# Can brain waves be used for playing computer games?

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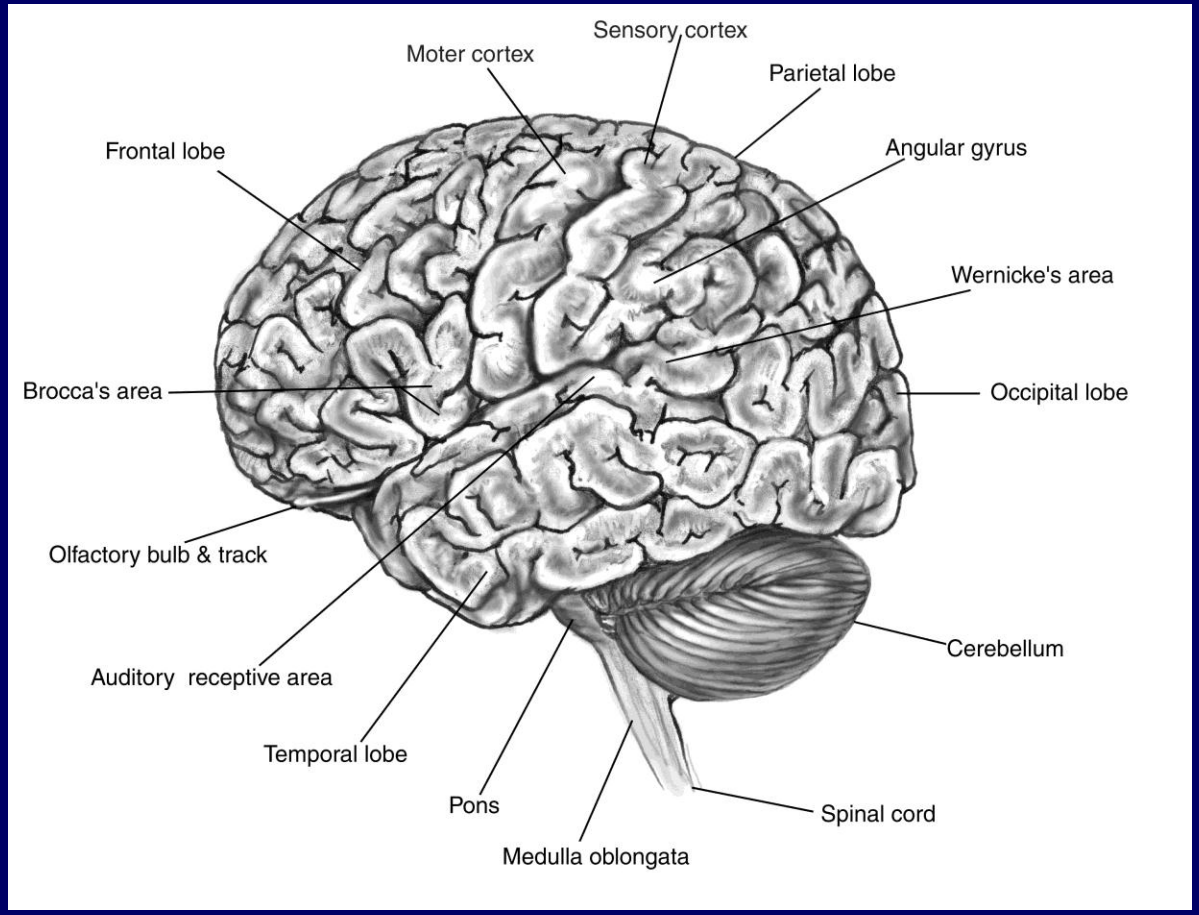
# Structure of Brain

