



## **Neuroforensics: Exploring the Legal Implications of Emerging Neurotechnologies—A Workshop**

*March 6, 2018*

*Keck Center of the National Academies  
500 Fifth Street, NW | Washington, DC*

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### **Background:**

Current developments in neuroscience, genomics, and computing are allowing unprecedented insight into human cognition and behavior in health and disease. Technological advances in noninvasive neuroimaging, neurophysiology, genome sequencing, and other methods together with rapid progress in computational and statistical methods and data storage have facilitated large-scale collection of human genomic, cognitive, behavioral, and brain-based data. As relevant technologies have become more widely disseminated and less costly, datasets have become progressively larger and more informative. For example, technologies for studying the central nervous system, approaches such as genome-wide association studies (GWAS), genome sequencing, and initiatives such as the Human Connectome Project have begun to yield large databases that are increasingly widely used. Such databases make it possible to characterize and make probabilistic predictions about individuals by imputation from studies of large populations. Several ongoing research efforts, such as the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative and the European Human Brain Project are strong catalysts for the development of the next generation of methods for observing the brain and for making experimental and therapeutic interventions. The next decade promises a burgeoning of these neurotechnologies.

The rapid development of neurotechnologies and associated databases has been mirrored by an increase in attempts to introduce neuroscience and behavioral genetic evidence into legal proceedings. Historically, the closest parallel to this kind of evidence has been the polygraph, which monitors peripheral consequences of nervous system activity to assess the veracity of testimony – and which is largely but not entirely excluded. Emerging neurotechnologies promise increased access to evidence obtained from the central nervous system and thus to brain function associated with complex behaviors and cognitive characteristics. Indeed, neuroscience evidence obtained from emerging neurotechnologies might conceivably be used by law enforcement, the courts, regulatory agencies and others as factors in predicting dangerousness; assessing competence to stand trial; assessing volitional control over actions; revealing mitigating factors relevant to sentencing; predicting recidivism; distinguishing pain from malingering; verifying intent; and manipulating memories.

To better understand the potential impact of emerging neurotechnologies on the legal system, the Forum on Neuroscience and Nervous System Disorders, in collaboration with the Committee on Science, Technology, and the Law (CSTL), will plan and conduct a one day public workshop bringing together leaders from academia, judicial and law enforcement systems, industry, government and regulatory agencies, non-profit foundations and other stakeholders to explore and advance efforts to identify and evaluate the potential effects of emerging neurotechnologies on the legal system.

## Workshop Objectives:

- Provide an overview of some of the state-of-the-art neurotechnologies relevant to the legal systems, and the use and impact of neuroscience evidence in the legal system.
- Explore emerging neurotechnologies—including methods for observing or manipulating the central nervous system and the genetics of cognition and behavior—and their potential implications and use by law enforcement, the courts, administrative proceedings, regulatory agencies and others.
- Consider the potential use of behavioral genetics based on large genetics databases and by the legal system.
- Discuss the ethical and societal considerations associated with the use of neuroscience evidence in criminal, administrative, and other judicial proceedings.
- Highlight topics at the nexus of emerging neurotechnologies and the law for further study, such as potential opportunities for developing standards and procedures for using evidence from emerging neurotechnologies in the legal system and identifying potential stakeholders across sectors that may be affected by this multidisciplinary area.

### Workshop Planning Committee

**HENRY T. GREELY**, Stanford University (*Co-Chair*)

**STEVEN E. HYMAN**, Broad Institute of MIT and Harvard (*Co-Chair*)

**JOE S. CECIL**, Federal Judicial Center

**NITA A. FARAHANY**, Duke University

**OWEN D. JONES**, Vanderbilt Law School and Department of Biological Sciences

**BEATRIZ LUNA**, University of Pittsburgh Medical Center

**BENJAMIN NEALE**, Harvard University and Broad Institute of MIT and Harvard

**HOWARD C. NUSBAUM**, University of Chicago

**JED S. RAKOFF**, United States District Court for the Southern District of New York

**KHARA RAMOS**, National Institute of Neurological Disorders and Stroke

**ADINAROSKIES**, Dartmouth College

**BARBARA J. ROTHSTEIN**, United States District Court for the District of Columbia

**JOSHUA R. SANES**, Harvard University

**March 6, 2018 | Room Keck 100**

**WELCOME AND INTRODUCTION**

8:00 a.m.      **Overview of the Workshop**

**Scientific Advances**

STEVEN E. HYMAN, Broad Institute of MIT and Harvard (CO-CHAIR)

