

# Reanimating Zombie™ DNA

Penn State Dickinson Law School  
September, 2012  
State College, Pennsylvania

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



Cybergenetics

Cybergenetics © 2003-2012

---

---

---

---

---

---

---

---

## Zombie DNA

*The Washington Post*

Virginia reevaluates DNA evidence in 375 cases

July 16, 2011

Scientific Working Group on DNA Analysis Methods  
SWGAM 2010: Interpretation Guidelines

“Mixture cases are their own little nightmare,” said William Vosburgh, director of the D.C. police’s crime lab. “It gets really tricky in a hurry.”

---

---

---

---

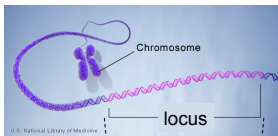
---

---

---

---

## 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.

**8, 9**

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

---

---

---

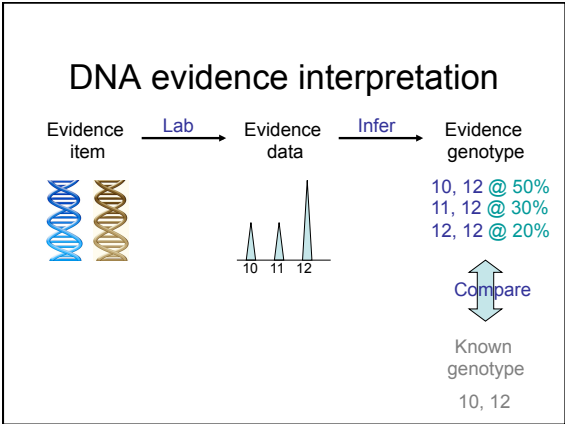
---

---

---

---

---




---

---

---

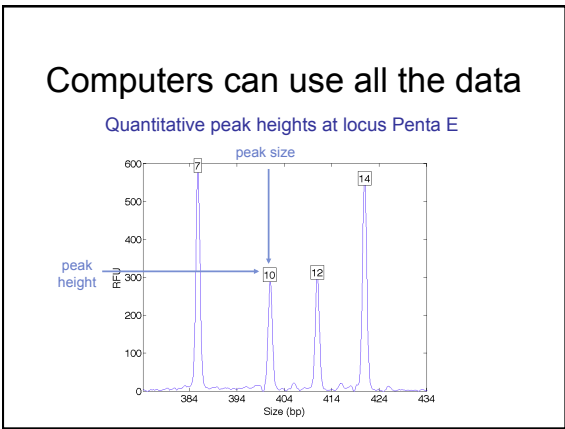
---

---

---

---

---




---

---

---

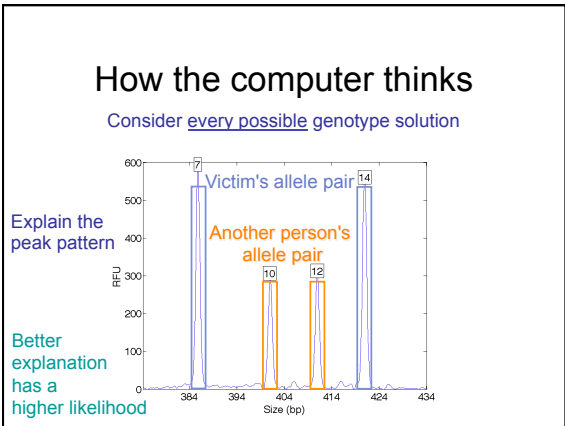
---

---

---

---

---




---

---

---

---

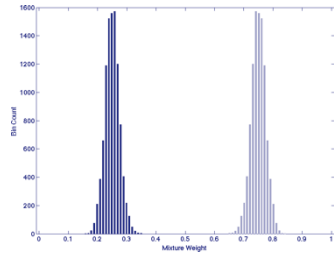
---

---

---

---

## Separate the contributors



---

---

---

---

---

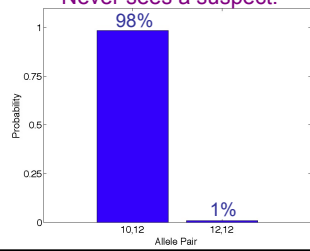
---

---

---

## Evidence genotype

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



