What is Forensic DNA?

Applications

- Criminal Justice
  - Investigation
  - Prosecution
  - Post-conviction
- Paternity
- ID for mass casualty
- Reuniting families
- Animals, Wines, Collectables...

Basic Technology

- DNA Profile
  - 1985 accidental discovery
  - STRs and Loci
  - *(SNPs, mtDNA, Y-Chromosome)
- Two Types of Information
  - Identity
  - Kinship

Four Issues

1. Legal Challenges: Science & Law
2. Popular Perceptions: CSI & Families
3. DNA Dragnets & Databases (CODIS)
4. Forensic Futures: Expansions

UK Origin Story

- Discovered 1985 (Alec Jeffreys)
- 1985 Immigration case
- 1986 Pitchfork case
- Quick success
- Rapid Adoption in US

1985 Immigration Case (UK)

- Immigration dispute:
  - A mother (UK citizen) originally from Ghana, youngest son had visited Ghana, then returned to London on a tampered passport; Immigration authorities refused to grant residence.
- Blood samples Used:
  - Full range of blood typing with equivocal results (but 99% certain son was related in some way).
  - Only had blood samples from mother, three undisputed children and boy with some question about paternity of boy.
- DNA fingerprinting identified boy as son and had same father as other children
  - 99.9999998% certainty mother and boy related
  - 99.997% certain boy was biological son
- Evidence submitted to the Home Office, case against boy dropped without cross-examination in tribunal. No legal precedent.
1986 Pitchfork Case (UK)

- Prime suspect confessed to 1986 murder
  - But his DNA profile did not match semen recovered from either victim.
- DNA profile launched the world's first DNA-based manhunt
  - Police requested DNA sample from all males in the local community.
- Resulted in successful arrest of Colin Pitchfork (now serving life for both murders)
  - Pitchfork tried to pass another's blood sample as his own.

Quick Success

- Linked the two murder/rapes.
- Exonerated an innocent man who confessed.
- DNA database collected in manhunt.
- Lead to arrest and conviction of Pitchfork.
- Use of DNA fingerprinting within a year of discovery (1985).

Forensic DNA in USA

- 1988: First jury conviction (Florida: Tommy Lee Andrews, raping and stabbing. DNA compared with semen from crime scene matched perfectly):
  - 1 in 10 billion chance of finding another person with the same DNA sequence. (LIFECODES Corp.)
  - Kansas v. Searles (1990)?
- 1990s: Death Penalty/Execution
  - Timothy Spencer (1990)
  - Texas v. Fuller (1992)
- 1998: FBI establishes DNA database → CODIS
  - By 2000 covenants labs to STR technology

1. Legal Challenges: Science and the Law

- Frye Standard 1923
  - Frye v. United States (1923): scientific evidence can only be used when most scientists agree that the methods and theory used to generate the evidence are well established.
  - But, use of DNA profiling was very quickly moved into legal arena:
    - Discovery 1985... use in UK same year... first convictions in 1986/7... FBI starts CODIS in 1998... converts labs in 2000 to STR testing...

DNA in Courtroom

- The use of DNA profiling was used within a month of its discovery to influence legal decisions (UK immigration case)
- Within a year DNA profiling was accepted in court cases and establishing legal rulings.
- How does the court adopt scientific advances? Frye and Daubert standards:
Legal Challenge in 1987 Case

- Jose Castro accused of murder a woman and her daughter. Blood stain on Castro's wristwatch matched sample of victim's blood: A chance of random match was 1 in 189,200,000 among Hispanic population (LIFECODES Corp.)
- Lawyers Barry Scheck and Peter Neufeld challenged DNA evidence
  - Challenged random match estimate for population*
  - No clear legal criteria for match/no-match
  - Competence of lab, possible errors, contamination of samples

(Judged determined bloodstain on watch was inadmissible evidence in pretrial hearing. However, Castro later confessed to the murders.)

