

# Crime and punishment

DNA is often the most incriminating evidence in a courtroom, but sloppy analysis has sent dozens of innocent people to prison. Alisa Opar reports on the efforts to lock down error-free tests.

In 1999 Josiah Sutton, then 16 years old, was sentenced to 25 years in prison for rape. The evidence seemed airtight: the victim had spotted Sutton walking down a Houston street five days after her attack, and crime lab analysis from Houston's police department showed his DNA was an exact match with semen from the crime. The DNA evidence, in particular, was convincing—the analyst testified that the probability of the match being a result of chance was 1 in 694,000. But it was wrong.

Four and a half years after Sutton was sent to prison, William Thompson, professor of criminology at the University of California in Irvine, and newspaper reporters investigated hundreds of instances of sloppy laboratory work at Houston's Harris County crime lab.

Thompson calculated that the probability of Sutton's DNA matching the vaginal samples had been grossly exaggerated—one in eight black men would have had a similar match, he found. After an external audit produced a scathing report, the county shut down the lab and retested DNA evidence in nearly 400 cases. In March 2003 the lab found that a semen stain found in the car did not match Sutton's DNA, and Sutton was exonerated.

The incident, though shocking, is just a small part of a systemic problem, says Thompson. "Part of the problem in Harris County was indeed the lab," he says, "but a big part of the problem was the failure of the legal system to detect how atrociously bad and misleading the lab work was."

DNA testing is considered the gold standard for forensic testing and an invaluable tool for the criminal justice community, who have relied on it since the mid-1980s. Nuclear DNA analysis of saliva, skin tissue, blood, hair and semen provide the strongest matches and are used most often. Newer techniques, such as mitochondrial DNA testing, are also being used.

"In many instances DNA is the make or break evidence," says Frederick Bieber, a geneticist at Harvard Medical School.

The evidence is often valid and has led to thousands of convictions in cases of rape, murder and other violent crimes. But in recent years, there have also been dozens of examples of mistakes that have sent innocent people to prison, or allowed the guilty to go free. The Innocence

Project, a New York-based nonprofit legal clinic and criminal justice resource center, alone has used DNA tests to exonerate 184 people who had been wrongly convicted. Erroneous DNA evidence was involved in 3 of those convictions.

"The value of DNA to identify people is beyond question," says Stephen Saloom, the project's policy director. "Human error is what can confound DNA testing results."

## Flimsy evidence

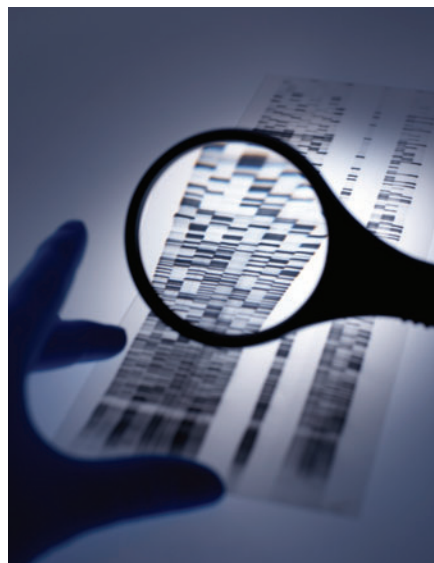
Labs need only a few human cells to produce a DNA profile using an extremely sensitive polymerase chain reaction. Analysts use the method to compare the DNA at 13 genomic sites with a crime scene sample.

The odds that two unrelated individuals have the same 13-locus DNA profile are about one in one trillion. The odds—statistical estimates based on known allele frequencies—increase with fewer markers.

The most common mistakes are inadvertent: samples can be accidentally switched or mislabeled, tainted by an analyst's DNA or mistakenly combined with DNA from another sample.

And in most of those cases, analysts catch the mistake in time. But not always.

In 2003, for instance, an analyst at the North



**Science of trouble:** The criminal justice community is increasingly relying on DNA tests.

Carolina State Bureau of Investigation mislabeled samples from a murder victim and the suspect, her daughter. The mistake led the analyst to conclude that DNA from the bloodstain on the mother's bed matched the daughter's DNA. A defense attorney challenged the evidence, and a new test in 2005 brought the error to light.

