



Testimony of

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on
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Introduction

Chairman Rockefeller, Ranking Member Hutchinson, and distinguished Members of the Committee, thank you for inviting me to participate in this hearing on “The Science and Standards of Forensics.”

I am pleased to have the opportunity to discuss the National Science Foundation’s (NSF) investments that strengthen the forensic sciences in the United States.

As you well know, NSF supports research at the frontiers of knowledge across all fields of science and engineering (S&E) and all levels of S&E education. Its mission, vision and goals are designed to maintain and strengthen the vitality of the U.S. science and engineering enterprise. In this role many of NSF’s activities contribute directly to building the human capital, infrastructure and advanced methods needed to ensure the vigor and quality of the forensic sciences.

NSF is supporting significant basic research that may be applied in forensic settings both in the near and longer term. Supported research investigates the effectiveness of currently employed forensic science approaches and also explores potential applications of cutting edge theory and technologies. Activities in NSF’s Education and Human Resources Directorate, as well as in basic science directorates, support training programs and activities which directly address the need for a 21st century forensics workforce.

A search of the NSF Awards Abstracts Database identifies 210 active awards using the search-term “forensics.” Each of the Foundation’s 7 directorates is represented in this

sample of awards. Of these awards, 147 were made in the years 2009-2011 and several awards have been made thus far in 2012. The awards represent many facets of NSF activity including basic research awards, Major Research Instrumentation, Small Business Innovation Research, Doctoral Dissertation Improvement awards, Research Experience for Undergraduates, and Workshops. For 2009-2011 alone, the awards total in excess of \$53 million and awards were made to institutions in 36 states and the District of Columbia. Awards were made to large and small universities, state and private universities, minority-serving institutions, small liberal arts colleges, community colleges and a number of small businesses. Awards have also included collaborations with international scholars.

After a brief discussion of background issues I will provide you with a number of examples of our activities in support of the forensic sciences. I will also point to several actions currently underway at the Foundation that should enhance our contribution to this effort.

Background

In 2009, the National Research Council (NRC) published “Strengthening Forensic Science in the United States: A Path Forward.” The report was prompted by the Senate’s concern in 2006 that “... there exists little or no analysis of the remaining needs of the (forensic science) community outside the area of DNA.”

The NRC report goes on to indicate areas where it determined there to be significant challenges facing the forensic science community:

- lack of mandatory standardization, certification, accreditation
- disparities between local, state and federal laboratories
- insufficient funding for instrumentation
- unacceptable backlogs

The most significant comment that has direct relevance to NSF is that

...forensic science...research, education, and training lack strong ties to our research universities. The forensic science system is underresourced also in the sense that it has only thin ties to an academic research base that could support the forensic science disciplines and fill knowledge gaps (pg 15).

Further, the report advocates for investment in research:

*...of the various facets of underresourcing, the committee is most concerned about the knowledge base. ... [There are] **fundamental limitations in the capabilities of forensic science disciplines to discern valid information from crime scene evidence** (pg 15; emphasis added).*

Activities at NSF that contribute to Strengthening Forensic Science

Workshops

NSF has long used workshops and other small gatherings of scholars and members of relevant communities to discuss cutting edge ideas and to identify and investigate gaps in knowledge and to propose future directions. In the area of forensic science, NSF has supported several workshops in the recent past; the NSF awards database lists 11 active awards containing the key words “forensic science” and “workshop.”

Two recent examples:

In direct response to a recommendation of the NRC report that research on human observer bias be encouraged, the Behavioral and Cognitive Sciences Division of the Social, Behavioral and Economic Sciences (SBE) Directorate supported “**Cognitive Bias and Forensic Science**” at Northwestern University in September, 2010. The workshop brought together lawyers, forensic scientists, and academic researchers in the area of cognitive bias to examine the role that psychological factors may play in forensic pattern recognition. The report of the workshop is available at <http://www.law.northwestern.edu/faculty/conferences/workshops/cognitivebias/>. In line with the workshop goal to ‘...convert general theories and testable hypotheses into concrete research proposals’ attendees continue planning the development of joint research projects.

