Intro to Brain-Computer Interfaces

NeurotechSF BCI workshop

Overview

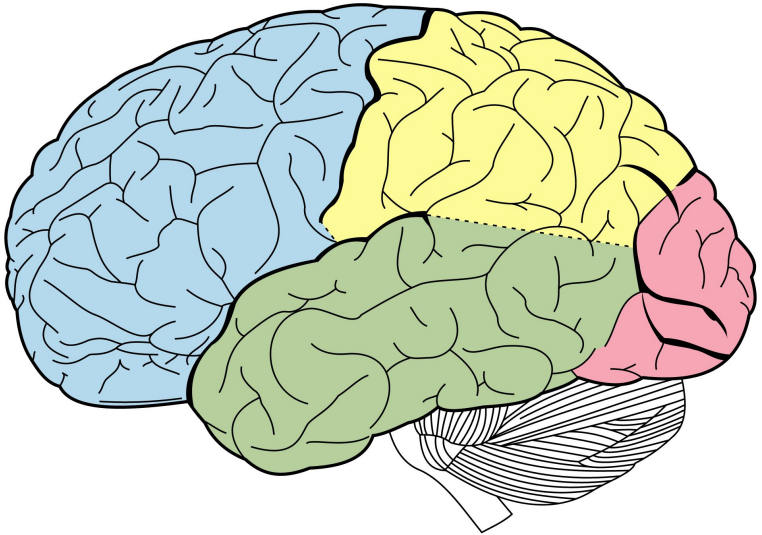
- Brain Structure
  - Lobes
  - Neuron
- Brain Recording
  - Invasive
  - Non-invasive
- What is BCI?
- Applications
- How does it work?
- BCI Types

Frontal

- Logic
- Reasoning
- Motor planning
- Speech initiation

Parietal

- Sensory processing
- Orientation



Temporal

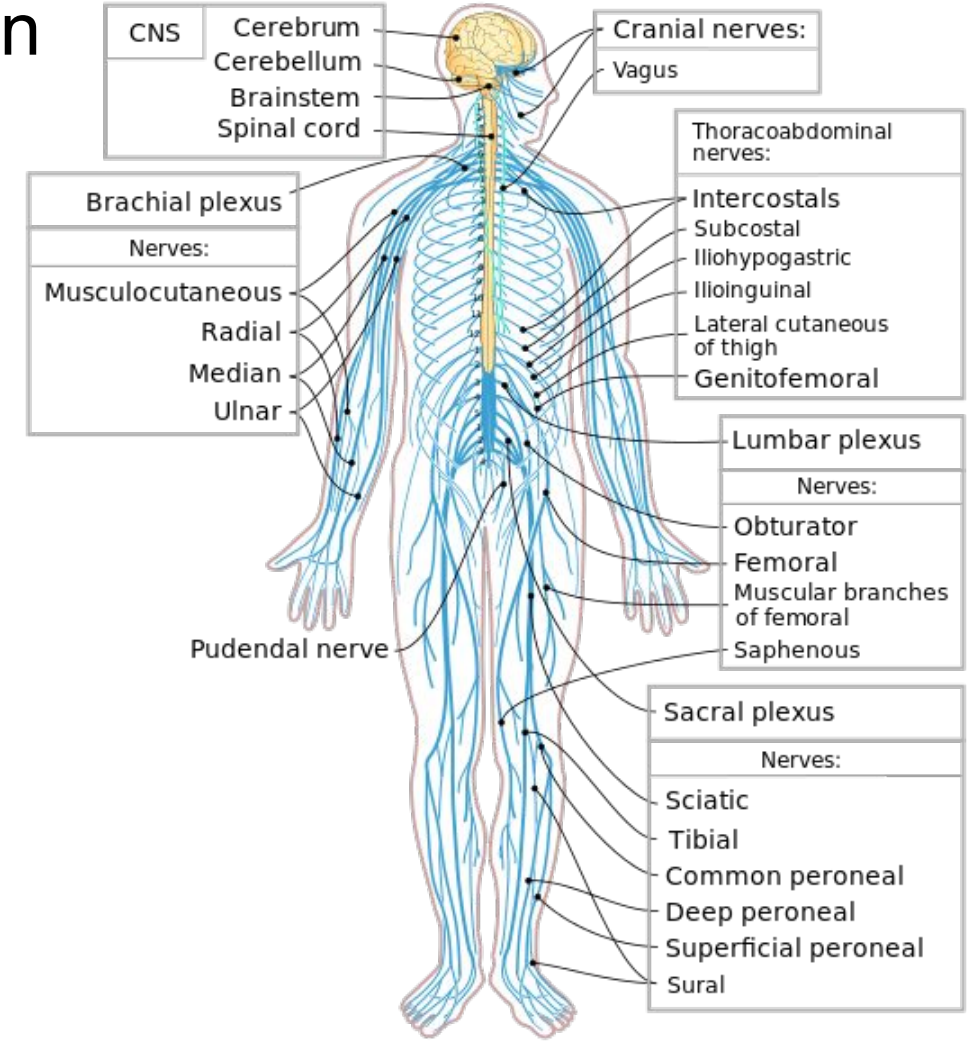
- Memory
- Speech processing

Occipital

- Visual processing

Measuring human cognition

- Central nervous system
  - PET
  - fMRI
  - fNIRS
  - MEG
  - EEG
  - ECoG
- Peripheral nervous system
  - EMG (muscles)
  - ECG (heart)
  - EGG (stomach)
  - EOG (eyes)
  - GSR (sweat)



