

## Solving Crimes

Forensic science, especially the analysis of DNA, is radically changing how crimes are investigated. Using the smallest remnants of evidence, forensic scientists can hasten arrests, prevent further crime, and exonerate the innocent. NIJ supports a number of projects that advance forensic science. DNA analysis is the best known, but progress continues to be made in other areas such as digital evidence, handwriting analysis, and ballistic signature analysis.

### **DNA analysis**

Although the cost of analyzing DNA is decreasing, most U.S. law enforcement agencies still do not routinely collect DNA evidence, especially “invisible evidence” such as the sweat in the lining of a suspect’s baseball cap.

NIJ is working in partnership with the President’s DNA Initiative (discussed on page 2) to build the Nation’s capacity to:

- Use DNA as a routine law enforcement tool.
- Eliminate current backlogs of convicted offender and casework DNA samples.
- Use DNA to identify missing persons and provide closure to families.
- Benefit from future developments in DNA technology.

A major part of NIJ’s portfolio focuses on using DNA to solve crimes that have reached a dead end. DNA technology and databases with DNA profiles of convicted offenders are inspiring law enforcement agencies to reevaluate their cold cases. For example, in 1990, in Goldsboro, North Carolina, a man broke into several homes, raped three elderly women, and murdered two of the women and one of their husbands. This “Night Stalker” case had no suspects, though the intruder’s DNA was entered into a database. More than 10 years later, the intruder’s DNA matched with that of an offender whose DNA was entered into the database after he was convicted of a shooting. The match solved the Goldsboro “Night Stalker” case.

Justice professionals face two significant hurdles in analyzing DNA: a backlog of samples from convicted offenders and a backlog of forensic samples from cases. The convicted-offender backlog includes as many as 300,000 unanalyzed DNA samples from offenders convicted of crimes, with more than 500,000 samples yet to be taken. According to the best estimates, the forensic casework backlog includes approximately 52,000 homicide cases, 169,000 sexual assault cases, and 264,000 property crime cases.

Lack of funding is frequently cited as the reason why law enforcement agencies do not make greater use of DNA analysis. To help with the financial strain, NIJ awarded \$39.7 million to 39 States in 2003 to analyze DNA from crime scene evidence and improve the capacity of crime labs. In 2004, NIJ awarded \$66.5 million to State and local crime labs to help reduce the estimated 543,000 criminal cases with biological evidence waiting for DNA testing and to enhance the capacity of DNA laboratories.<sup>6</sup>

Ongoing NIJ research is helping police chiefs understand how DNA evidence from property crime offenders can solve more serious personal crimes. Police departments in Miami-Dade County (Florida), New York (New York), and Palm Beach (Florida) are achieving dramatic results by analyzing biological evidence collected from property crime scenes. In New York, one DNA profile uncovered a five-burglary serial offender. Many profiles from burglaries link to serious violent crimes such as sexual assault and robbery.

The cost of DNA testing depends on the number of samples tested, the type of DNA testing needed, and the costs involved for police to collect biological evidence at property crime scenes and pursue investigative leads generated by DNA. But these costs must be weighed against the losses incurred by the public from crime and the cost for investigators to follow clues the traditional way.

NIJ's forensics research and development portfolio is designed to create innovative tools and technologies crime lab personnel can use to reduce costs while increasing efficiency and accuracy. In 2004, NIJ awarded funds for a variety of research projects to develop or explore:

<sup>6</sup> Awards totaling \$38.1 million are for reducing backlogged DNA casework; awards totaling \$28.4 million are for laboratory enhancement.

*Topics from NIJ research that appeared in peer-reviewed journals in 2004 include: mitochondrial DNA; mini-STR's; characterization of DNA damage in bloodstains; Y-chromosome studies for use in investigations of crimes involving males; a microdevice system for forensic DNA analysis; and insect DNA studies, which are useful in homicide investigations for determining the time since death.*

- Better ways to identify and separate male and female DNA in sexual assault cases.
- New DNA markers to help pinpoint the source of DNA evidence.
- Methods to determine the tissue origin of biological evidence.
- Miniaturized forensic DNA testing devices with potential field use.
- Improved methods for examining nonhuman DNA, which is often associated with crime scene evidence and may play a key role in an investigation.

NIJ disseminates research findings through several mechanisms, including traditional peer-reviewed scientific literature and sharing information about products developed through NIJ research. For example, in 2004, a rapid method for testing mitochondrial DNA was commercialized. The method, called the Linear Array Assay, was previously used to examine skeletal remains recovered from mass graves in Croatia.

Technology transfer activities familiarize practitioners with newly developed methods. In 2004, an NIJ grantee conducted a workshop that provided hands-on training in methods developed by the grantee to analyze plant DNA.

#### **For more information**

- The President's initiative, *Advancing Justice Through DNA Technology*, is described in detail on <http://www.DNA.gov>.
- *DNA in "Minor" Crimes Yields Major Benefits in Public Safety, In Short—Toward Criminal Justice Solutions*, Washington, DC: U.S. Department of Justice, National Institute of Justice, November 2004 (NCJ 207203), available at <http://www.ncjrs.org/pdffiles1/nij/207203.pdf>.
- *Using DNA to Solve Cold Cases*, Special Report, Washington, DC: U.S. Department of Justice, National Institute of Justice, July 2002 (NCJ 194197), available at <http://www.ncjrs.org/pdffiles1/nij/194197.pdf>.