The Division of Electrical, Communications and Cyber Systems/Directorate for Engineering (ENG) supported a workshop in August 2011 on “**Nanoscale Science and Technology for Forensics**” at the University of Connecticut. “The workshop assembled key experts from nanotechnology areas (optoelectronics, materials, fabrication, engineering and medicine) to focus on applications in forensic science.” This multidisciplinary meeting was designed to advance identification of future research needs and to promote new collaborations. The workshop also established recommendations for the development of programs for training graduate and undergraduate students to become the next generation of forensic scientists and engineers. A special effort was made to include student attendees.

Training Activities

NSF supports numerous activities designed to achieve excellence in U.S. science, technology, engineering and mathematics (STEM) education at all levels and in all settings (both formal and informal) in order to support the development of a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators, as well as a well-informed citizenry. This is certainly the case in the realm of forensic science. Many students participate in NSF supported research and thereby gain exposure to the conduct of research and some of these students ultimately focus their

attention and career in a forensic science. In addition, there are a number of awards that specifically expose students to research in a forensics setting.

Some awards capitalize on the popularity of shows such as CSI to engage students in science. One example is an award to Arkansas State University titled “CSI: Classroom Student Investigations” that was supported by the Division of Research on Learning in Formal and Informal Settings/ Directorate for Education and Human Resources (EHR). This project “...uses the popularity of the Crime Scene Investigation television show to train teachers in forensic science topics and use that training in their science classrooms to stimulate and encourage middle and upper school students in science topics generally.” Upon completion, the project will “...examine the impact on students’ interest in STEM careers in classrooms of participating teachers and examine how participation in the program affects participating teacher implementation of reform based pedagogy and technology.”

Other basic research projects, while not focused on educational goals, include capacity building components. With support from the Division of Mathematical Sciences of the Directorate for Mathematical and Physical Sciences (MPS), researchers at Michigan State University are investigating modeling and computational issues in fingerprint analysis. A central question in fingerprint analysis is the individuality of a person’s prints. The whorls, ridges and valleys present complex data that lead to the assumption of uniqueness. But in a legal setting, there are significant questions as to what constitutes a match when comparing a latent print from a crime scene and those of a defendant. These researchers are developing computational models for addressing the question of uniqueness and this may significantly impacts how fingerprint evidence is reported and used for the identification of individuals. Graduate students working with the principal investigators will be equipped with the analytic, computing and methodological skills that are necessary to perform high level forensic research.

Basic Research

Numerous basic research projects have potential applications in forensic science. Questioned Documents analysts attempt to extract information from a document utilizing as many sources as possible, including handwriting analysis. A recent Early Concept Grants for Exploratory Research (EAGER) award by the Division of Information and Intelligent Systems/ Computer & Information Science and Engineering (CISE) to a researcher at SUNY Buffalo is using computer approaches to “Automatic Identification of Writer Accent and Script Influences in Handwriting.” The investigator is testing hypotheses with respect to handwriting analysis by examining and analyzing the written works of native and non-native writers of a particular script or alphabet.

One of the most recent awards, supported by the Division of Behavioral and Cognitive Sciences of the Social, Behavioral and Economic Sciences (SBE) Directorate, uses GPS to track vultures. Vultures arrive early in the process of decomposition of human remains and leave few clues to indicate their scavenging activity. This can greatly complicate

medico-legal death analysis. This doctoral dissertation improvement award seeks “to establish a predictability model of likely vulture scavenging habitats using remote sensing techniques and spatial and temporal statistics,” the results of which could have significant implications for the practice of forensic pathology.

The Division of Chemistry (MPS) awarded funds to a researcher at the University of Iowa to use surface enhanced Raman scattering (SERS) for the detection of small molecules without the use of traditional receptor—based surface chemistry. If successful, this process could provide new means of detecting trace levels of drugs and biomolecules and thereby enhance the sensitivity of forensic investigations.