Some analysts have been caught taking shortcuts, disregarding quality assurance standards. US Federal Bureau of Investigation (FBI) analyst Jacqueline Blake did not run controls in 90 cases she analyzed from 2000 to 2002. Sarah Blair, an analyst at the Maryland-based Orchid-Cellmark, the nation's largest private DNA lab, falsified data in 11 of the 27 cases she handled in 2004 for the Los Angeles Police Department, including the evidence for a triple murder. When controls were contaminated with DNA, Blair substituted 'clean' controls from other cases and changed computer files instead of reanalyzing the samples.

Sloppy DNA tests can go undetected for any number of reasons. Laboratories might not strictly enforce testing standards. Or, as happened in Houston and at the FBI, judges and lawyers accept the analysts' conclusions without question.

"I tend to see very good scientific work in jurisdictions where the work is actively scrutinized by competent people," says Thompson. In states such as Texas, the government is not required to turn over information as readily as in Illinois or Ohio. "Where there are legal barriers to scrutiny of the science, so labs can in effect be doing secret science, those tend to be the places where we see problems," Thompson says.

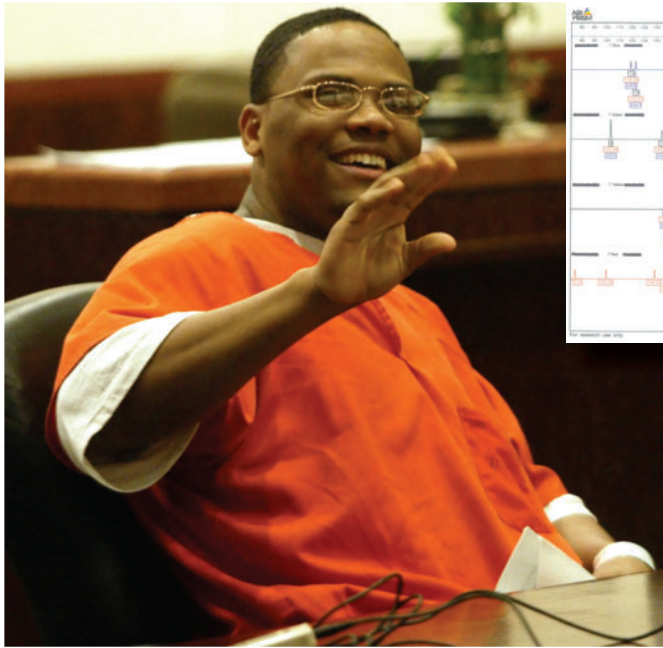
## False links

Those mistakes could potentially have far-reaching implications if erroneous DNA profiles are entered into a database. The FBI's Combined DNA Index System, or CODIS, allows local, state and federal crime labs to exchange and compare electronic DNA profiles, enabling them to link crimes to convicted offenders.

Despite the many instances of errors, few of the database's 3.5 million profiles have ever been removed or changed. After the fiasco at the FBI lab, the agency pulled 29 profiles from the database. More recently, after a Sacramento lab supervisor discovered that an analyst had misinterpreted DNA test results and entered the wrong profile into California's database, the lab had to review 69 other DNA profiles that the analyst had uploaded.

Those cases did not finger the wrong person for a crime. But there have been instances where the database has mistakenly linked a suspect to an unsolved crime or cold case.

In 2002, for instance, Michigan state's crime lab found DNA from two men on the clothing



**Not guilty:** Four years after he was sent to prison, fresh DNA tests, like those seen above (inset), exonerated Josiah Sutton.

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agency's minimum standards, including periodic audits and external proficiency testing for analysts every six months.

"Laboratories have got to satisfy us that all of the procedures they use will protect evidence from loss, cross-

of a victim murdered in 1969. The database produced two hits: Gary Leiterman and John Ruelas. Leiterman was charged and convicted in 2005 of the murder. But Ruelas was only four years old when the crime occurred and was living in a different town. The prosecutor explained Ruelas' DNA as a nose bleed that got on the victim's hand.

But there could be a simpler explanation for the baffling results: the lab was processing DNA samples from Leiterman and Ruelas on the same day as the samples from the old murder.