Brain Recording

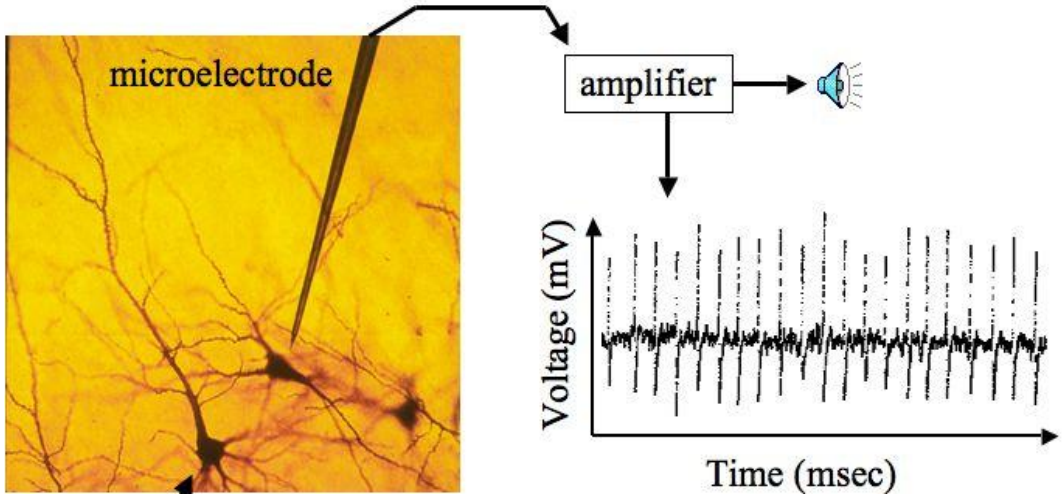
Invasive

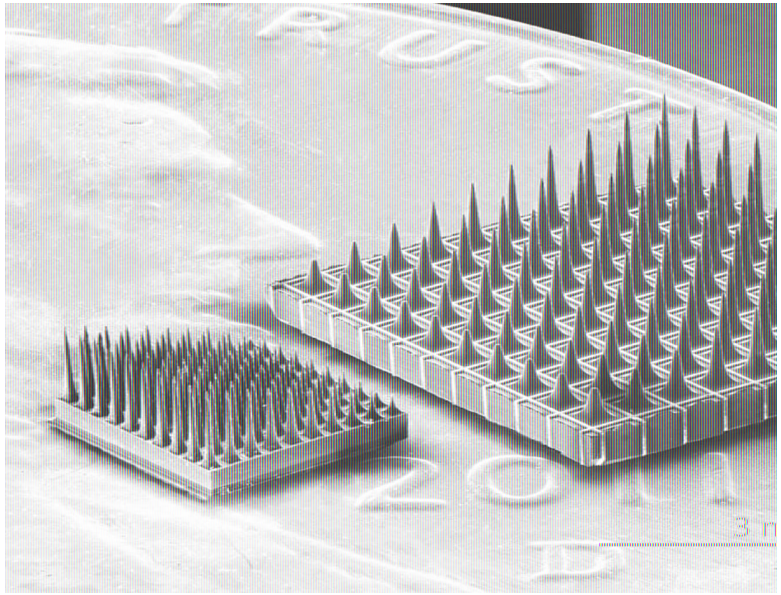
- Requires surgery
- More accurate
- Single-neuron
- Group of neurons

