Probabilistic Genotyping to the Rescue for Pinkins and Glenn

Wrongful Conviction Day
Indiana University McKinney School of Law
October, 2018

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

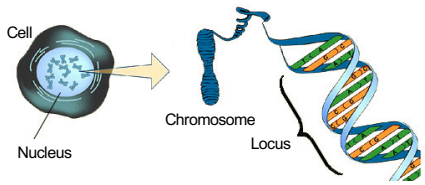
Cybergenetics

Darryl Pinkins confined

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

DNA biology



Short tandem repeat

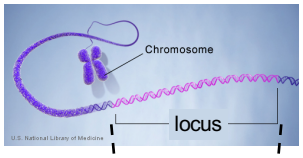
23 volumes in
cell's
DNA encyclopedia

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

ACGT repeated word

father allele

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

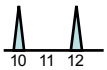
Many alleles allow for many many allele pairs. A person's genotype is relatively unique.

DNA evidence interpretation

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

10, 12

DNA from one person



Compare

Known genotype
10, 12

Jacket evidence

Lab separates DNA
into sperm and nonsperm

sperm mixture → 90% → **major J**
sperm mixture → minor

nonsperm (victim V)

Match table

References

	V	Pinkins
J	-15.39	-18.00

Sweater evidence

Lab separates DNA
into sperm and nonsperm

sperm mixture → 80% → **major S**
sperm mixture → minor

nonsperm fraction (victim)

Match table

References

		V	P
	J	-15.39	-18.00
	S	-15.39	-15.17

FOR PUBLICATION

ATTORNEY FOR APPELLANT

CHARLES E. STEWART, JR.,
Crown Point, Indiana

ATTORNEYS FOR APPELLEE

STEVE CARTER
Attorney General of Indiana

ANDREW A. KOBE
Deputy Attorney General
Indianapolis, Indiana

IN THE
COURT OF APPEALS OF INDIANA

DARRYL KEITH PINKINS,
Appellant-Defendant,
vs.
STATE OF INDIANA,
Appellee-Plaintiff.

No. 45A03-0301-PC-30

APPEAL FROM THE LAKE SUPERIOR COURT
The Honorable Richard W. Maroc, Judge
Cause No. 45G01-9001-CF-0005

December 8, 2003

OPINION - FOR PUBLICATION

BAKER, Judge

Hair evidence

Roosevelt Glenn case

DNA analysis
H

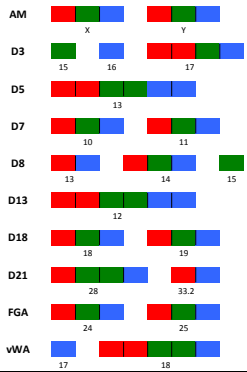
Match table

		References		
		V	P	Glenn
	J	-15.39	-18.00	-15.39
	S	-15.39	-15.17	-15.39
	H	-15.39	-18.00	-15.39

Evidence vs. evidence

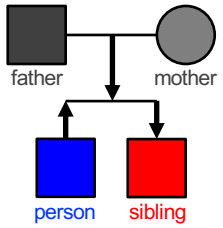
		 J	 S	 H
	J	11.07	1.21	4.15
	S	1.21	10.22	-2.39
	H	4.15	-2.39	10.31

Similar genotypes



Jacket
Sweater
Hair

Kinship analysis



Sibling vs. evidence

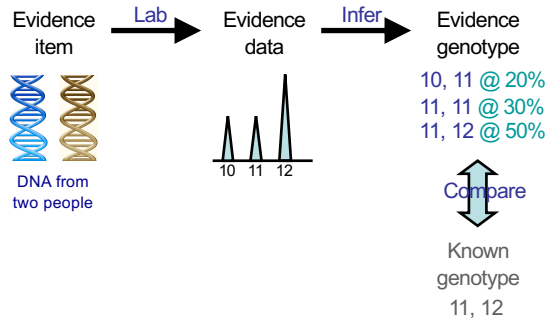
sibling of	J	S	H
J	6.67	4.85	5.08
S	4.70	6.01	3.34
H	5.78	4.18	5.55

