

The Cyborg You Are and The Cyborg You Will Be

Brain Machine INTERFACE

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If you could have a neural prosthetic, what level of risk are you willing to tolerate?

Consider:

1. Biological risks
2. Ethical concerns
3. Privacy



What is a cyborg?



Biological brains that are **enhanced** with technology. But enhanced in what aspect? Does using a calculator make you a cyborg?

What about using a boomerang? What about a cochlear implant?

How about electrodes implanted into your brain?

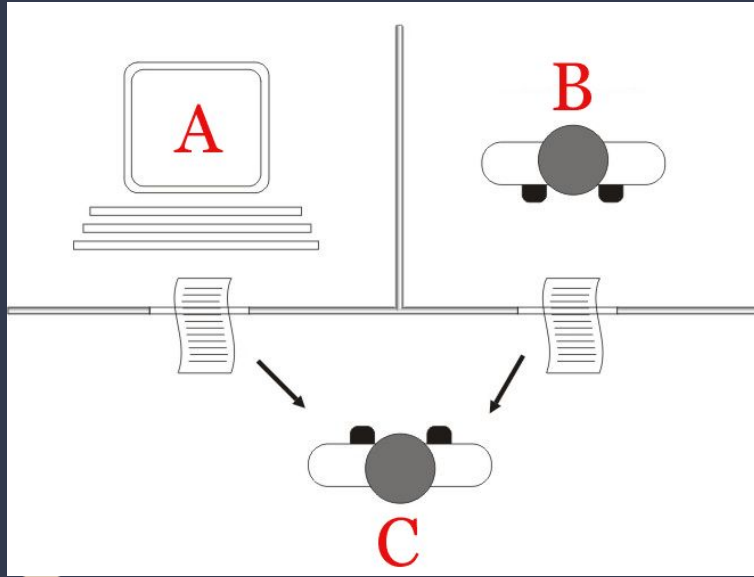
Ask yourself what you think of when you imagine a cyborg.

Fun questions to think about - but are they important?

Ways to Become A Cyborg

- 1. **Education and Training**
- 0. **Using a Smartphone**
- 1. **Brain Machine Interfaces (BMI)**
- 2. **Exoskeletons and Prosthetic Limbs**
- 3. **Wearable computing devices**
- 4. **Vision Implants**
- 5. **Auditory Implants**

Turing Test



The Imitation Game

"I propose to consider the question,
'Can machines think?'"

Neural Prosthetics

Artificial body parts that can substitute or enhance a brain function

Brain function = motor, sensory or cognitive.



Brain–Machine Interfaces (BMI/BCI)

- Record Neuronal signals (such as CNS signals)
- Translate these signals
- Output the translated signal to a device

Vision



Summary - we're really bad at it.

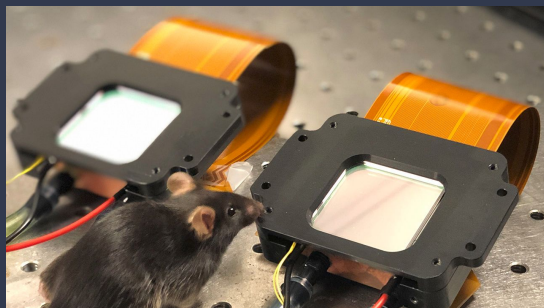
Glasses are cool though!

- Jerry
 - Blinded in adulthood
 - BCI designed by William Dobbelle
 - Phosphenes
 - Can now do some tasks unassisted

Scientific Basis



Induced Hallucinations

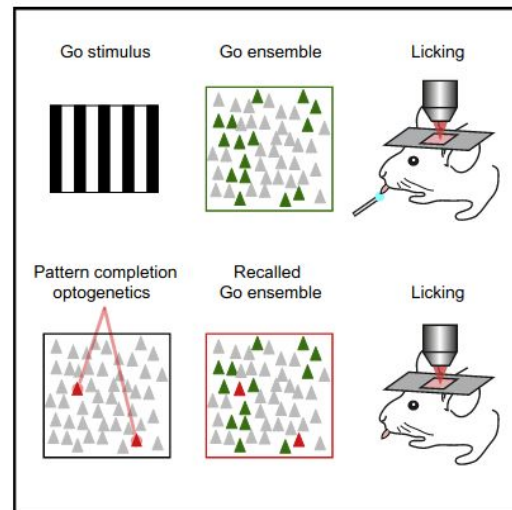


Cell

Article

Controlling Visually Guided Behavior by Holographic Recalling of Cortical Ensembles

Graphical Abstract



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In Brief

The activation of a small set of pattern completion neurons via two-photon holographic optogenetics triggers neuronal ensembles that appear to be necessary and sufficient for behavior.

Deep Brain Stimulation

- Very promising technology, approved by the FDA
- Neurostimulator - a pacemaker for the brain
- sends electrical impulses
- Partial treatment for essential tremor, Parkinson's
- Complications include hemorrhage and infection

Companies



Neurable – Neuralink but better?