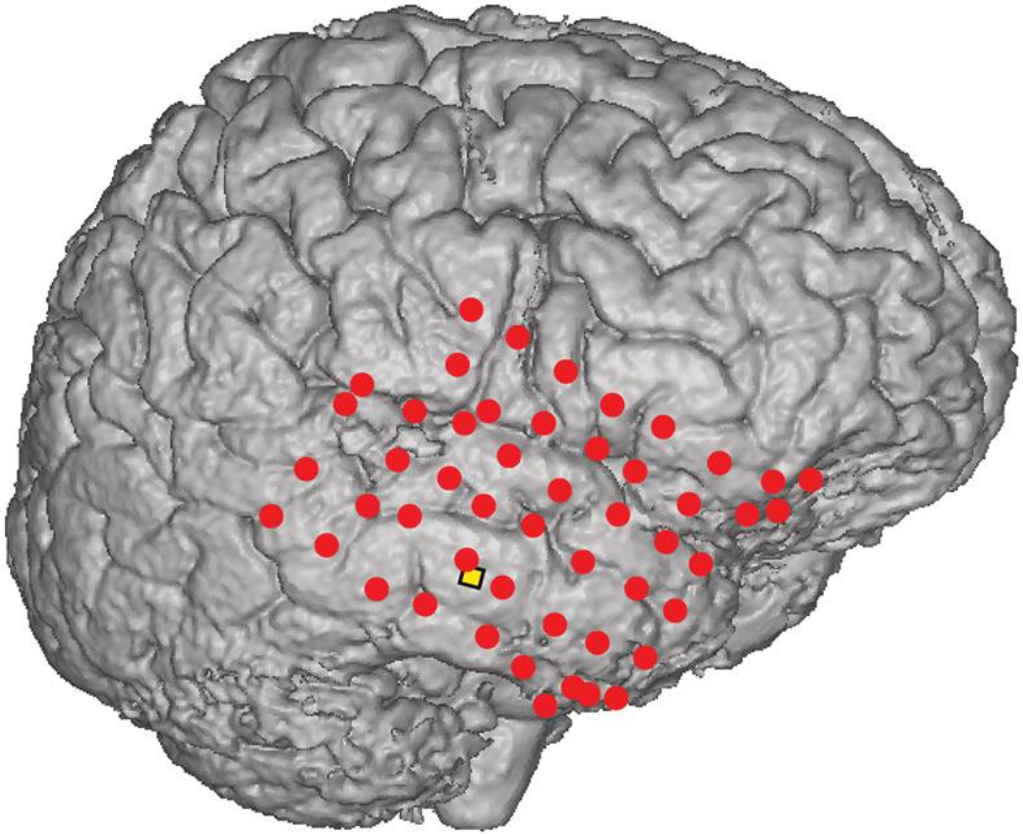
Non-invasive

- No surgery
- Less accurate
- Larger groups of neurons

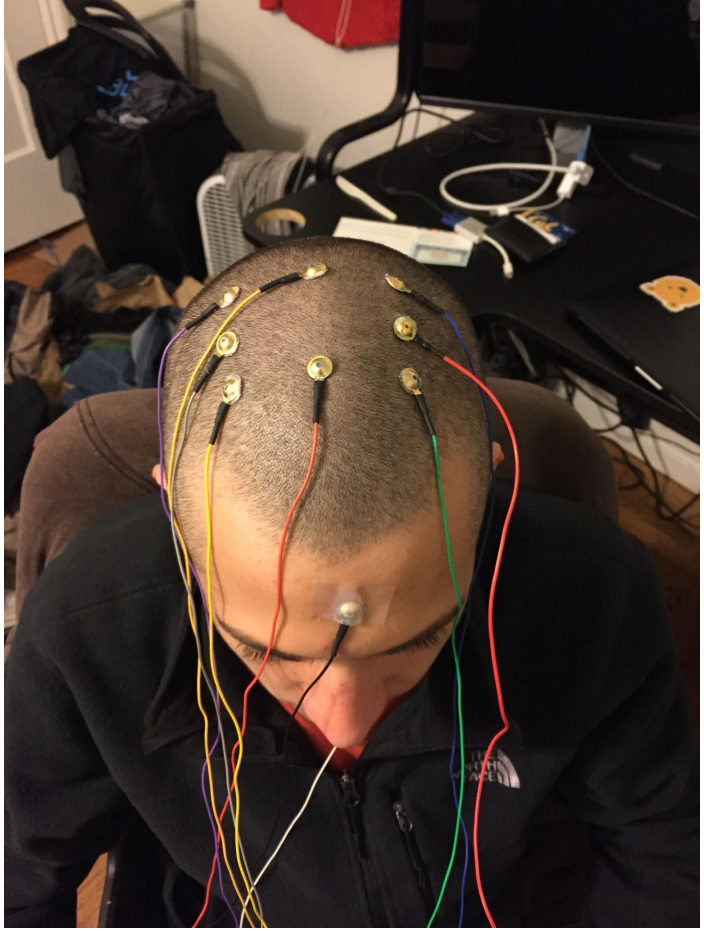
Invasive - Single cell recording





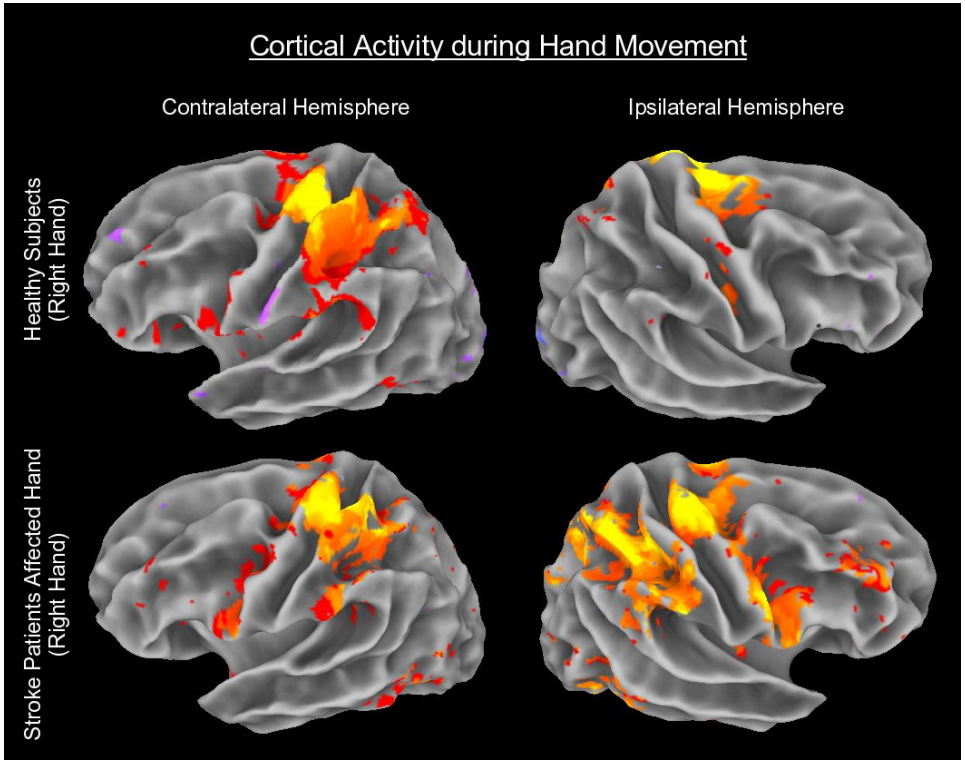


Invasive - Electrocorticography (ECOG)



Noninvasive - Electroencephalography (EEG)

Noninvasive - fMRI

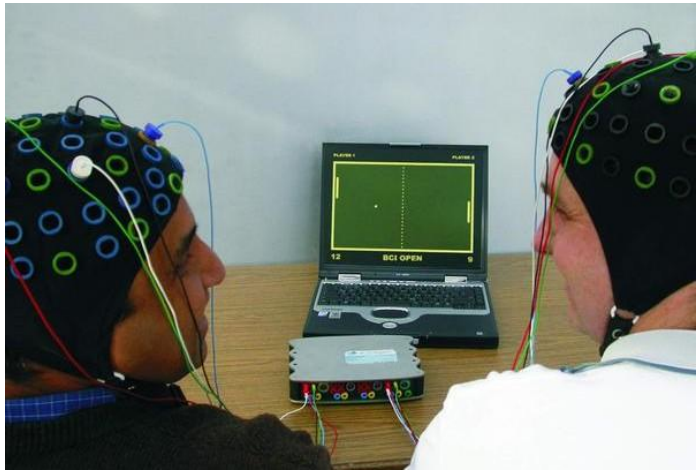


What is BCI?

