

Neuroforensics: **Exploring the Legal Implications of Emerging Neurotechnologies**

**A Workshop | March 6, 2018
Washington, DC**

 **#NeuroForum**



Workshop on Neuroforensics: Exploring the Legal Implications of Emerging Neurotechnologies

Session 2

The Landscape of Emerging Neurotechnologies— Anticipating the Next 20 Years

Moderator:

Khara Ramos

National Institute of Neurological Disorders and Stroke

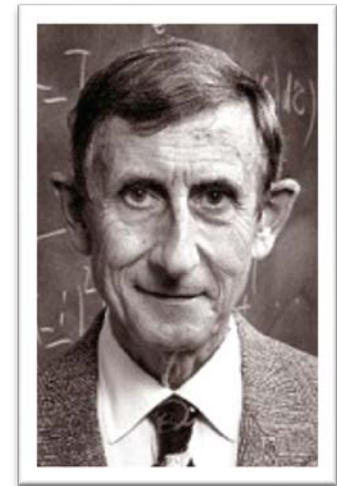
Session 2: The Landscape of Emerging Neurotechnologies— Anticipating the Next 20 Years

Where does scientific progress come from?

“New directions in science are launched by new tools much more often than by new concepts. The effect of a concept-driven revolution is to explain old things in new ways. The effect of a tool-driven revolution is to discover new things that have to be explained.”