XY male genotype, so three brothers

Match table

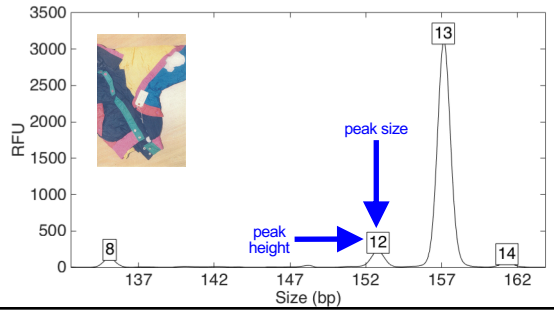
		References					
		V	P	G	J	S	H
J	J	-15.39	-18.00	-15.39	11.07	1.21	4.15
S	S	-15.39	-15.17	-15.39	1.21	10.22	-2.39
H	H	-15.39	-18.00	-15.39	4.15	-2.39	10.31

DNA mixture interpretation



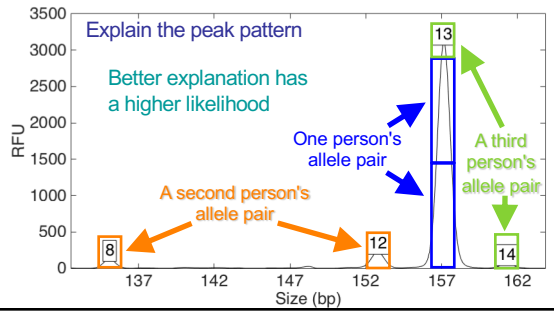
Computers can use all the data

Quantitative peak heights at locus D5S818



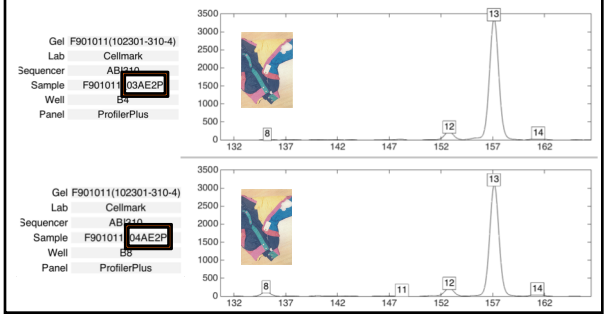
How the computer thinks

Consider every possible genotype solution



Joint data analysis

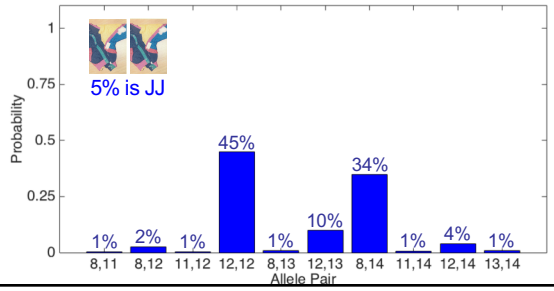
Examine multiple experiments simultaneously



Evidence genotype

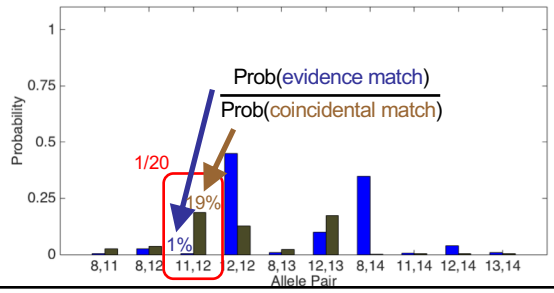
Objective genotype determined solely from the DNA data.

Never sees a comparison reference.