Daubert Standard 1993

- Daubert v. Dow Pharmaceuticals
- Criteria: scientific information must be relevant and reliable.
  - ‘relevant’ = come from an expert
  - ‘reliable’ = following the scientific method
- Implication: judges as ‘gatekeepers’ of scientific evidence
  - Cf. earlier Frye standard (1925)
  - Are judges qualified to determine admissibility of DNA evidence?
  - Are juries qualified to determine reliability of DNA evidence?

Stephen Breyer, p. 13-14

- Judges don’t have background in the natural sciences.
- Genetic science is rapidly changing, affecting many aspects of law.
- Law is complex, many different levels and aspects…
- Legal institutions react slowly.

Questions

- Has DNA profiling been adopted by the courts too quickly?
- Is the Daubert standard sufficient given the background of the judicial system (Breyer)?
- What cautions should be considered when using DNA evidence in the criminal justice system?
  - investigation, prosecution, post-conviction…?

The “CSI Effect”

- Influence of shows like CSI on popular expectations for forensic science
  - “Unrealistic” expectations for forensic DNA in court
  - Also, increased enrollment in forensic science programs
- Raised awareness of forensic use of DNA
### Three Myths of “CSI Effect”

**Unrealistic expectations of and overvaluation of DNA evidence?**

1. **DNA evidence is always available:** False
   - Only 10%-20% of cases
   - Problem of lost, degraded, or destroyed DNA evidence.

2. **DNA is always right:** False and True
   - Accurate yes, but some caveats
   - Limited inference to guilt: what does DNA evidence tell us?

3. **DNA is fast and easy:** False
   - Time to process is long
   - CSI underfunded and overloaded
   - Backlog

### Influence of “CSI Effect”

- Notions of guilt and innocence may be influenced:
  - "DNA doesn’t lie?"

- Types of prosecutions and other legal action possible given the expectation of DNA evidence.
  - Prosecutions will favor only cases with DNA evidence
  - Less than 20% of cases have or require DNA evidence

- Criminals become aware of Forensic practice.
  - More difficult to detect and prosecute

- DNA evidence always is viewed as good
  - Review of potential and real problems with database, immigration, and proposed expansions of databases
  - Challenge of proportionality...

### Family Ties: Jefferson & Hemings

- In a 1998 *Nature* study use of Y-chromosome to determine descendant’s relationship to Sally Hemings’ sons, Madison and Easton.
- Descendants of Easton, but not Madison have link with Jeffersons.
- Conclusion: at least one of Sally Hemings’ sons is fathered by a Jefferson.

### DNA Tests Offer Immigrants Hope or Despair


Federal officials are increasingly turning to genetic testing to verify the biological bonds between new citizens and the overseas relatives they hope to bring here, particularly those from war-torn or developing countries where identity documents can be scarce or doctored. But while the tests often lead to joyful reunions among immigrant families, they are forcing others to confront unexpected and sometimes unbearable truths.


### Issac’s Family

For 14 years, Isaac Owusu’s has remained in contact with his boys in Ghana, their mother now deceased. When he became an American citizen and officials suggested taking a DNA test to prove his relationship to his four sons, he embraced the notion. But modern-day science often unearths secrets long buried. When the DNA results landed on Isaac Owusu’s dinner table here last year, they showed that only one of the four boys (the oldest) was his biological child.

### What is a ‘family’?

- ~75,000 of 390,000 DNA family cases involve immigration cases (2004); Of those, 15-20% do not produce a match.

- Parent-child relationship defined by biology (DNA)?

- Unfair Impediments to reunion for immigrants?
  - Complex families?
  - Cost?
  - Abandonment?
Some Resources

- CSI Effect
  - Wiki article: http://en.wikipedia.org/wiki/CSI_Effect (with many links to news articles)

  http://www.monticello.org/plantation/hemingscontro/hemings-jefferson_contro.html

Next Time

DNA Databanks and Privacy

Chapters 7 & 9

(Recommend all others…).