The Future or Neural Implants

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Neural Implants?

Neural Implants (Input): Record and/or monitor neural activity.

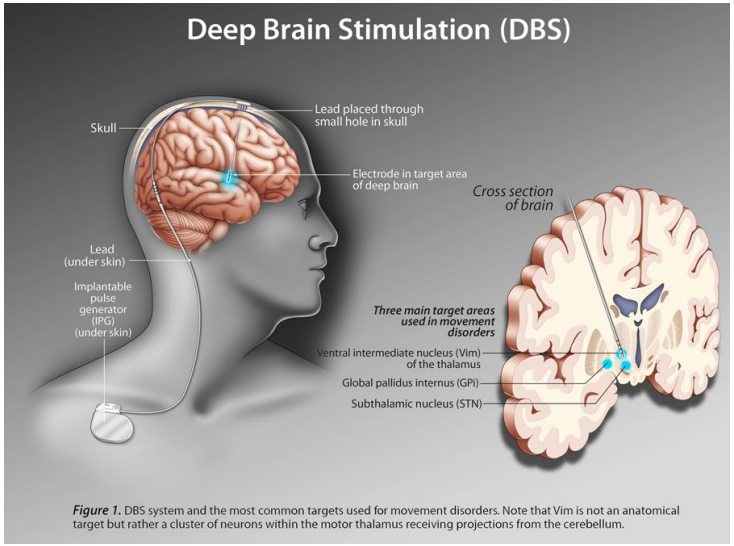
Neural Implants (Output): Sending electrical impulses to specific neural circuits to restore/stimulate neural functions.

Brain Computer Interface (BCI): enables a direct communication pathway between neural activity and a external computer system. Able to translate neural input into signals that can control software or hardware.

The Promise of Neural Implants

- Billions worldwide suffer from conditions that can potentially be alleviated with neural implants
  - Epilepsy with responsive neurostimulation systems
  - Motor function loss with BCIs and neural prosthetics
  - Depression/Obsessive Compulsive Disorder with deep brain stimulation
  - etc.
- Limitations of current treatments
  - Many patients have varied responses to medications
  - Patients develop tolerance to treatment over time
  - Assistive devices do not fully replicate natural movement

Current Neural Implant Applications



Neural implants have already been changing lives.

- Over one million people have cochlear implants as of 2022, allowing them to regain hearing abilities and allowing them a much better quality of life.
- Deep brain stimulation has been used as a treatment for Parkinson's for years.
    - Patients experience a reduction in tremors and motor function

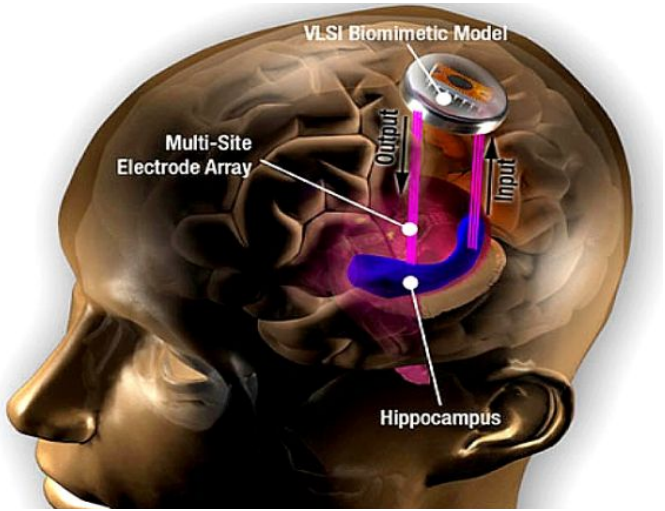
Human Enhancement

- Cognitive enhancement
  - Increased memory retention
  - Accelerated learning
  - Enhanced problem solving
  - Mood regulation

Nelson, McKinley, Golob, Warm, and Parasuraman (2014): Transcranial Direct Current Stimulation can be used to enhance vigilance in neurologically unimpaired participants

Access and Risks

- Neural implants in the long term
  - Insertion of implantable device results in tissue wound around the area, leads to giant cell body forming around the implant
  - Continuous growth of fibrous cells leads to device failure, can no longer record/modulate electrical signals when covered
  - Requires additional surgery to replace device
  - Costly and risky
  - If user changes their mind, very hard to remove
- Restricted to certain people
  - Mainly wealthy people will have access to neural implants, giving them big advantage over those who don't



Human?

- Control over your body
  - Neural implants can send or block electrical signals in your brain, affecting your behaviour
  - Can alter your memories
  - May change who you are as a person
    - Personality
    - Identity
    - Morals
  - AI driven neural implants can take away user control
    - Ex: AI algorithm may predict what users want to hear and not what is actually said, leading to misunderstandings

Mistakes

- Mistakes made by AI model can be detrimental
  - Ex: user is using it for vision to drive on the road
- Biases of AI model may leak into the info being transmitted to the user
- Difficult for users to learn what AI lacks

Privacy

- Neural networks may be able to access user thoughts, invading user privacy
- People may be able to hack into these systems, releasing all of this personal information to the public
- Data also coming from surrounding people

Dependence

- People may grow too dependent on these technologies
- In the case that a trial is stopped for various reasons, it is harmful to expose trial participants to the benefits of neural implants then immediately cutting them off
    - Ex: someone is allowed to experience sight for the first time then that is stripped away

Questions?