---

---

---

---

---

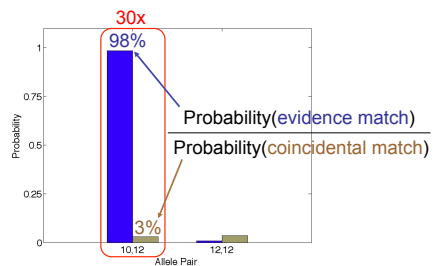
---

---

---

## DNA match information

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



---

---

---

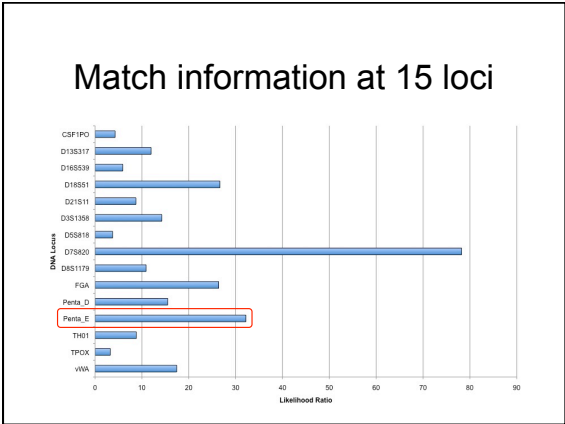
---

---

---

---

---




---

---

---

---

---

---

---

---

### Is the suspect in the evidence?

A match between victim's underpants and the suspect is:

- 36.6 quintillion times more probable than a coincidental match to an unrelated Black person
- 20.7 quadrillion times more probable than a coincidental match to an unrelated Caucasian person
- 212 quadrillion times more probable than a coincidental match to an unrelated Hispanic person

---

---

---

---

---

---

---

---

### Magazine articles

Perlin MW. [Forensic science in the information age](#). *Forensic Magazine*. 2012;9(2):17-21.

Perlin MW, Galloway J. [Computer DNA evidence interpretation in the Real IRA Massereene terrorist attack](#). *Evidence Technology Magazine*. 2012;10(3):20-23.

Perlin MW. [Easy reporting of hard DNA: computer comfort in the courtroom](#). *Forensic Magazine*. 2012;9(4):32-37.

---

---

---

---

---

---

---

---

## Validation studies

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

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):in press.