Mission: create everyday Brain-Computer Interfaces (BCIs)

- founded in 2015, headquartered in Boston
 - roots in UMich Direct-Brain Interface laboratory
- 2017: demonstrates the world's first mind-controlled VR game
 - Awakening, escape room-based game
- 2019: \$6 million Series A, moving on to more general applications
 - headphones that measure brain activity to generate insights





<https://sj-bass.tumblr.com/post/172484296656>



Neuralink – Musky



Mission: "If you can't beat em, join 'em" - Elon Musk re Artificial Intelligence.

- Founded by Elon Musk and "Others"
 - Who's "others"
 - Flip Sabetz - UCSF Prof on BCI
 - Ben Rapoport - Neurosurgeon
 - DJ Seo - UCB
 - Paul Merolla - Brain inspired chips!
 - Vanessa Tolosa - Biocompatibility
 - Max Hodak - Duke
 - Tim Hanson - Berkeley Sensor and Actuator Center
 - Tim Gardner - Assoc. Prof at Boston Uni

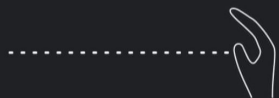
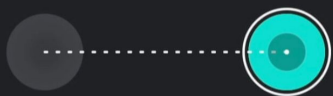
Neuralink – Musky



- The science behind it, as explained by Neuralink
- Approach
 - Micron-scale threads are inserted into areas of the brain that control movement.
 - Each thread contains many electrodes and connects them to an implant, called the Link.
 - Wireless charger
- How to get a neural implant? What are the risks?
- So...what's new about Neuralink?

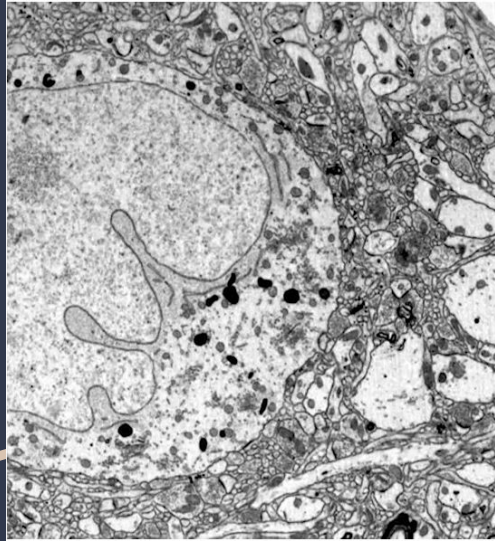
Neuralink – Musky

Neuralink trains to pick up increasingly accurate signals.



- The App!
 - Bluetooth to control mouse, keyboard
 - Will teach you to use the device
- Transfer information to and from brain
- Large number of electrodes
- Smaller
- >1024 channels of information from the brain

Nectome – preserve your brain and upload it!

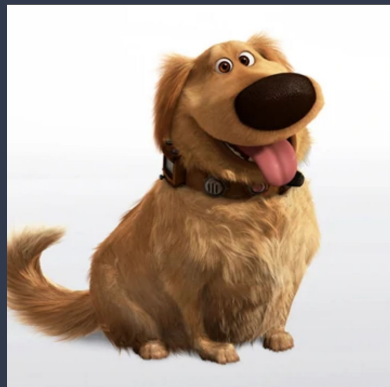


Layers of cells and synapses of a preserved pig brain as seen through an electron microscope. Some believe mapping such a "connectome" could be used to reconstruct memories.

The Brain Preservation Foundation

- Y Combinator backed, has raised \$1 million in funding
 - used to have a partnership with the MIT Media Lab
- Sam Altman has joined a "waiting list" for having Nectome digitize your brain
 - for the low price of a (refundable) \$10k deposit
- the procedure is 100% fatal!
 - embalming + cryogenics
- Alcor Life Extension Foundation
- ethical issues with brain preservation

Zoolingua – Communicate with Doggos



Mission - allow dogs and humans to communicate in both directions

Thoughts

- Why stop at doggos
- Hooman interface

<https://zoolingua.com/>

Some other uses

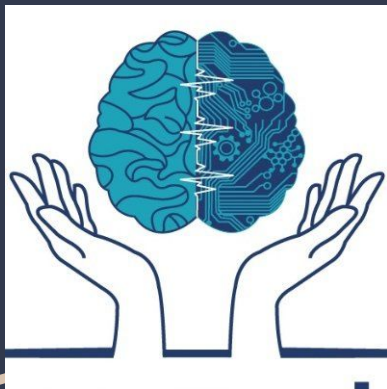
- tremor suppression
- communication for those with paralysis
- productivity software

Neurosecurity & Neuroethics

- Preserve neuronal information about you
- Neuromarketing
- Ransomware
- Doping for intellectual sports?

Do you trust a private corporation or a government with access to your neuronal data?
What happens in authoritarian regimes?

The NeuroRights Initiative



Five Neuro-rights:

1. Mental privacy
2. Identity (self)
3. Agency (free will)
4. Fair Access (to cognitive augmentation)
5. Protection (from Bias and Discrimination)

13 April 2021: Chilean Congress approves a constitutional amendment that acknowledges and protects mental integrity in light of current advances in neurotech.

Challenges

1. Size *does* matter
2. Power consumption
3. Biocompatibility
4. Surgical precision
5. Mathematical modelling

How are cognitive enhancements different from education and training?

Why would they pose ethical questions that are not already caused by education?

Acknowledgement

PSY 409 (Cyborg Psychology), Dr.Junge and co.