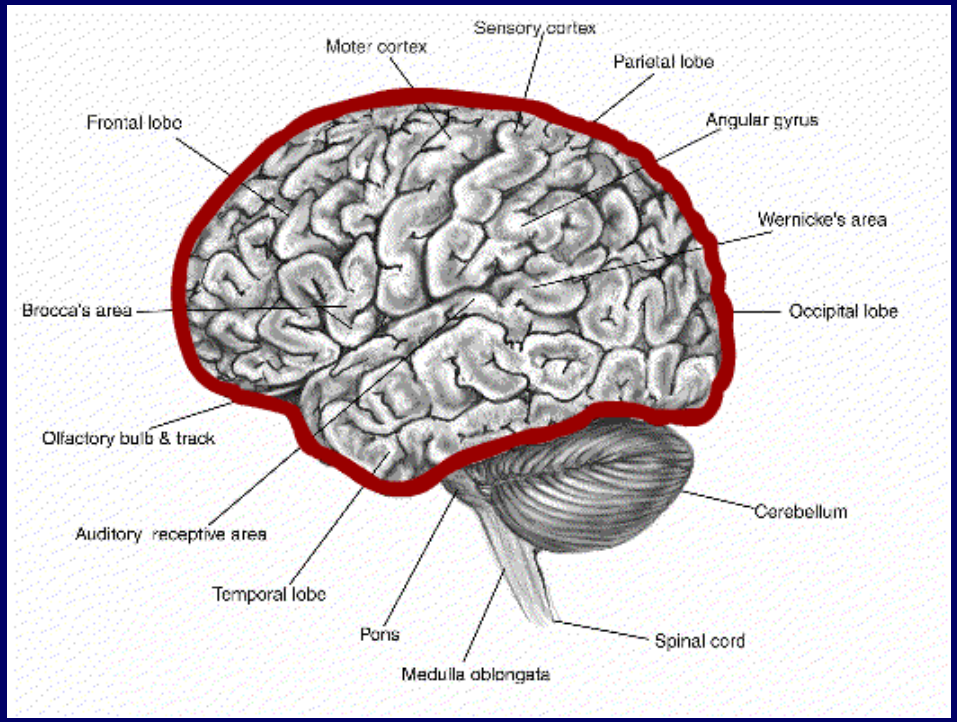


# Brain

1. Cerebrum
2. Cerebellum
3. Brainstem

# Cerebrum

- The cerebrum is the section where thoughts are created and memory is stored.
- Injury to the cerebrum can leave a person fully aware of their surroundings but unable to react to any events happening in the surroundings

