S818	12
D7S820	8	9	10							D7S820	10
D8S1179	8	11	12							D8S1179	8 11
FGA	21	22	23							FGA	21 22
TH01	7									Penta_D	12 14
TPOX	8	9								Penta_E	7 14
vWA	16	19								TH01	9 9.3
										TPOX	8
										vWA	15 18

7 of 13 loci hit

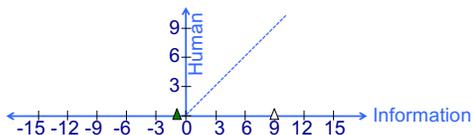
moderate stringency

Information Comparison

Type of DNA database	Sensitive?	Specific?
Probabilistic genotype	LR average is about a quadrillion	False positive rate < 0.01%
Allele list (moderate stringency)	Upload fails about 1/3 of the time	Hits 5%-25% of the DNA database

State v. Sullivan

Location: Western United States
 Crime: Assault with weapon
 Evidence: Gun
 True information: -1, +9
 Human guess: 0 (inconclusive)
 Reason: Mixture
 Outcome: Still in prison



DNA database exoneration?



Computer-inferred
evidence genotype

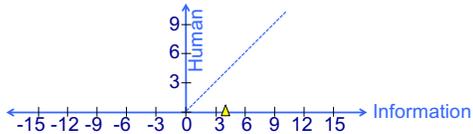
Post-conviction test
Information < 0

The right person?
Information ~ 9

10 million offenders
CODIS ineffective
Any alternative?

State v. Diggins

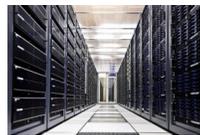
Location: Southern United States
Crime: Rape
Evidence: Tampon string
True information: 4
Human guess: 0 (inconclusive)
Reason: Low DNA amount
Outcome: Still serving life sentence



DNA database identification?



Computer-inferred
evidence genotype



Anonymized offender
suspect genotypes

Is everything being done that could be done?

- Government monopoly
- offender genotypes
- database access
- uses old technology
- not highly effective

Balancing public safety v. personal privacy
Access to anonymized DNA database

Reducing rape by DNA prevention



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