Memory Enhancement Through Deep Brain Stimulation

PSYC182J

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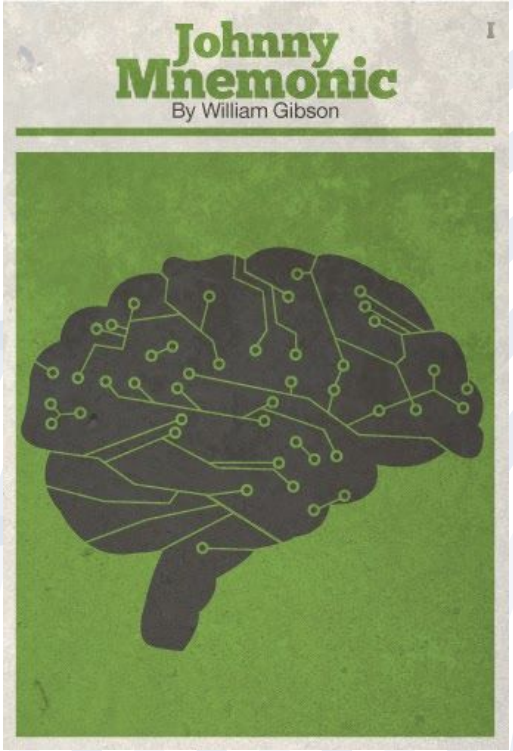
Science Fiction: Johnny Mnemonic

- **Plot Summary**
  - Johnny is a data trafficker who has undergone cybernetic surgery for implantation of data storage system.
  - He is unaware of content of information stored and is unable to retrieve it.
  - Fight to free self from stored data.
  - “...One day I’ll have a surgeon dig all the silicon out of my amygdalae. And I’ll live with my own memories and nobody else’s. Like the way other people do” (Gibson).



Science Fiction: Johnny Mnemonic

- “Mnemonic”: device (i.e. letters, associations, etc.) that assists in retrieving information from memory.
  - Irony: Johnny cannot consciously “remember” anything being stored.
- **How can data storage be expanded in the human brain? How will individuals organize and easily retrieve information being stored?**
  - Internal or external solution?

Science Fiction: Drawing Connections

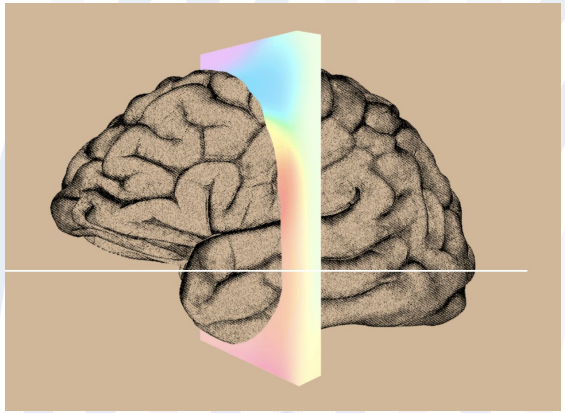
- Which area of the brain would be most productive in memory enhancement and memory consolidation?
  - Johnny Mnemonic: mention of amygdala
  - Scientific Literature: focus on hippocampus, entorhinal cortex
- Why Deep Brain Stimulation?
  - **Advantages**: studies have shown that stimulation can enhance motor and cognitive function
  - **Limitations**: severe side effects and question of ethics/dependency

Empirical Research

- New England Journal of Medicine: “Memory Enhancement and Deep Brain Stimulation of the Entorhinal Area”
- **Background**: The medial temporal structures are critical for the ability to transform daily experience into lasting memories.
- **Methods**: Tested on spatial learning task and memory.
- **Findings**: Stimulation enhanced subsequent memory of locations from spatial learning task.
- **Connection**: Intracranial depth electrodes implants.
- **Hypothesis**: Deep-brain stimulation of the entorhinal cortex alters memory performance.

Non Empirical Research

- **Neuralink**
  - Neural implant inserted into areas of brain that control movement; ultimately can be used to control external device (i.e. iOS device, keyboard, mouse) directly with activity of brain.