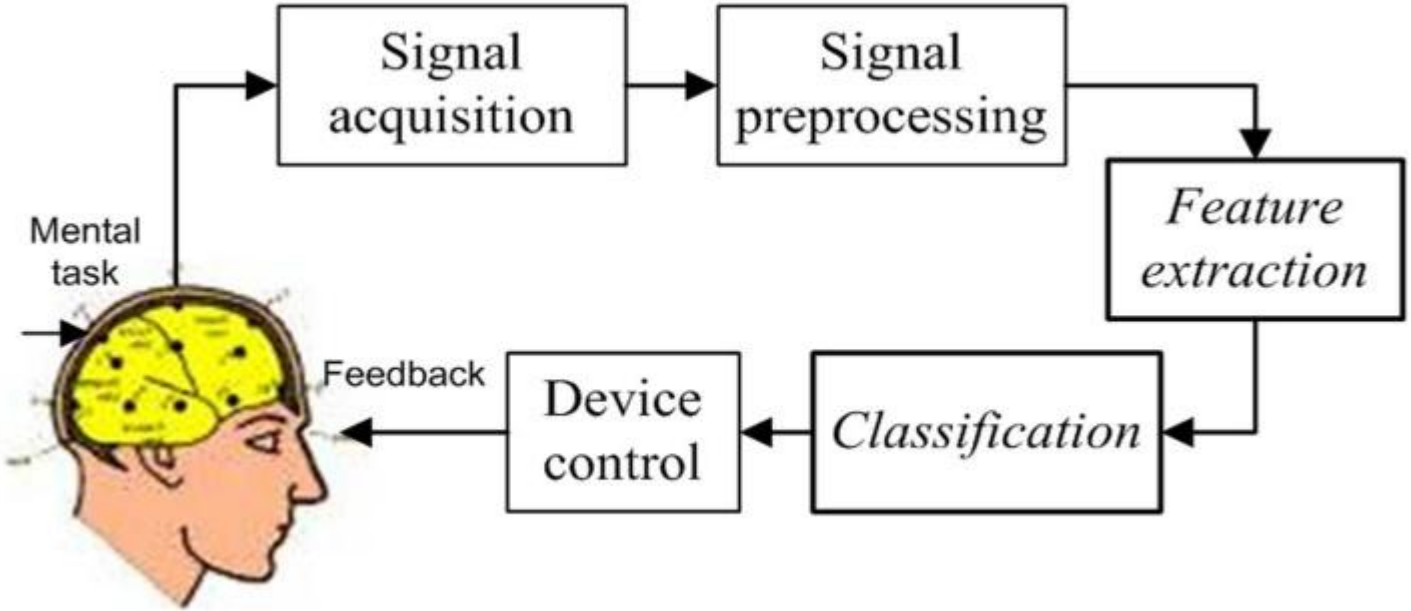
Brain-Computer Interface

“Direct communication pathway between the brain and an external device” (Wikipedia)

Applications



How does it work?