---

---

---

---

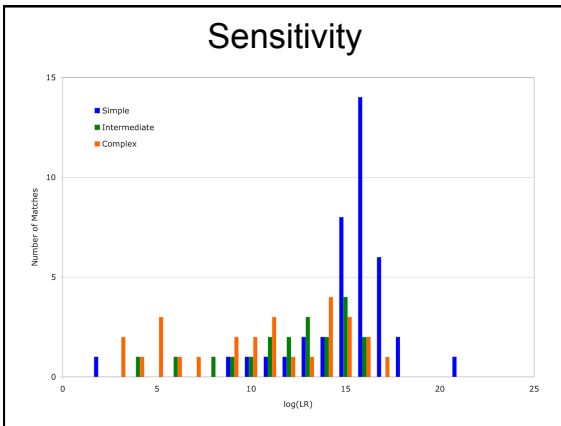
---

---

---

---

## Sensitivity



---

---

---

---

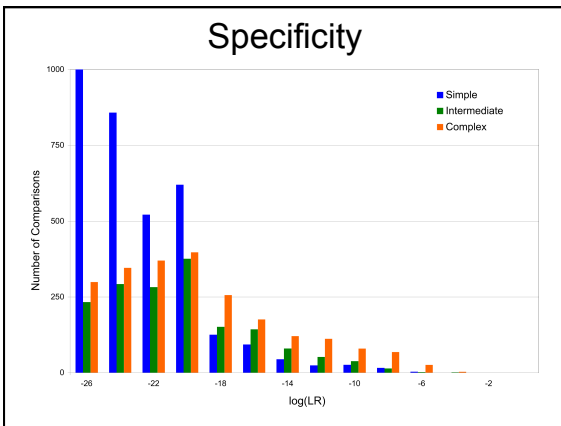
---

---

---

---

## Specificity



---

---

---

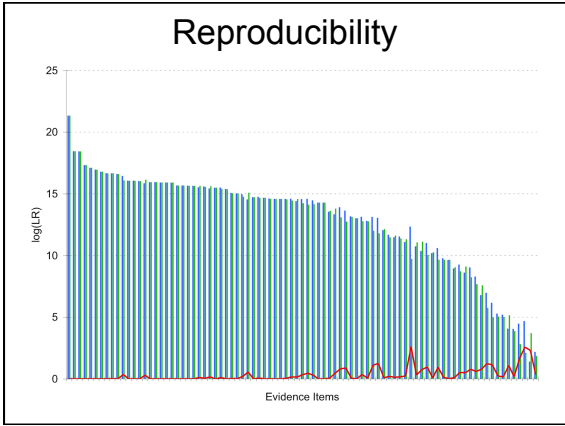
---

---

---

---

---




---

---

---

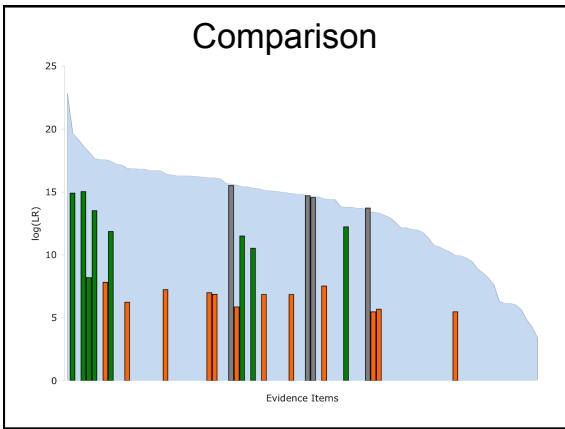
---

---

---

---

---




---

---

---

---

---

---

---

---

## Legal Precedent

2012

Over 100 TrueAllele case reports filed on DNA evidence

Court testimony:

- state
- federal
- military
- foreign

J-110009-11      2012 PA Super 31

COMMONWEALTH OF PENNSYLVANIA,      IN THE SUPERIOR COURT OF PENNSYLVANIA

Appellee

v.

KEVIN JAMES FOLEY,

Appellant

No. 2009 WDA 2009

Appeal from the Judgment of Sentence of June 1, 2009  
in the Court of Common Pleas of Indiana County,  
Criminal Division at No. 01: CP-22-CR-0001179-2007

BEFORE: PAMELLA SHOGAN, and COLVILLE, JJ.  
OPINION BY PAMELLA, J.      FILED: FEBRUARY 15, 2012

Appellant, Kevin James Foley, appeals from the judgment of sentence entered on June 1, 2009, by the Honorable William J. Martin, President Judge of the Court of Common Pleas of Indiana County, Criminal Division. After careful review, we affirm.

\* \* \*

Because Foley has failed to establish the existence of a legitimate dispute over Dr. Perlin's methodology, he has failed to show that Dr. Perlin's testimony constituted "novel" scientific evidence. See *Betz*, 998 A.2d at 972. Therefore, we find that the trial court's decision to admit the testimony was not an abuse of discretion. Absent a legitimate dispute, there is no reason to "impede admissibility of evidence that will aid the trier of fact in the search for truth." *Id.*