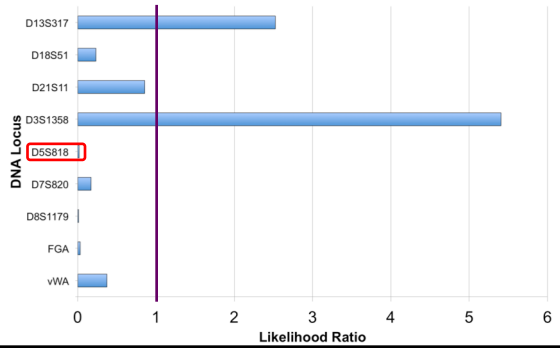


DNA match information

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



Match information at 9 loci



Is the defendant in the evidence?

A match between
the joint jacket cuttings and Darryl Pinkins is

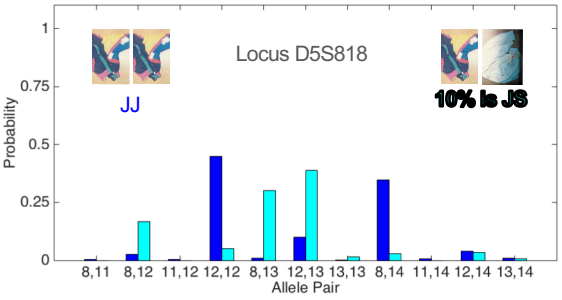
a million times *less* probable

than coincidence

Match table

		References						
		V	P	G	J	S	H	JJ
J	J	-15.39	-18.00	-15.39	11.07	1.21	4.15	-6.19
S	S	-15.39	-15.17	-15.39	1.21	10.22	-2.39	-5.81
H	H	-15.39	-18.00	-15.39	4.15	-2.39	10.31	-3.52
JJ	JJ	-2.78	-8.50	-8.43	-6.19	-5.81	-3.52	7.05

#5. Jacket + sweater joint minor



Match table

References	V	P	G	J	S	H	JJ	JS
J	-15.39	-18.00	-15.39	11.07	1.21	4.15	-6.19	-7.66
S	-15.39	-15.17	-15.39	1.21	10.22	-2.39	-5.81	-8.09
H	-15.39	-18.00	-15.39	4.15	-2.39	10.31	-3.52	-5.80
JJ	-2.78	-8.50	-8.43	-6.19	-5.81	-3.52	7.05	-1.49
JS	-10.47	-5.79	-12.60	-7.66	-8.09	-5.80	-1.49	8.06

Conclusions

References	V	P	G	J	S	H	JJ	JS
J	-15.39	-18.00	-15.39	11.07	1.21	4.15	-6.19	-7.66
S	-15.39	-15.17	-15.39	1.21	10.22	-2.39	-5.81	-8.09
H	-15.39	-18.00	-15.39	4.15	-2.39	10.31	-3.52	-5.80
JJ	-2.78	-8.50	-8.43	-6.19	-5.81	-3.52	7.05	-1.49
JS	-10.47	-5.79	-12.60	-7.66	-8.09	-5.80	-1.49	8.06

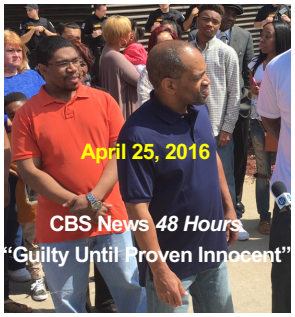
TrueAllele Pinkins findings

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

Search CODIS?

Pinkins released



feature

Hidden DNA Evidence: Exonerating the Innocent

Mark W. Perlin, Ph.D., M.D.

In 1989, northwest Indiana was plagued by bump-and-rob road crimes of escalating violence. In the darkness of a cold December night, a woman's car was rear ended on highway I-65. Upon exiting her car, she was dragged into another vehicle, then stripped and raped by five strangers. The men left her in her car, draped by green coveralls. The same night, coworkers Darryl Pinkins, Roosevelt Glenn and William Durden had engine trouble along that highway. They parked their car on the roadside, and went to get help and motor oil. On their return, they found shattered side windows and their work coveralls gone.