Research Proposal

- **Connection**: Recurring theme, Johnny is unable to retrieve the data in his ‘expanded’ memory.
- **Background:**
  - Entorhinal cortex stimulation can enhance memory performance.
- **Hypothesis:**
  - Neural implants connected to an external device can allow for effective organization/retrieval of substantial amounts of information from memory.
- **Method**:
  - Entorhinal cortex implants using deep brain stimulation therapy (DBS) connected to a cloud-based platform (similar to Neuralink) to improve retrieval process.

Applications

- **Medical:**
  - Help delay age-related decline in memory and cognition.
    - Dementia, Alzheimer's Disease, etc.
  - Victims of brain trauma that are affected by difficulty with memory/cognition processing.
- **Professional/Educational:**
  - Instant 'skilled' labor force.
  - Enhanced academic performance.

Limitations/Implications

- Realistically, knowledge becomes reduced to a greater dependence on socioeconomic status.
- Impact on Maslow's need of self-actualization.
  - The need to fulfill your full potential as an individual.
  - Decreased motivation due to a lack of effort needed to accomplish professional and other personal goals.
- How does this affect academic achievement/performance in a competitive environment?
- Ethical role of dependency to this memory enhancement in professional roles (medical, academic, labor, etc.)

Works Cited

Breakthrough Technology for the Brain. (n.d.). Retrieved March 12, 2021, from https://neuralink.com/

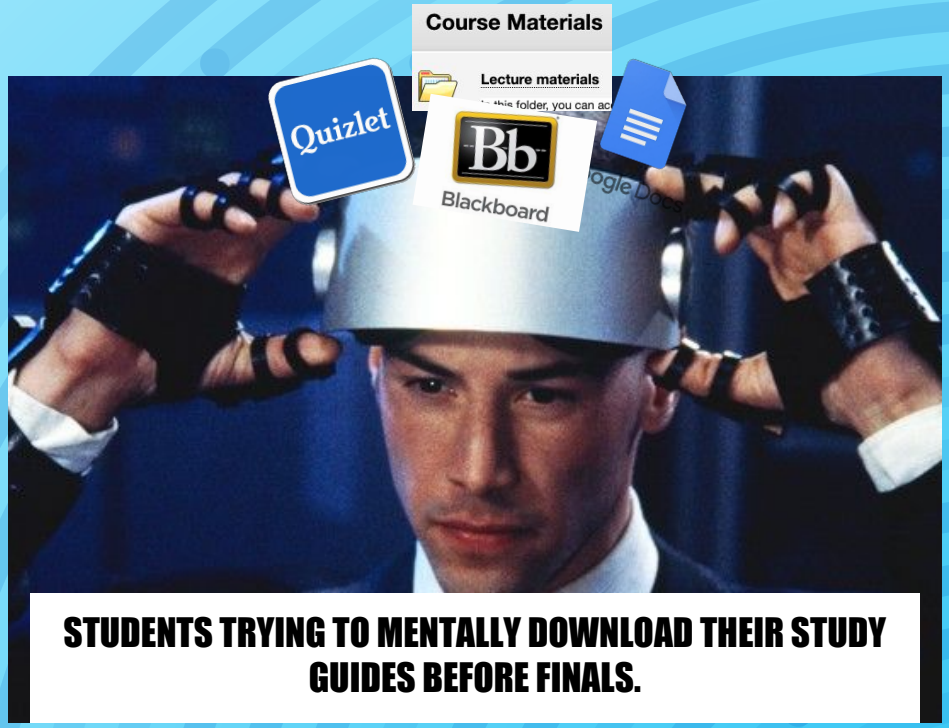
Gibson, W. (1981, May). Johnny Mnemonic. Retrieved March 11, 2021, from https://digitallibrary.ucr.edu/s/psych182j-w2021 item/795.

Suthana, N., Ph.D., Haneef, Z., M.D., Stern, J., M.D., Mukamel, R., Ph.D., Behnke, E., B.S., Knowlton, B., Ph.D., & Fried, I., M.D., Ph.D. (2012). Memory enhancement and deep-brain stimulation of the entorhinal area. *New England Journal of Medicine, 366*(20), 1945-1946. doi:10.1056/nejmc1203204

Questions?

Thank you.

GOOD LUCK
ON FINALS EVERYONE!



Keanu Reeves in the film *Johnny Mnemonic (1995).*