The Division of Social and Economic Sciences (SBE Directorate) funded researchers at the University of Arkansas, in collaboration with researchers at the University of Central Lancashire in the United Kingdom, to assess current methods of forensic age progression (assessing likely age changes in facial features), including identifying factors that influence the accuracy of age progression methods. The PIs will also explore novel methods for creating and presenting age progressed images that may improve the accuracy of forensic identifications.

Data and Scientific Infrastructure

Forensic scientists benefit from access to large databases as they attempt to analyze and interpret crime scene evidence. NSF has supported a variety of data infrastructure projects in recent years that generate valuable resources for forensic practitioners. These projects also include support for the training of future scholars.

The Division of Behavioral and Cognitive Sciences (SBE) continues to fund the **Allele Frequency Database (ALFRED)** at Yale University. This database currently houses information on human genetic variation on a global scale –ALFRED now has data on 663,602 genetic polymorphisms, 714 populations and more than 37,000,000 frequency tables (one population typed for one site). These data are invaluable for investigating human population structure, migrations and relationships, and can also be utilized by forensic scientists.

The Biology (BIO) Directorate’s Division of Biological Infrastructure supports The Human Impact Pollen Database at the University of Massachusetts, Boston. This searchable digital image database of pollen from plants that are associated with human activities is critical for investigating both past and current human-environment interactions. This on-line database provides value for a variety of disciplines including forensic identification.

The NSF also provides Major Research Instrumentation (MRI) grants to support the development of specialized laboratories or the acquisition of cutting-edge equipment that facilitates research and training opportunities at U.S. institutions. Several such awards have supported forensic science research and training in recent years.

The Office of Cyberinfrastructure provided MRI support to Jacksonville State University for the development of a cybersecurity laboratory facility to facilitate research and training activities in digital forensic methods of analysis, among other relevant areas.

Civil, Mechanical and Manufacturing Innovation in the Directorate of Engineering provided MRI support to Southern Illinois University at Edwardsville for the acquisition of a 3D laser scanner and associated modeling software that promote research and training on high resolution photographic and three-dimensional coordinate data which is often used by forensic scientists in the analysis of crime scenes. The instrumentation is being used to test new modeling and analytic approaches for investigating forensic sites in a multidisciplinary context.

Finally, the Division of Chemistry / Directorate of Mathematical and Physical Sciences has provided MRI support to Cleveland State University for the purchase of a triple quadrupole/linear ion trap liquid chromatograph mass spectrometer system. The instrument will support a wide range of research and training activities, including the ante- and post-mortem forensic analysis of drugs and other specimens.

Small Business Innovation Research

The NSF provides funding for Small Business Innovation Research (SBIR) to stimulate technological innovation in the private sector and to increase the commercial application of federally supported research results. A number of awards in recent years have supported the development of materials, algorithms, and instrumentation that have significant implications for the practice of forensic science. Two examples are provided below.

SBIR support was recently provided to DNA Polymerase Technology Inc. for the development of novel enzymes that can aid the rapid detection of pathogens via DNA detection and amplification. The processes explored may aid forensic practice, where the acquisition of small amounts of DNA in the context of inhibitors can present challenges to identification.

NSF support was also provided to Deurion, LLC for SBIR development of Surface Acoustic Wave Nebulization (SAWN) for use with mass spectrometers. SAWN provides a means of ionization outside of the laboratory with significant portability and ease of use. This technique may improve law enforcement's ability to collect and analyze crime scene materials.

Human Resources

In addition to funded research, training and workshops, NSF has invested significant human resources in support of the forensic sciences.

The National Science and Technology Council's (NSTC) Committee on Science established a Subcommittee on Forensic Science in direct response to the NRC report. NSF has been represented on the subcommittee since its inception. The individual who attends the Subcommittee meetings also co-Chairs the Research, Development, Testing and Evaluation (RDT&E) Interagency Working Group (IWG). An NSF program officer also serves on this working group.

NSF has provided input in numerous areas including discussions about:

- conducting merit-based peer review,
- identifying and prioritizing research opportunities,
- designing survey instruments for assessing current practices and needs,
- judging validity and reliability in laboratory sciences

Over the past several years SBE/BCS science assistants also aided in the design of the Subcommittee's website (<http://www.forensicscience.gov/iwg.html>) and supported the Interagency Working Group on Outreach and Communication.