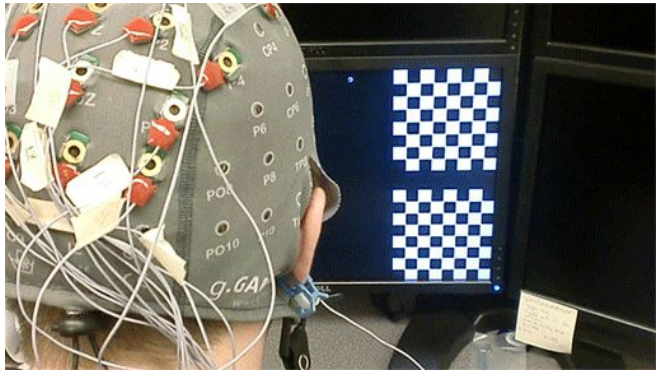


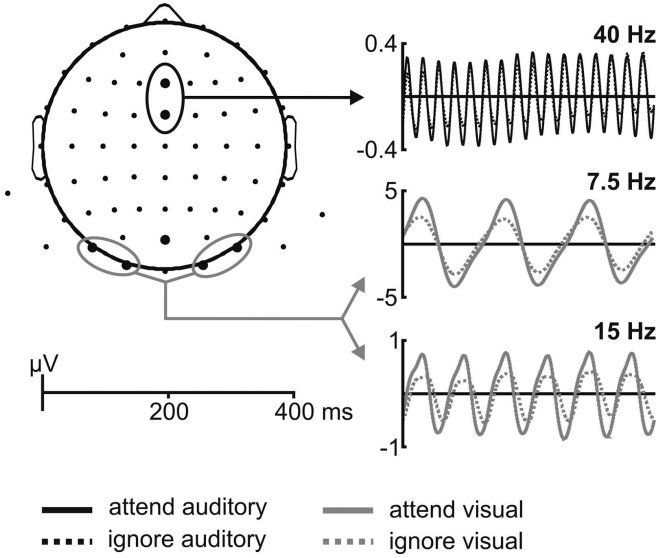
BCI Types

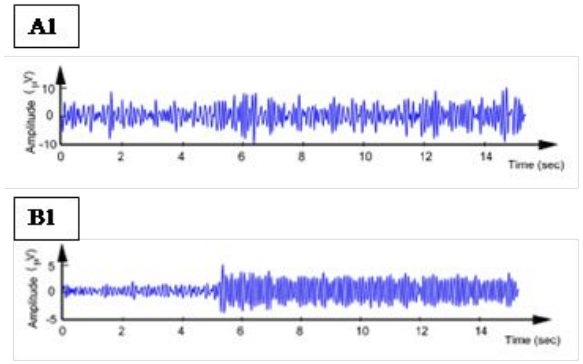
- **SSVEP**
- Frequency-based BCI
- Event related potentials
- Motor imagery
- Slow cortical potentials
- Neurofeedback