*A “questioned” document is any signature, handwriting, typewriting, or other mark whose source or authenticity is doubtful or in dispute. Letters, checks, driver’s licenses, contracts, wills, voter registrations, passports, petitions, threatening letters, suicide notes, and lottery tickets are the most commonly questioned documents.*

<sup>7</sup> Noting that the “general acceptance” test established in *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923), was superceded by the adoption of the Federal Rules of Evidence, the Court held that “nothing in the text of ... [Federal Rule of Evidence 702] establishes ‘general acceptance’ as an absolute prerequisite to admissibility.” *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 588, 113 S.Ct. 2786, 2794 (1993).

### Other forensics

NIJ’s portfolio of projects related to forensic evidence includes studies to interpret handwriting and collect and process digital evidence.

**Questioned documents.** Questioned document examination is concerned with handwriting analysis and technical aspects of document writing. In a 1993 landmark case, *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, the U.S. Supreme Court found that the forensic techniques on which experts testify should be based on rigorous scientific procedures (such as peer reviews and replicated findings) rather than on what the Court called “generally accepted” practices.<sup>7</sup> For many years handwriting analysis determined the authenticity of questioned documents, but until *Daubert*, the forensic methods for analyzing questioned documents had not been rigorously tested. After *Daubert*, NIJ became interested in work being done for the U.S. Postal Service by scientists at the State University of New York at Buffalo (SUNY). Using a computer algorithm, their system was able to read handwritten addresses on envelopes.

Through NIJ funding, SUNY researchers have developed a software system called CEDAR-FOX to perform tasks normally done by forensic document examiners. In early demonstrations, CEDAR-FOX correctly identified the writer in 96 percent of the samples tested. In 2004, NIJ funded further development and refinement of CEDAR-FOX to increase its capability as an operational tool for questioned document specialists.

**Digital evidence and electronic crime.** Hacking and disruption due to “phishing” (e-mail spoofs, fraudulent Web sites), child pornography, and any number of other crimes committed using computers and the Internet have led businesses and law enforcement agencies to invest in computer forensics.

In 2004, NIJ released the second in its series of guides for investigating electronic crime (see “For more information,” below) and continued testing the accuracy of various forensic tools to investigate and solve electronic crimes. One notable result in 2004: NIJ, through funding to the National Institute of Standards and Technology, Office of Law Enforcement Standards, released test results of software write block tools and disk imaging tools. The latter were used in the proceedings against suspected 9-11 terrorist Zacharias Moussaoui.

With its partners in the Critical Incident Technology Initiative (the Federal Bureau of Investigation [FBI], the U.S. Customs and Border Protection Service, and the U.S. Department of Defense), NIJ developed a system in which software from various data sources is compiled into a data set—the National Software Reference Library. Investigators can compare digital evidence from the hard drive of a computer seized as evidence with software in the reference library data set, which reduces investigative time. The current version (2.4) was released in 2004.

#### **For more information**

- *Test Results for Disk Imaging Tools: dd Provided with FreeBSD 4.4*, Special Report, Washington, DC: U.S. Department of Justice, National Institute of Justice, January 2004 (NCJ 203095), available at <http://www.ncjrs.org/pdffiles1/nij/203095.pdf>; and *Test Results for Software Write Block Tools: RCMP HDL VO.8*, Special Report, Washington, DC: U.S. Department of Justice, National Institute of Justice, February 2004 (NCJ 203196), available at <http://www.ncjrs.org/pdffiles1/nij/203196.pdf>.
- *Forensic Examination of Digital Evidence: A Guide for Law Enforcement*, Special Report, Washington, DC: U.S. Department of Justice, National Institute of Justice, April 2004 (NCJ 199408), available at <http://www.ncjrs.org/pdffiles1/nij/199408.pdf>.

**Ballistic analysis.** Through NIJ funding, researchers at Intelligent Automation, Inc., have developed a 3-dimensional (3-D) imaging system for examining the markings that are imprinted on a bullet as it travels through the barrel of a gun. This system can automatically obtain 3-D data from bullets, store the information in a database, extract a “signature” associated with the data, and evaluate the degree of similarity between signatures. Forensic Technology, Inc., commercialized the system in 2004 and currently is moving the new 3-D-based technology from the research stage to the marketplace for law enforcement and forensic use.

### Training crime scene investigators

Securing a crime scene and collecting evidence have always formed the backbone of successful investigation and prosecution. These skills are arguably even more critical in the changed landscape of 2004, where rapid technological advances have greatly expanded the amount of information that can be obtained from physical evidence.

NIJ formed the Technical Working Group on Crime Scene Investigation to compile comprehensive technical training manuals for crime scene investigation. These manuals continue to be NIJ “best sellers.” In June 2004, NIJ released the latest manual: *Crime Scene Investigation: A Reference for Law Enforcement Training*.<sup>8</sup>

<sup>8</sup> *Crime Scene Investigation: A Reference for Law Enforcement Training*, Special Report, Washington, DC: U.S. Department of Justice, National Institute of Justice, June 2004 (NCJ 200160), available at <http://www.ncjrs.org/pdffiles1/200160.pdf>.