**Legal Developments**

HENRY T. GREELY, Stanford University (CO-CHAIR)

8:40 a.m.      **Discussion**

**SESSION I: CUTTING-EDGE NEUROSCIENCE AND NEUROTECHNOLOGIES AND THE LEGAL SYSTEM—CASE STUDIES**

**Session Objectives:**

- Explore case studies of innovative neurotechnologies and cutting-edge neuroscience that are of great interest for use in various legal settings, including, for example, police investigation, suppression hearings, and administrative proceedings, and settlement negotiations.
- For each case, discuss current use and what would be needed to appropriately use these neurotechnologies in legal settings in the future.

8:50 a.m.      **Session Overview**

JOSHUA SANES, Harvard University (MODERATOR)

9:00 a.m.      **Presentations**

**Detecting Deception**

JOSHUA BUCKHOLTZ, Harvard University

**Can Brain Identify Pain?**

TOR WAGER, University of Colorado Boulder

9:30 a.m.      **Discussion**

9:45 a.m.      **--- Break ---**

10:00 a.m.      **Presentations**

**Mind Reading**

JACK GALLANT, University of California, Berkeley

**Predicting Mental States**

READ MONTAGUE, Virginia Polytechnic Institute and State University

- 10:30 a.m.     **Discussion**
- 10:45 a.m.     --- *Break* ---
- 11:00 a.m.     **Presentations**

**Electrophysiology Measures in Perception and Recognition**  
ADRIAN NESTOR, University of Toronto

**Contribution of Genetics to Behavioral Prediction**  
BENJAMIN NEALE, Broad Institute of MIT and Harvard

- 11:30 a.m.     **Discussion**
- 11:45 a.m.     --- *Lunch* --- [*seating available in 3rd floor atrium*]

**SESSION 2: THE LANDSCAPE OF EMERGING NEUROTECHNOLOGIES—ANTICIPATING THE NEXT 20 YEARS**

**Session Objectives:**

- Describe specific neurotechnologies and methods in conceptual or early stages of development and assess their projected paths for growth and implementation over the next 20 years.
- Evaluate the potential utility of emerging neurotechnologies for collecting evidence and information for use in the legal system, including out-of-court settings.
- Identify the challenges for developing scientific standards for use of evidence obtained from these technologies.

- 12:50 p.m.     **Session Overview**  
KHARA RAMOS, National Institute of Neurological Disorders and Stroke (MODERATOR)

- 1:00 p.m.     **Presentations**

**Closed-Loop Brain Stimulation**  
AYSEGUL GUNDUZ, University of Florida

**Understanding the Neural Basis of Volitional State through Continuous Recordings in Humans**  
SYDNEY CASH, MGH / Harvard University

- 1:40 p.m.     **Discussion**
- 2:00 p.m.     --- *Break* ---

**SESSION 3: DEVELOPING A FRAMEWORK FOR USE OF EVIDENCE FROM EMERGING NEUROTECHNOLOGIES—A WAY FORWARD**

**Session Objectives:**

- Brainstorm potential approaches to establishing frameworks and standards for using neuroscience evidence, in anticipation of the burgeoning use of neurotechnologies in the coming decades.

2:15 p.m.

**Session Overview**

CHIEF JUDGE PATTI SARIS, United States District Court for the District of Massachusetts  
(MODERATOR)

2:25 p.m.

**Presentations and Reflections**

DAVID FAIGMAN, University of California, San Francisco  
FRANCIS SHEN, University of Minnesota  
JUDGE BARBARA HERVEY, Texas Court of Criminal Appeals  
JUDGE NANCY GERTNER (Ret.), Harvard Law School

3:45 p.m.

**Moderated Discussion**

4:20 p.m.

**Q&A**

**SUMMARY AND CLOSING REMARKS**

4:30 p.m.

HENRY T. GREELY, Stanford University (CO-CHAIR)  
STEVEN E. HYMAN, Broad Institute of MIT and Harvard (CO-CHAIR)

5:00 p.m.

**--- Adjourn Workshop ---**