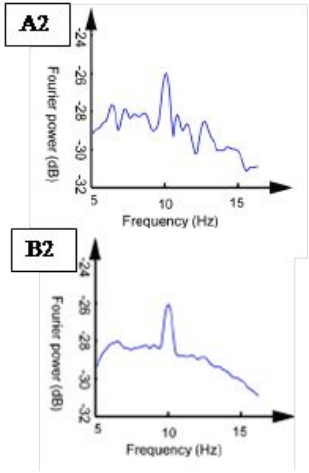
SSVEP

Steady State Visually Evoked Potentials

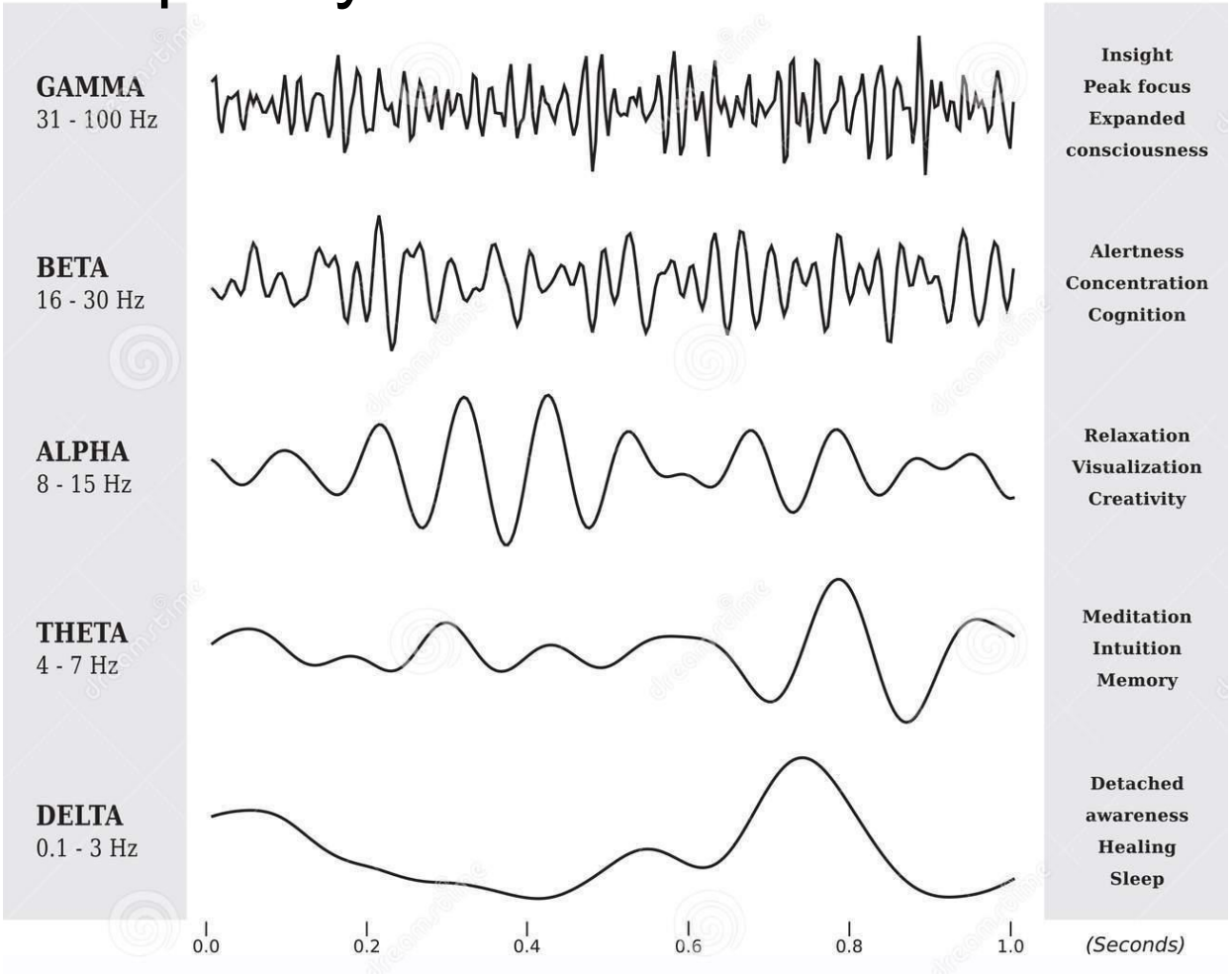








Frequency-Based



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