

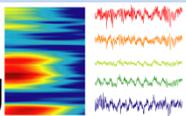
# NExtRAC: Neurotechnology

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Laboratory for Psychiatric  
Neuroengineering

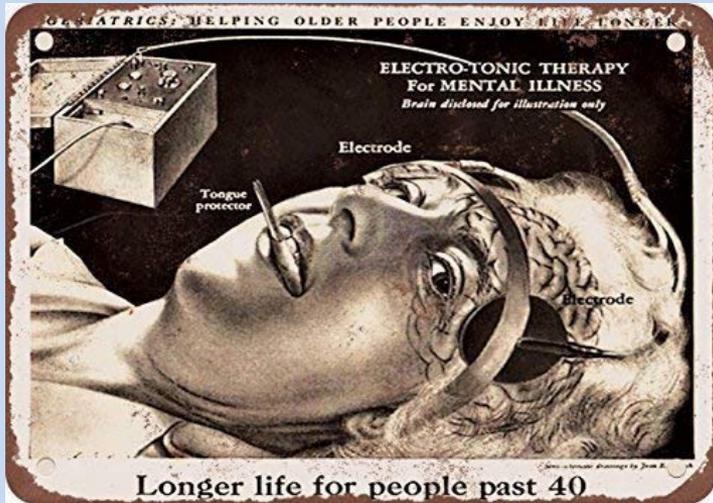


# History of Neurotechnology



# History of Neurotechnology

## Brain stimulation



<https://www.pinterest.com/pin/129548926767533278/>

<https://science.howstuffworks.com/life/inside-the-mind/human-brain/electroconvulsive-therapy2.htm>

# History of Neurotechnology

## Brain stimulation

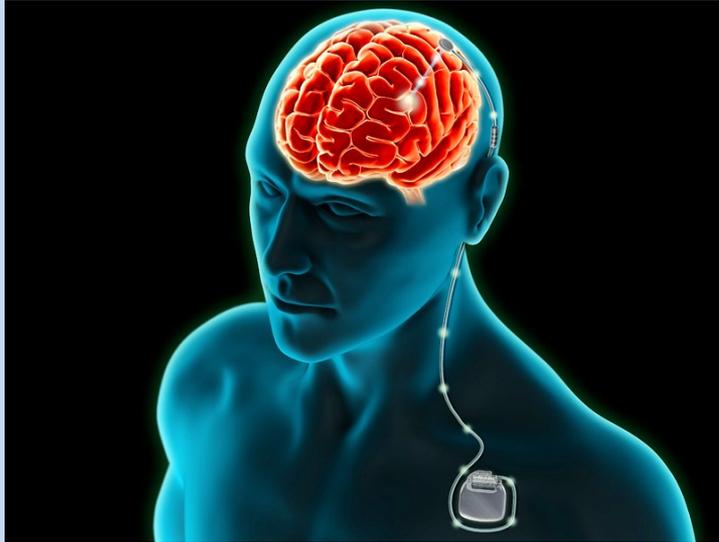


<https://science.howstuffworks.com/life/inside-the-mind/human-brain/electroconvulsive-therapy2.htm>

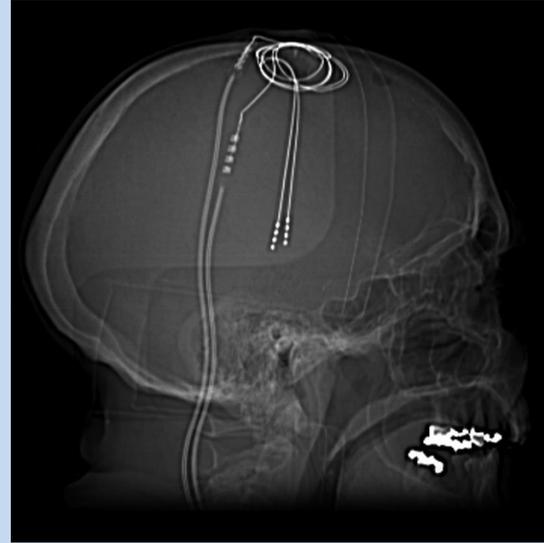


# History of Neurotechnology

## Brain stimulation



<https://www.medscape.com/viewarticle/898369>

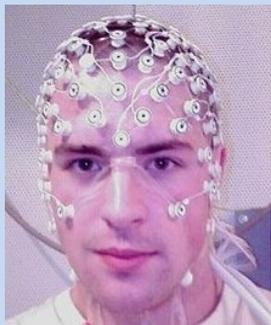


<https://radiopaedia.org/articles/deep-brain-stimulation>

Parkinson's Disease, Epilepsy, Tremors, Obsessive Compulsive Disorder, Depression