"Knowing how it is that DNA transfer can occur, knowing how little material needs to be transferred," the defense's DNA expert, Dan Krane, told jurors during the trial, "it certainly seems to be a very improbable coincidence to me that contamination did not occur."

Most mistakes in recent years have come from uncertified labs—which then apply for accreditation after blunders are publicized. After the incident at the Houston crime lab, for example, Texas ruled that only evidence from accredited forensic labs could be used in courts. New York and Oklahoma are the only two other states that require forensic crime labs to be certified.

In 1998, the FBI issued standards for DNA labs that use the national database or the database's software or receive federal funding. Labs must show in annual audits that they meet 17 minimum standards for DNA analysis, several of which specifically address contamination. In 2004, a new federal law required that those labs also become accredited.

As of 31 October, labs must adhere to the

transfer contamination and deleterious change," says Ralph Keaton, executive director of the American Society of Crime Laboratory Directors/Laboratory Accreditation Board, in North Carolina.

The government gave labs a two-year window to become accredited. Of the approximately 180 DNA crime labs in the US, 177 are accredited, and the few that aren't are working to be so by the deadline, says Keaton.

The accreditation board and FBI both recommend blind proficiency testing—where analysts do not know that they're being tested—but do not require it. In 2003, a National Institute of Justice scientific advisory board considered blind testing, but decided it would be too expensive and time consuming.

Accreditation is unlikely to resolve all the problems with DNA testing, however. "Accreditation is a good thing because it will pick up egregious failures like what was happening in Houston," says Thompson. "But the fact that you're accredited doesn't mean that you can't make a mistake and it doesn't mean that you can't follow dangerously sloppy procedures."

#### Human error

Given that the biggest cause of mistakes is human error, training law enforcement officials in analyzing the tests is also crucial. The federal government has dedicated \$1 billion from 2003 to 2008 to train analysts, educate the criminal justice community and enhance DNA databases. A main goal of the initiative is to clean up the backlog of samples waiting to be analyzed and entered into databases.

In the 1990s judges in every jurisdiction were given the role of 'gatekeepers,' responsible for ensuring that the evidence presented is suitable.

"That paradigm shift from the judge as a passive conduit of scientific acceptance to an active gatekeeper of the fitness of the evidence made all judges consumers of science in a way they never expected," says Franklin Zweig, president of the Advanced Science and Technology Adjudication Resource Center in Washington, DC, which provides judges with basic science education. "Most [judges] have no scientific or technical background," Zweig says.

The center, a consortium of state and federal courts, has thus far trained 50 judges from Ohio and Maryland in a 120-hour basic science program. The center is legally required over the next two years to recruit and train an additional 200 state and federal judges nationwide. Those 'resource' judges will continue overseeing cases, and will help other judges with less experience.

Lawyers are also becoming more DNA savvy. Public defenders' offices in Los Angeles County and Chicago's Cook County now have a cadre of lawyers that do only DNA casework.

The Cook County State's Attorney's Office went one better, in 2004 hiring a fulltime DNA resource specialist. Kara Stefanson advises lawyers on DNA evidence, assists in locating crime-scene evidence, evaluates what should be done in cold cases and post-conviction cases, and decides when forensic evidence should be retested.

"My role primarily is to make sure that the person who's responsible for presenting [DNA evidence] in court, or cross examining if it's being presented by the other side, that they understand the capabilities of DNA," Stefanson says.

Stefanson also teaches a four-day course for attorneys on DNA analysis in criminal investigations at Northwestern University.

These efforts are already long overdue. DNA databases are growing quickly and being used to cast a wider net than was originally expected. In the UK, any suspect can be asked for a sample, and the government recently began entering DNA found at crime scenes into databases and searching for family members of suspects. The US has had stricter rules, but some states are considering familial searching.

Cases like those of Sutton's may give pause to this widening of DNA's use in law enforcement. But despite these caveats, experts say, DNA tests are still the best forensic evidence and an invaluable tool for law enforcement.

"Any time you deal with human beings, there are mistakes," Keaton says. "There is no program or process that will eliminate human errors. What we hope to do is have a process in place so that we can catch them when they are made."

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