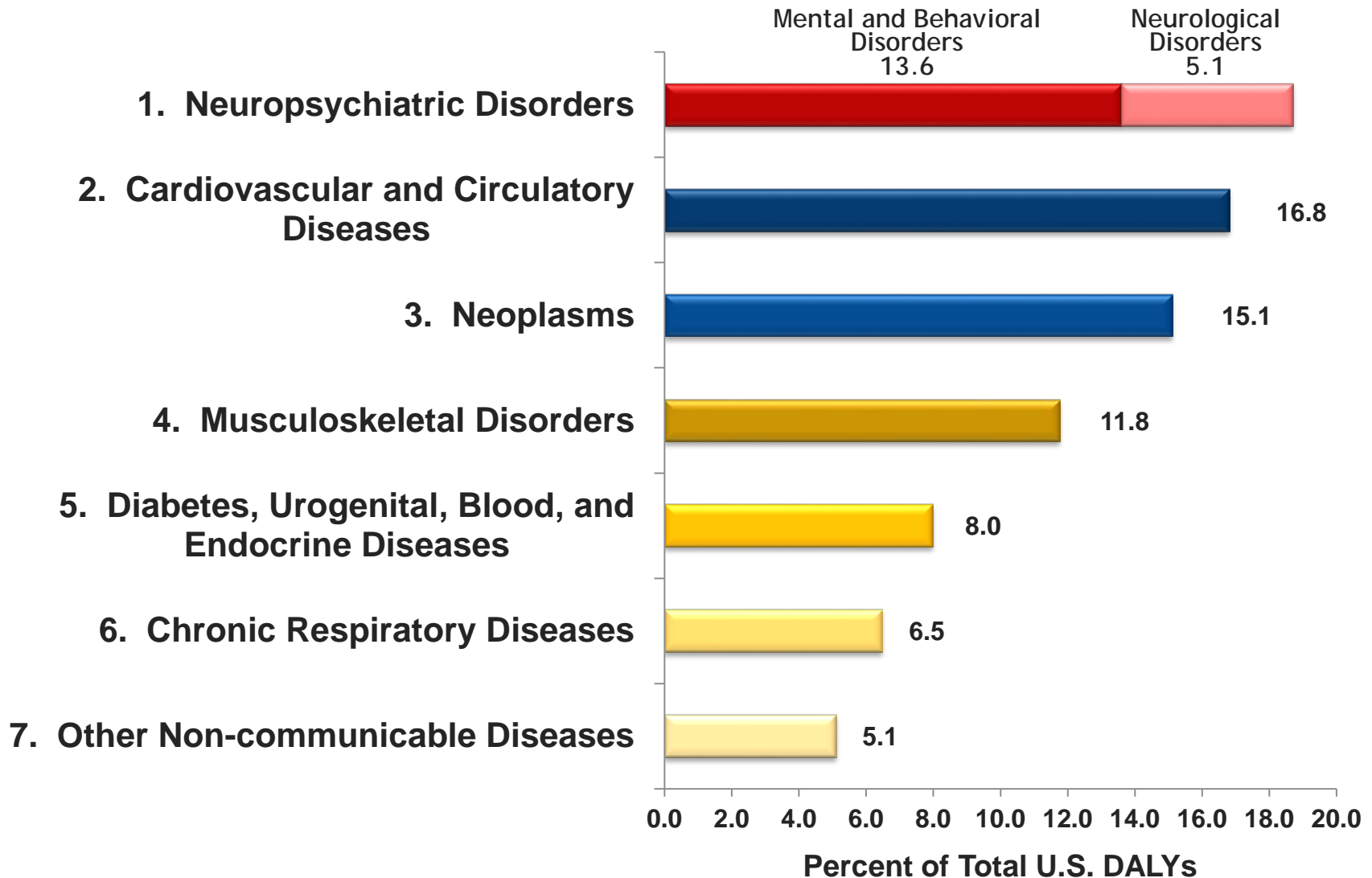
Freeman Dyson (1997) *Imagined Worlds*

Harvard University Press, Cambridge, MA



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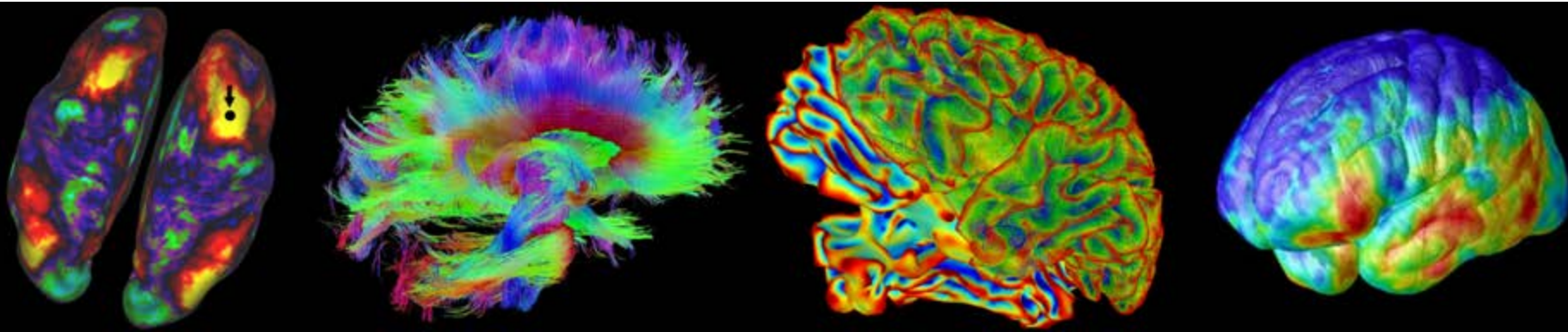
Leading Categories of US DALYs 2010



The BRAIN Initiative[®]

Brain disorders -- a leading source of disease burden and cost in the U.S.

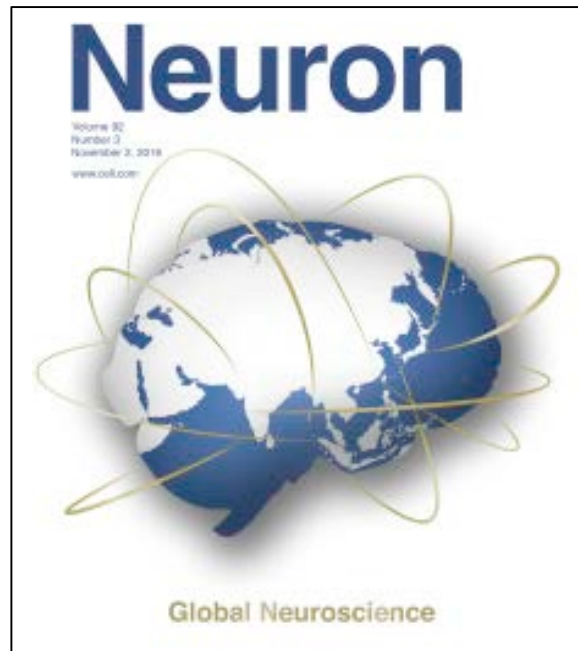
The BRAIN Initiative builds on advances in physical sciences to create tools that will accelerate discovery and build the foundation we need to reduce the burden of brain disorders