---

---

---

---

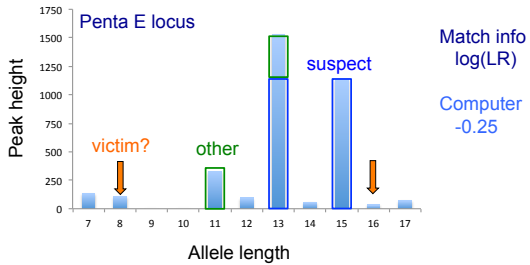
---

---

---

---

### Quantitative interpretation: accurately excludes




---

---

---

---

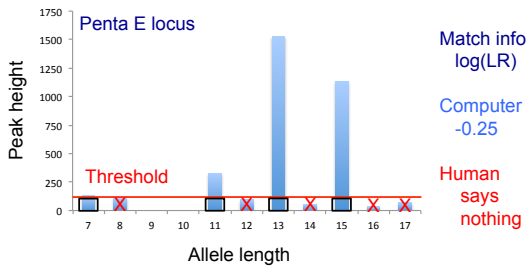
---

---

---

---

### Human misinterpretation can falsely implicate




---

---

---

---

---

---

---

---

### Computer reinterpretation, charges were dropped

log(LR)	human	computer
<b>suspect</b>	2	18
<b>other</b>	2	18
<b>victim</b>	2	0

---

---

---

---

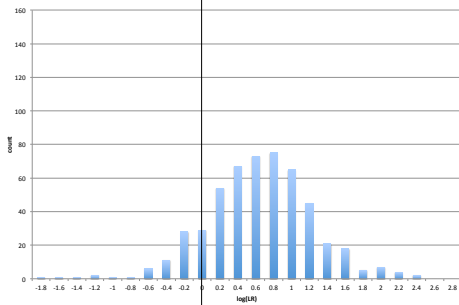
---

---

---

---

### Computer review: identification information



---

---

---

---

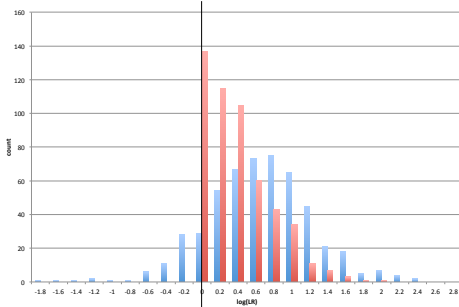
---

---

---

---

### Human review: information loss + bias



---

---

---

---

---

---

---

---

### 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.

---

---

---

---

---

---

---

---



Perlin MW. Investigative DNA databases that preserve identification information. American Academy of Forensic Sciences 64th Annual Meeting, 2012 February 23; Atlanta, GA. AAFS, 2012. p. 67.

## DNA mixture evidence



Type of DNA database	Sensitivity	Specificity
Genotype	$\log(LR) \sim 15$	No false positives
Allele	Can't upload 90% of the evidence	Many false positives




---

---

---

---

---

---

---

---

## DNA database exoneration



Computer-inferred evidence genotype

Post-conviction test  
 $\log(LR) \ll 0$

The right person?  
 $\log(LR) \sim 9$

10 million offenders  
can't use CODIS

---

---

---

---

---

---

---

---

## Open Access DNA

Kaye DH. [Trawling DNA databases for partial matches: what is the FBI afraid of?](#) *Cornell Journal of Law and Public Policy*. 2009;19(1):145-171.

Krane DE, Bahn V, Balding D, Barlow B, Cash H, Desportes BL, D'Eustachio P, Devlin K, Doom TE, Dror I, Ford S, Funk C, Gilder J, Hampikian G, Inman K, Jamieson A, Kent PE, Koppl R, Kornfield I, Krinsky S, Mnookin J, Mueller L, Murphy E, Paoletti DR, Petrov DA, Raymer M, Risinger DM, Roth A, Rudin N, Shields W, Siegel JA, Slatkin M, Song YS, Speed T, Spiegelman C, Sullivan P, Swienton AR, Tarpey T, Thompson WC, Ungvarsky E, Zabell S. [Time for DNA disclosure](#). *Science*. [Letter]. 2009 Dec 18;326(5960):1631-2.

---

---

---

---

---

---

---

---

## More information

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

- Courses
- Newsletters
- Newsroom
- Presentations
- Publications



**Cybergenetics**

[perlin@cybgen.com](mailto:perlin@cybgen.com)

---

---

---

---

---

---

---

---