John Ngai, Ph.D.
Director,
NIH BRAIN Initiative

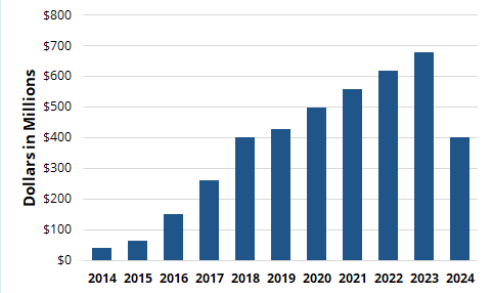
Why is the BRAIN Initiative important?

The human brain is the most powerful, flexible, and energy-efficient computational machine known to humankind. Understanding the mysteries of the human brain and what makes us human is one of the greatest challenges of our generation.

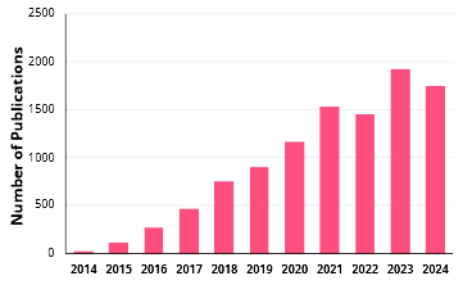
The National Institutes of Health (NIH) *Brain Research Through Advancing Innovative Neurotechnologies*® Initiative, or The BRAIN Initiative®, has met this challenge head-on since 2014. An exciting and productive decade of innovation facilitated by BRAIN Initiative research has changed neuroscience in ways we couldn't have imagined 10 years ago. The Initiative continues to deliver innovative results through its mantra: "think big, start small, scale fast."

BRAIN by the Numbers

Budget: Fiscal Years 2014 – 2024



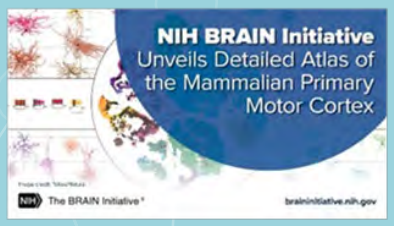
Publications: 2014 – 2024



Awarded Institutions: 2014 – 2024

1,791 PIs across
266 Institutions
supported by
Over 1,600 Awards

Accelerating Interdisciplinary Neuroscience Discoveries Across Institutions



Integrating neuroscience across 10 participating NIH Institutes or Centers

- NINDS
- NIDCD
- NIDA
- NIA
- NCCIH
- NIMH
- NICHD
- NIBIB
- NEI
- NIAA

Scientific Vision: BRAIN Priority Areas

CELL TYPE
Brain cell atlases: Identify different brain cell types and determine their roles in health and disease.

CIRCUIT DIAGRAM
Maps at multiple scales: Generate circuit diagrams that vary in resolution from synapses to the whole brain.

MONITOR NEURAL ACTIVITY
The brain in action: Tool development to monitor large-scale neural activity to produce a dynamic picture of the brain.

INTERVENTIONAL TOOLS
Demonstrating causality: Interventional tools to establish causal links between patterns of brain activity and behavior.

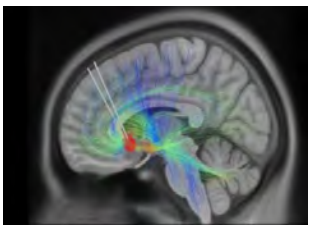
THEORY & DATA ANALYSIS TOOLS
Fundamental principles: Theoretical & analytical tools for conceptual understanding of neural processes.

HUMAN NEUROSCIENCE
Advancing human neuroscience through innovative technologies to understand the brain and treat its disorders.

INTEGRATED APPROACHES
Integrate technological/conceptual approaches to discover neural basis of cognition, emotion, perception, and action.

Laying the Foundation for Cures and Understanding What Makes Us Human

Life-changing innovations in deep brain stimulation

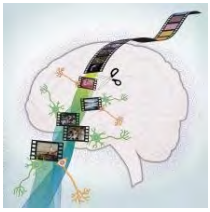


- BRAIN-funded innovations in deep brain stimulation-based treatments are showing success in small clinical studies for stroke recovery, obsessive-compulsive disorder, binge eating disorder, traumatic brain injury, post-traumatic stress disorder, substance use disorder, and depression.
- This research provides hope for people living with devastating brain conditions.

Post stroke cerebellar deep brain stimulation is found safe and effective:

- 9 out of 12 participants showed motor function improvements after combining deep brain stimulation and physical therapy.
- No serious adverse events or device failures were reported (Baker, *Nature Medicine*, 2023).

Researchers uncover how the human brain separates, stores, and retrieves memories.



- Researchers have identified two types of cells in our brains that are involved in organizing discrete memories based on when they occurred.
- This finding improves our understanding of how the human brain forms memories and could have implications in memory disorders such as Alzheimer's disease (Zheng et al, *Nature Neuroscience*, 2022).

BRAIN-Funded Cell Census Tools Create New Avenues to Understand the Brain

The BRAIN Initiative Cell Census Network (BICCN) revealed the genetic, cellular, and structural makeup of the human and non-human primate brain in a groundbreaking collection of 21 papers in *Science*, *Science Advances*, and *Science Translational Medicine* (October, 2023).

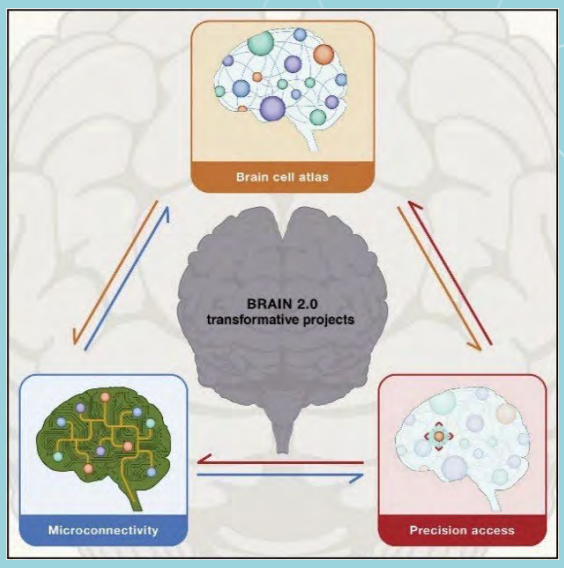
Brain single-cell mapping of multiple **brain regions and species across the lifespan** was conducted at unprecedented levels of detail, setting the stage for the BRAIN Initiative Cell Atlas Network (BICAN) to map the brain's cellular landscape at scale, a critical step toward understanding how the brain functions in health and disease.

In a subsequent collection of 10 papers published in *Nature*—nine of which were funded by the NIH BRAIN Initiative—an international team of researchers revealed a complete cell atlas of a whole mammalian brain. This map paves the way for a greater understanding of the human brain (December 2023).

The impact from BICCN is far reaching. Through separate research projects, such as the Seattle Alzheimer's Disease Brain Cell Atlas and Single Cell Opioid Response in the Context of HIV program, **BRAIN-funded cell census tools** are being used to actively investigate disorders of the brain, such as Alzheimer's disease and opioid use disorder.

BRAIN 2.0: Looking to the Future

Transformative projects that will change the future of neuroscience research and accelerate the search for cures *(Ngai, Cell, 2022)*



Brain cell atlas: A parts list of the human brain
Microconnectivity: Wiring diagrams of the brain at unprecendented scale
Precision cell access: An armamentarium of tools to access brain cell types with exquisite specificity