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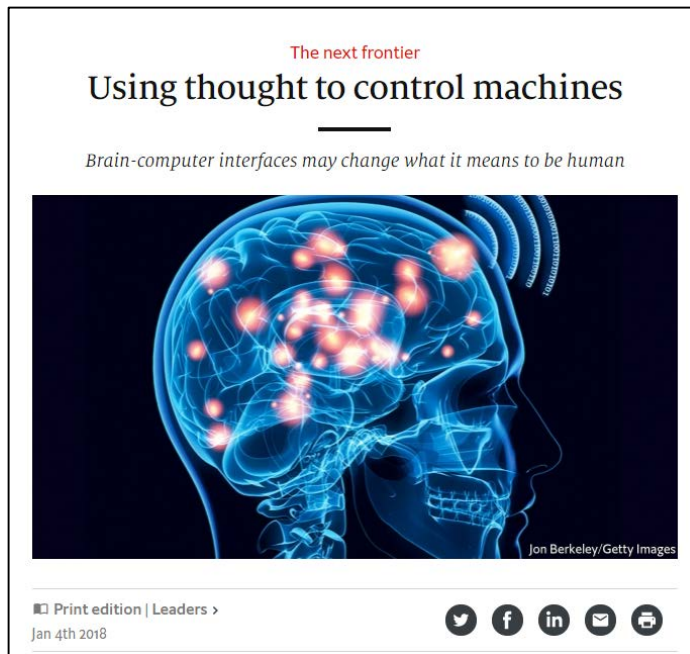
Neurotechnology - leading the way for neuroscience

- \$4.2B projected total for lifetime of the NIH BRAIN Initiative
- There are many national brain projects around the world
 - European Union, Korea, Japan, China, Australia, Canada



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Neurotechnology - interest from the private sector



JOHN H. RICHARDSON SCIENCE 11.16.17 06:00 AM

INSIDE THE RACE TO HACK THE HUMAN BRAIN



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NIH: Focus on brain circuit structure and function



FIRST FIVE YEARS

Emphasize
technology
development

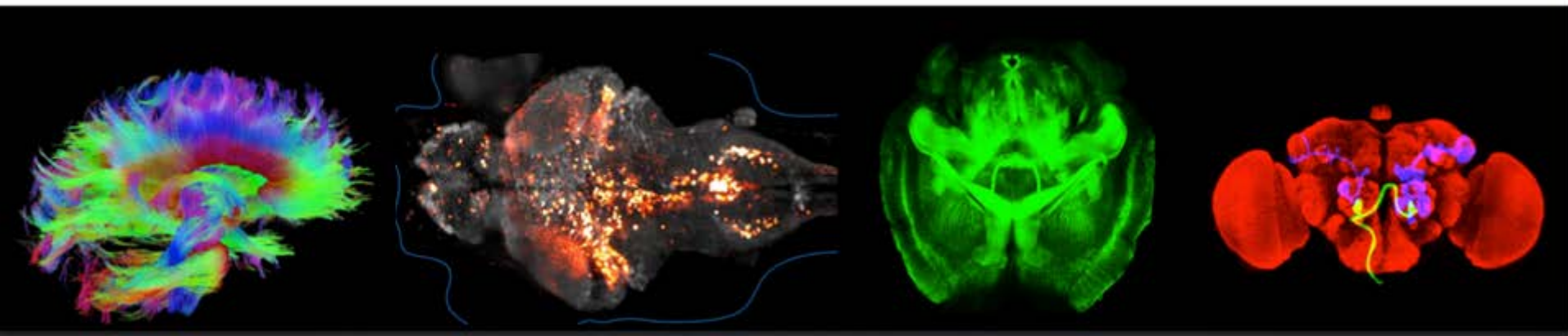
SECOND FIVE YEARS

Emphasize
discovery
driven science

Goal: See the circuits in action to understand:

- How the brain moves, plans, executes
- How to monitor/manipulate circuits for improved function
- How disordered brain circuits cause neuro/mental/substance use disorders

Long-term goal: Make circuit abnormalities the basis of diagnostics, and normalization of circuit function the target of intervention