Traced to their employer by the crime scene coveralls, Pinkins, Glenn and Durden, along with two other coworkers, were arrested for the I-65 bump-and-rape. RFLP testing of semen DNA left on the victim's jacket and sweater excluded the defendants. But nonspecific serology testing, along with faulty hair evidence and tainted eye witness identification, led to Pinkins' and Glenn's wrongful convictions. Pinkins was found guilty of all charges in May 1991, and sentenced to 65 years in prison. Glenn's 1992 jury deadlocked, but on retrial he was convicted of rape in 1993, and sentenced to 36 years. Despite their incarceration, the bump-and-rob and rape crimes continued unabated. The men's exoneration by science would not happen soon.

When DNA Is Not a Gold Standard: Failing to Interpret Mixture Evidence

Forensic science connects evidence through shared characteristics. Markings on a bullet can appear to match grooves in the barrel of a gun. Latent fingerprints left at a crime scene may be similar to ridge patterns on a suspect's hand. Tracks in the mud may mirror the treads of a shoe or tire. Police gather forensic evidence to help build a case, and police dramas on television convey the myth of forensic infallibility through the "CSI" effect.[1]

In 2009, the National Academy of Sciences (NAS) published its seminal report titled *Strengthening Forensic Science in the United States*.[2] The NAS report reviewed many forensic modalities and questioned their scientific validity. The interpretation of forensic data is often unreliable. Match statistics are needed to gauge the strength of match between items, relative to coincidence. But forensic statistics are typically absent or incorrect. Human bias can skew answers by unconsciously selecting favorable data, using knowledge about defendant characteristics, or by trying to please stakeholders who have a desired criminal justice outcome.

Deoxyribonucleic acid (DNA) evidence seems immune to such criticism, long serving as a gold standard for other forensic disciplines. Abundant DNA from one person produces pristine data signals. Interpreting these clear signals yields an unambiguous genetic type ("genotype"). Comparing definite genotypes, relative to a random person, yields a reliable match statistic that numerically conveys the probative force of DNA evidence. But most crime scene DNA is now a mixture of two or more people, with good data but less certain interpretation. As the NAS report noted, there may be problems with how the DNA was interpreted, such as when there are mixed samples.

Simplistic interpretation of DNA mixture data often fails to produce an accurate match statistic or give any answer at all. While the limitations and liabilities of unscientific DNA mixture interpretation were recognized early on,[3] only recently has this profound forensic failure come to the fore. Crime laboratories in Austin, Texas, and Washington, D.C., have been shuttered in large part because of failed DNA mixture interpretation.[4] Virginia re-evaluated DNA match statistics for mixture evidence in hundreds of cases.[5] Texas is reviewing 24,000 criminal cases for flawed interpretation of DNA mixture evidence.[6] The New York State Police (NYSP) has suppressed reliable DNA mixture interpretation methods that could expose its crime laboratory's mistakes in thousands of cases.[7] These numbers extrapolate to hundreds of thousands of mixture items throughout the United States, and the national press has taken notice.[8]

This failure of forensic DNA interpretation is of broad concern. Pervasive errors in DNA match statistics undermine public trust in science and erode confidence in government agencies that misuse science to obtain convictions. A failed DNA gold standard portends little hope for fledgling forensic fields. Perhaps the greatest loss is true justice in a free society. Misinterpreting DNA evidence causes injustice for defendants denied potentially exculpa-

BY MARK W. PERLIN, PH.D., M.D., PH.D.

Public unaware of problem

"While you describe some interesting capabilities in DNA testing developed by your company, it takes a while for readers to work through the case you explicate essentially to learn that there have been advances in DNA testing, which most know or would assume. So we'll have to pass."

Greg Victor
Op-ed/Forum editor
Pittsburgh Post-Gazette

Pittsburgh nonprofit

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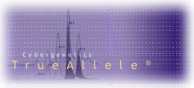
http://www.cybgen.com/information



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Cybergenetics

perlin@cybgen.com