Near and Longer Term Activities

Collaborating with mission agencies.

The NSF continues to work with other agencies to identify opportunities for advancing the forensic sciences. As the recent past indicates, many investigator-initiated projects directly address scientific questions of importance in forensic settings.

NSF continues to be represented on NSTC Subcommittee on Forensic Sciences and on its RDT&E IWG. The IWG has assessed the state of the science in a number of forensic settings (e.g. latent print analysis, questioned documents, fiber analysis, odontology) and is preparing annotated bibliographies and other documents that will help to elucidate foundational aspects of the forensic sciences and encourage further scientific inquiry.

The NSF's Directorate for Social, Behavioral and Economic Sciences is developing a Memorandum of Understanding with the National Institute of Justice regarding research, development, and evaluation of social and behavioral sciences as they pertain to legal and forensic matters. Activities undertaken via the MOU will foster information-sharing about the most promising areas of research in the social and behavioral sciences, and serve as a catalyst to identify synergies and opportunities for future collaboration.

Coordination within NSF

As clearly documented above, NSF invests significant human and financial resources in advancing the forensic sciences. In order to better coordinate our efforts going forward, we are planning to convene an internal group of appropriate program officers to share information regarding support for activities with obvious forensic applications.

Another potential activity that could benefit the forensic sciences would be the issuance of a Dear Colleague Letter (DCL) that notifies researchers of the Foundation's interests in supporting activities with potential applications to the forensic sciences. Such a DCL would draw the attention of academic and forensic communities to the potential for utilizing forensic settings as test-beds for asking basic research questions. Some psychology researchers, for instance, have already begun to utilize forensic laboratories as settings for asking basic questions about human cognition and decision making. The DCL could be designed to encourage collaborative, interdisciplinary teams (to include basic and applied forensic scientists) to develop scientific proposals around the relevant questions. Likewise the DCL could encourage the use of forensic settings for development of new methodologies and instrumentation.

In keeping with the philosophy of OneNSF, the Foundation could develop a cross-cutting panel to review a set of proposals that focus on aspects of forensic science emanating from a number of relevant basic science directorates. Such an interdisciplinary approach that brings together basic researchers and practitioners would create new knowledge, stimulate discovery, and address a range of complex problems.

NSF continues to develop a multi-year plan of Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE). This activity responds to issues raised in a variety of publications and to perceptions in the research community that NSF does not always provide good opportunities for comprehensive review and support of unsolicited interdisciplinary research. The current INSPIRE activity provides funding for high risk/high reward research that brings together ideas and approaches that cross intellectually distinct areas of science. Given the strong potential for coordinating the interests of basic scientists and the forensic science community through such opportunities, we have encouraged the development of interdisciplinary partnerships that address forensic science issues under this umbrella.

Summary

In summary, NSF is committed to supporting the basic sciences that form the foundation for forensic applications. Many of the projects funded in recent years will strengthen the forensic sciences both through support of research with obvious application to forensic settings and, in the longer-term, through as yet unimagined scientific and technological developments. In keeping with the NRC's recommendations, research in the behavioral and social sciences will also inform the forensic community regarding the impact of cognitive biases on the evaluation and utilization of forensic information.

The forensic sciences are also strengthened by NSF's support of many other activities. As a general statement, involvement of students in supported research will help to ensure a skilled scientific workforce for the 21st century and provide important training opportunities that will ultimately improve the practice of forensic science. The Small Business Innovation Research program will help to spur economic growth with projects that improve the precision and operability of instrumentation and processes in forensic laboratories. Major Research Instrumentation and database development activities will

also assist in building infrastructure for pursuing forensic-related opportunities. And NSF will continue to provide human and financial resources in the years ahead to coordinate and collaborate with other Federal agencies as we work to improve the practice of forensic science.

Mr. Chairman, this concludes my remarks. Once again, thank you for the opportunity to appear before you today on this topic. I would be happy to answer any questions you may have.