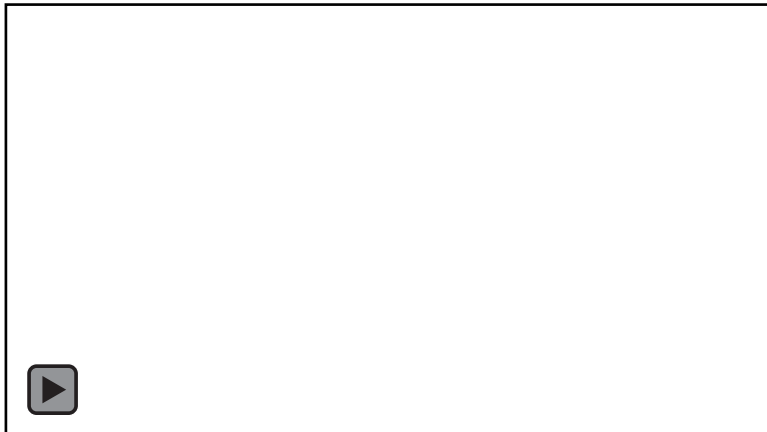


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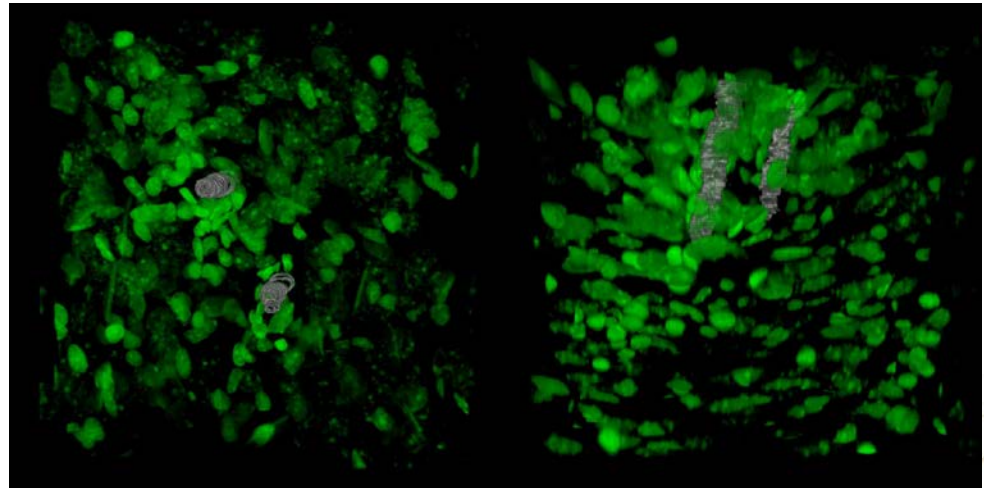
Discoveries supported by the NIH BRAIN Initiative

- Data Coordination/Informatics
- Neuroethics
- Training/Dissemination
- Human Imaging/Modulation
- Understanding Circuits
- Neural Recording/Modulation
- Cell/Circuit Tools
- Cell Types

- *Develop and improve large-scale monitoring of neural activity to produce a dynamic picture of brain activity*
- *Link brain activity to behavior via interventional tools*



Scientists reconstructed this zebrafish larva's brain wiring from 16,000 slices. Credit: Hildebrand, Engert, Lichtman – Nature



Scientists created neural probes as small as neurons, avoiding an immune response from the body. Credit: Cynthia Chestek, University of Michigan

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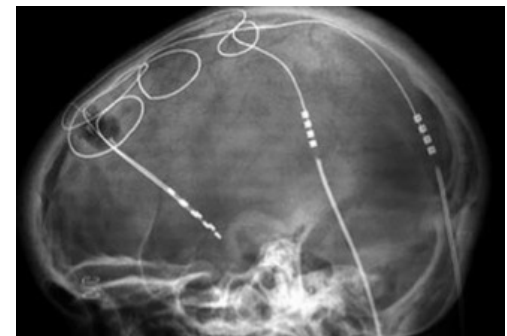
■ Understanding Circuits

■ Neural Recording/Modulation

■ Cell/Circuit Tools

■ Cell Types

- *Next generation human imaging technologies (phase 2 awards)*
- *Foundations of human imaging*
- *Noninvasive neuromodulation*
- *Next generation DBS devices for a range of disorders*



Researchers are improving on FDA-approved Deep Brain Stimulation to incorporate feedback from brain to automatically adjust brain stimulation from pacemaker

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- Now is a transformative time for development of novel neurotechnologies
- The BRAIN Initiative is a catalyst, aimed at revolutionizing our ability to record and modulate brain function for therapeutic interventions
- What are the implications for these powerful new tools and neurotechnologies beyond health?
- Now is the time to pro-actively consider possible implications for the legal system

Opportunity



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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.



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- 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 ---**