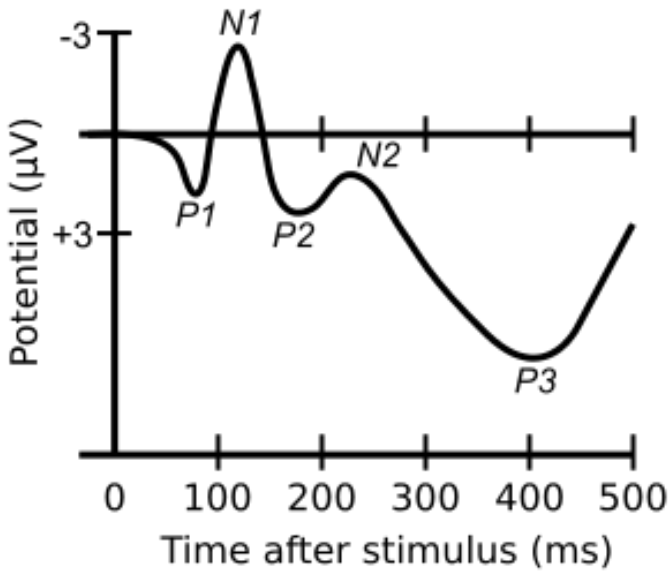
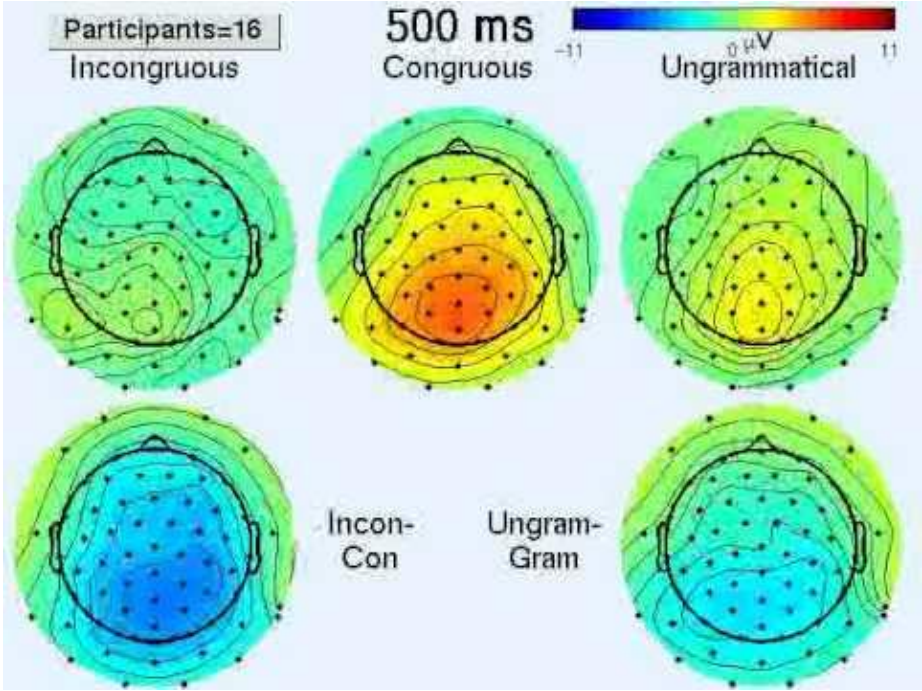
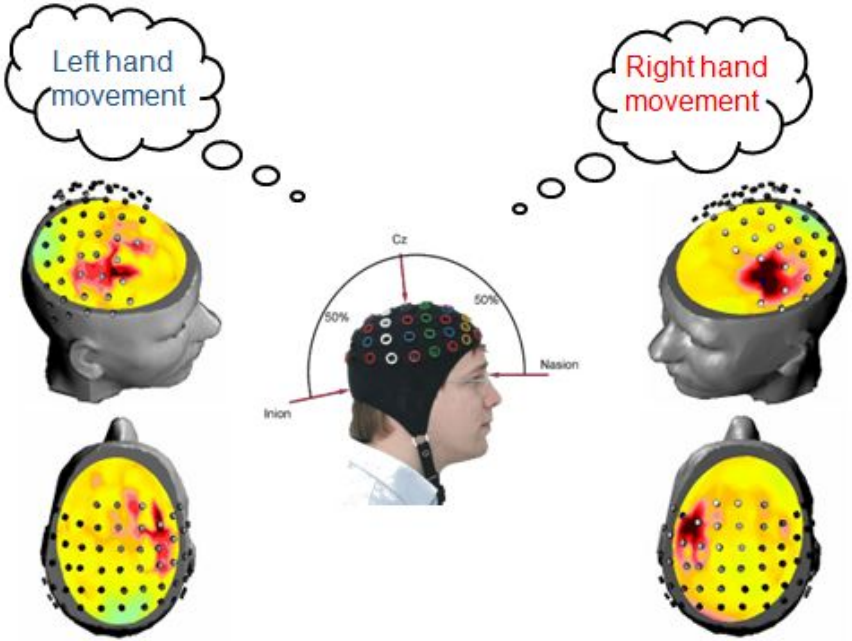
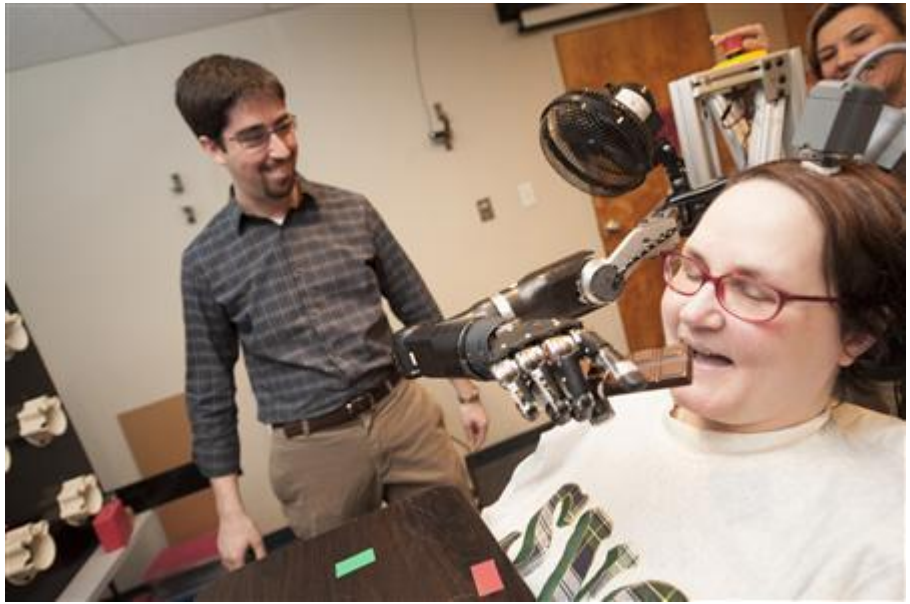
Event Related Potentials (ERP)