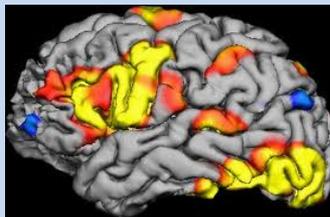
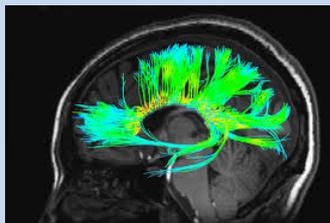
# EEG

Electroencephalography



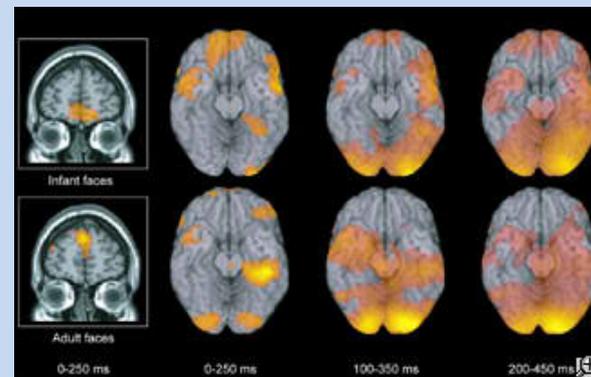
# MRI

Magnetic Resonance Imaging



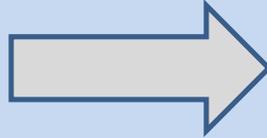
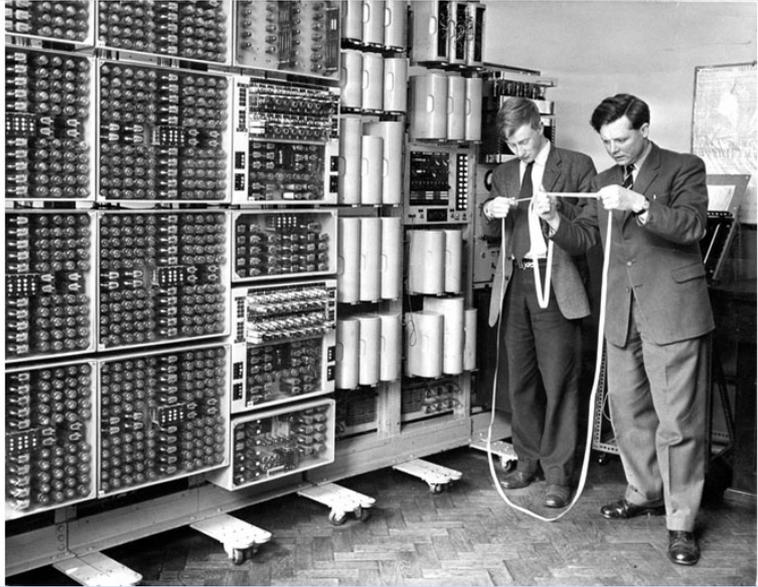
# MEG

Magnetoencephalography



Why add neurotechnology to RAC?

# Evolution of technology



# Federal BRAIN Initiative

- Brain Research through Advancing Innovative Neurotechnologies
- Launched in 2013 (\$300M)
- Budget for \$4-5B through 2026 (Cures Act and other appropriations)
- BRAIN 2.0 Launched Oct 2019



# Federal BRAIN Initiative

- Tools to monitor the human brain
- Tools to modulate the human brain
- Analytics and theories to understand the human brain

THE WHITE HOUSE IS ANNOUNCING  
OVER \$300 MILLION IN PUBLIC AND PRIVATE INVESTMENTS  
IN SUPPORT OF THE BRAIN INITIATIVE

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the WHITE HOUSE  
 **BRAIN  
INITIATIVE**

BRAIN RESEARCH THROUGH ADVANCING  
INNOVATIVE NEUROTECHNOLOGIES

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Since President Obama announced the **BRAIN Initiative** in April 2013, dozens of leading technology firms, academic institutions, scientists and other key contributors to the field of neuroscience have answered his call and made significant commitments to advancing the Initiative.

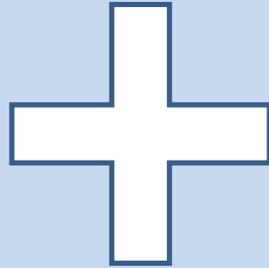
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 [VIEW THE FULL INFOGRAPHIC](#)

# Federal BRAIN Initiative

- Laying the ground-work to treat brain disorders
  - From Autism to Alzheimer's
- Circuit Cures

# Next wave of neurotechnology?



# Outside the NIH

- Kernel
  - “How *Brains* and Machines Can Be Made to Work Together”
- Neuralink
  - “Developing ultra high bandwidth brain-machine interfaces to connect humans and computers.”
- DARPA
  - “bi-directional brain-machine interfaces .... control of unmanned aerial vehicles and active cyber defense systems or teaming with computer systems to successfully multitask during complex military missions.

# Neuroethics

- Brain Neuroethics Subgroup (BNS) report (Oct 2019)
  - Privacy
  - Autonomy/Agency
  - Bias
  - Applications
  - Moral significance (neuromorphic chips)