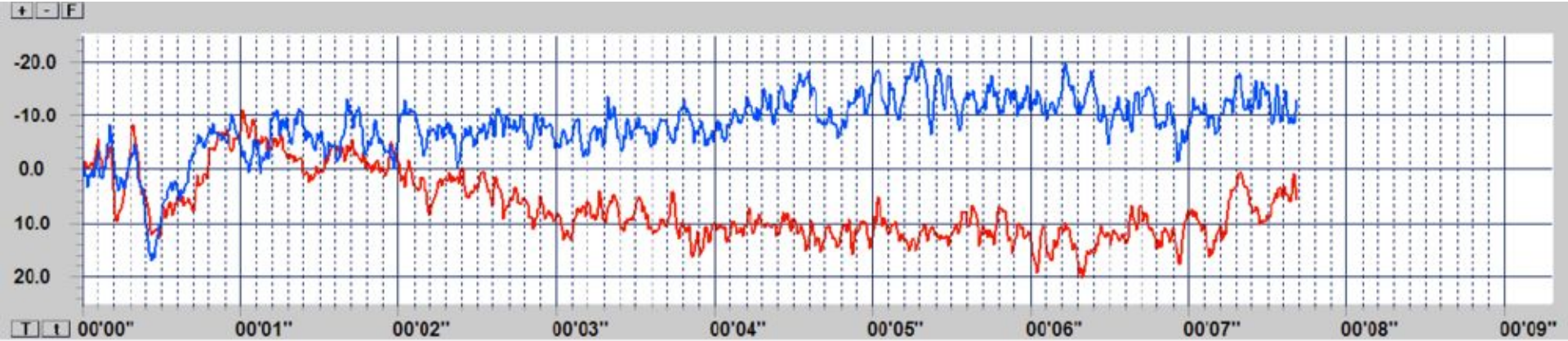


Motor Imagery

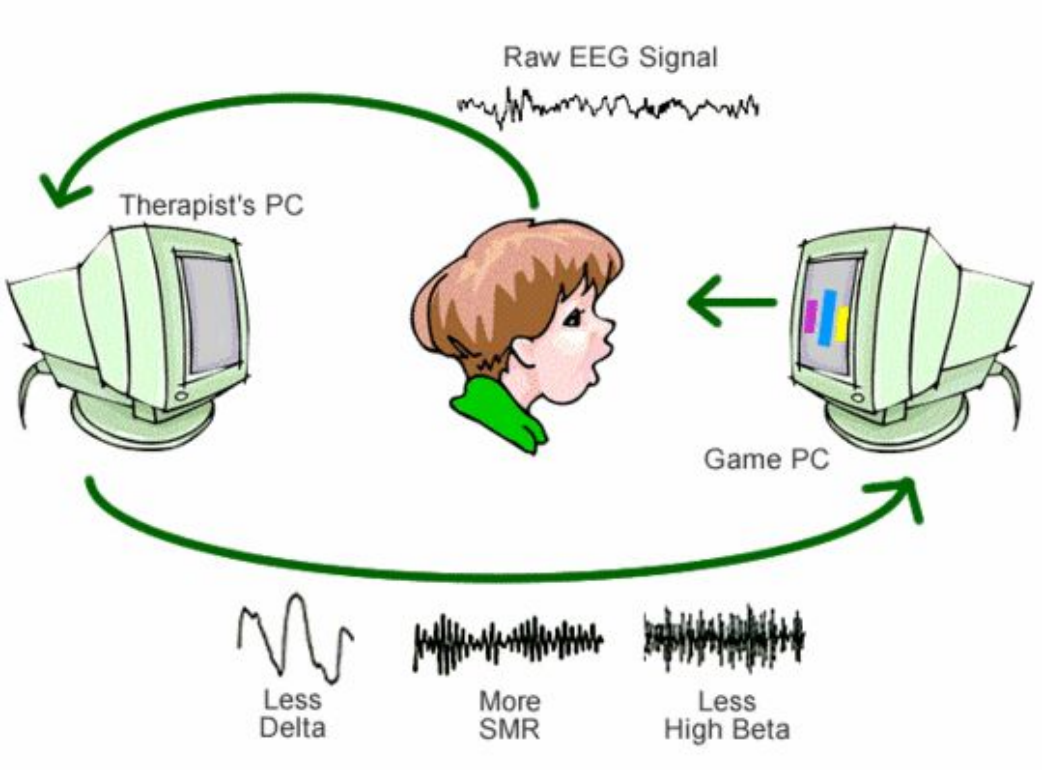




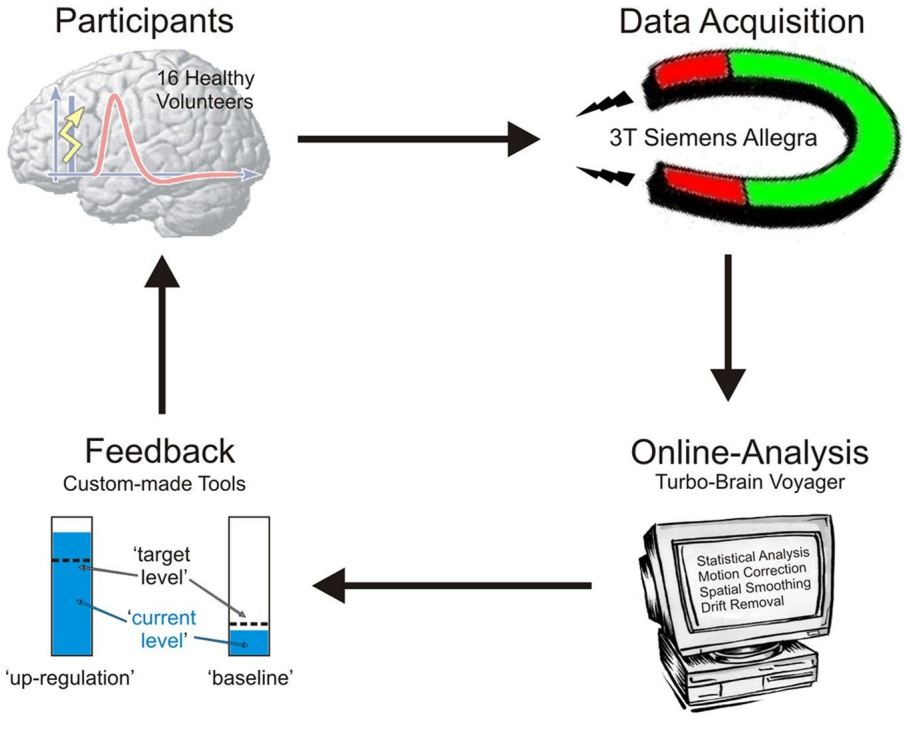
Slow Cortical Potentials (SCP)

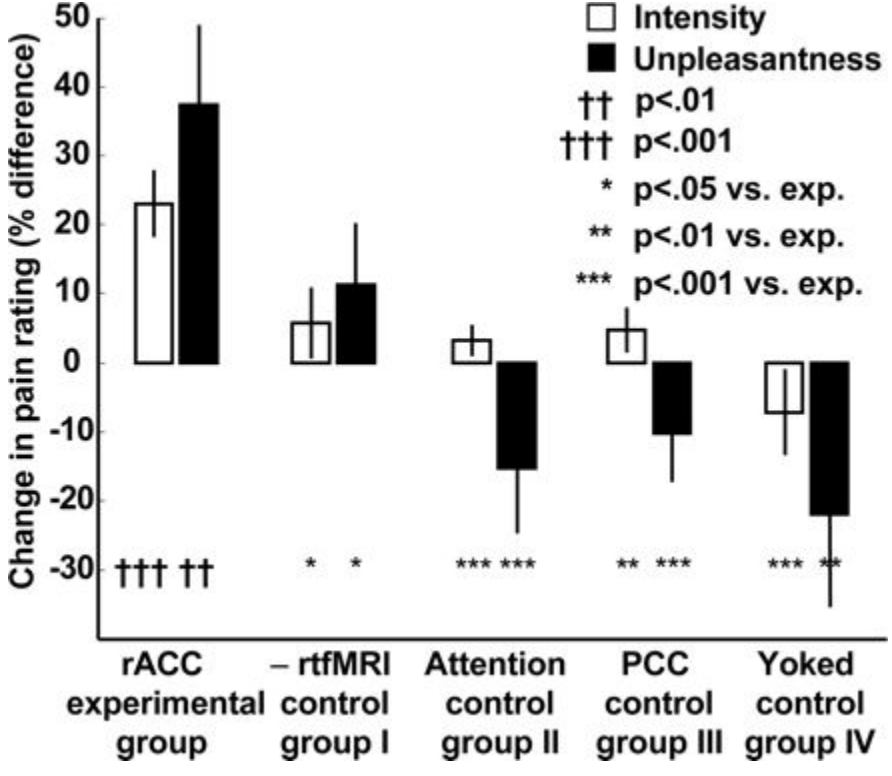


EEG Neurofeedback

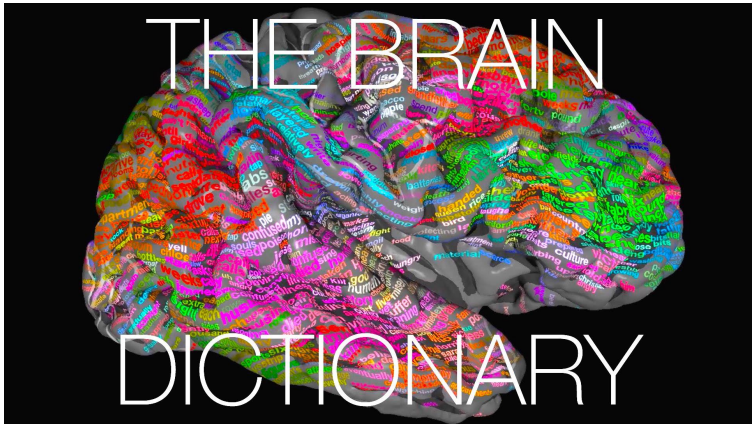


fMRI Neurofeedback





Advanced Decoding



Break