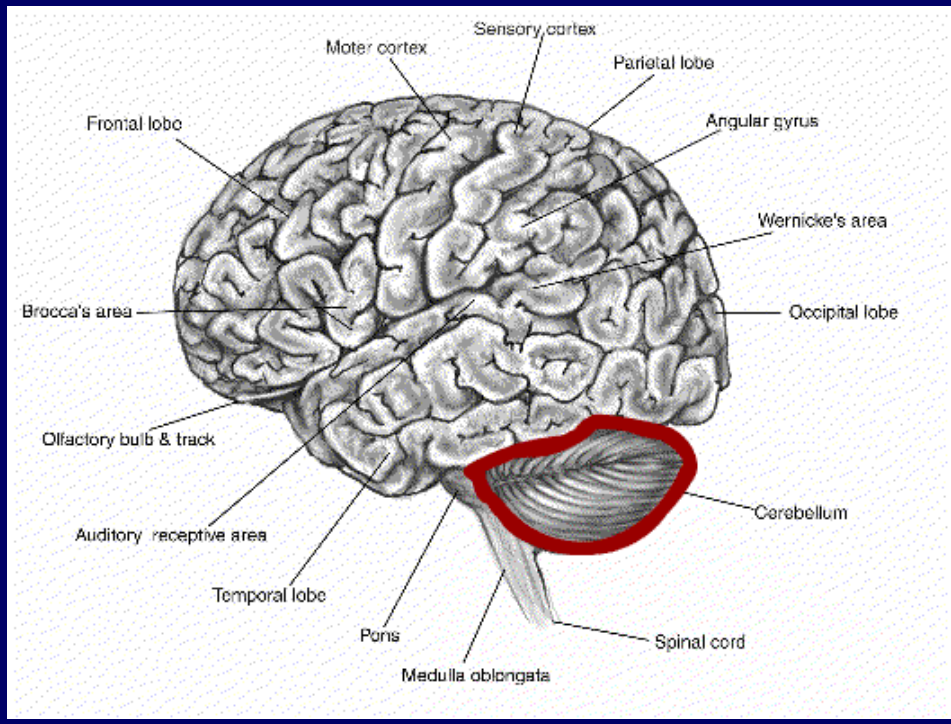


# Lobes of Cerebrum

- The cerebrum also has five lobes:
  - **Frontal lobe:** motor cortex, which creates alpha brain waves
  - **Occipital lobe:** visual cortex that effects the visual perception
  - **Temporal lobe:** contains the cranial nerve and auditory cortex, damage can result in deafness
  - **Parietal lobe:** primary somatosensory cortex. Damage to this area of the brain affects the ability to use bio-potentials to manipulate a Brain-Body Interface
  - **Insular lobe:** affects emotion and damage to this region may affect a person's ability to relax

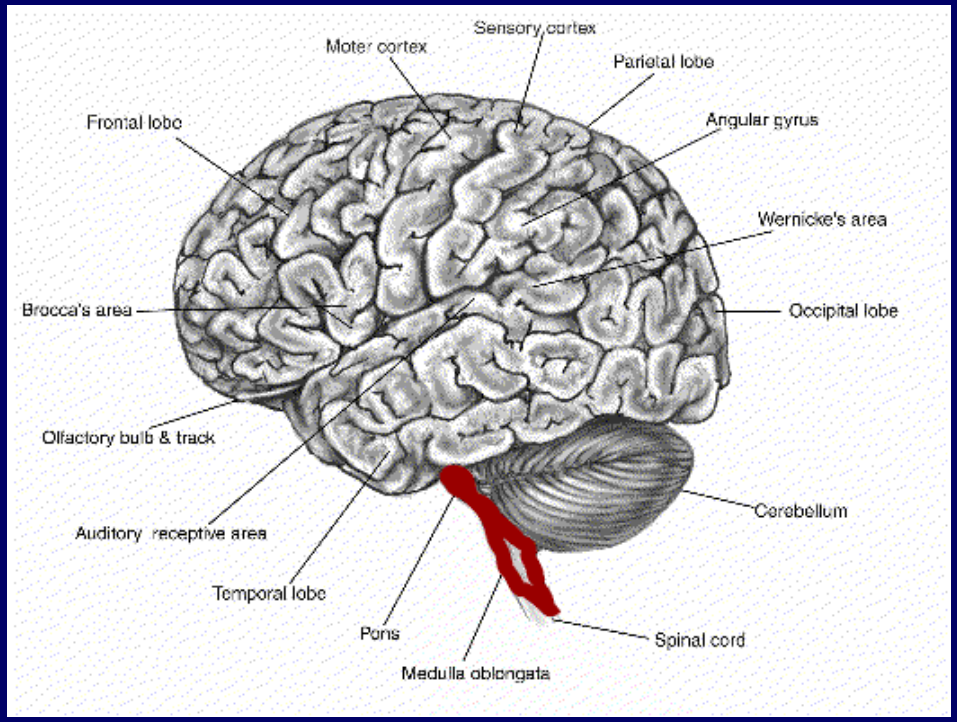
# Cerebellum

- Controls facial muscle co-ordination
- Damage to this area affects the ability to control eye movements and other facial muscle movements
- Will affect signals needed by Brain-Body Interfaces



# Brainstem

- Controls basic functions such as eating, respiration, heart rate
- The cranial nerves that carry the signals to control facial movements originate in the brainstem

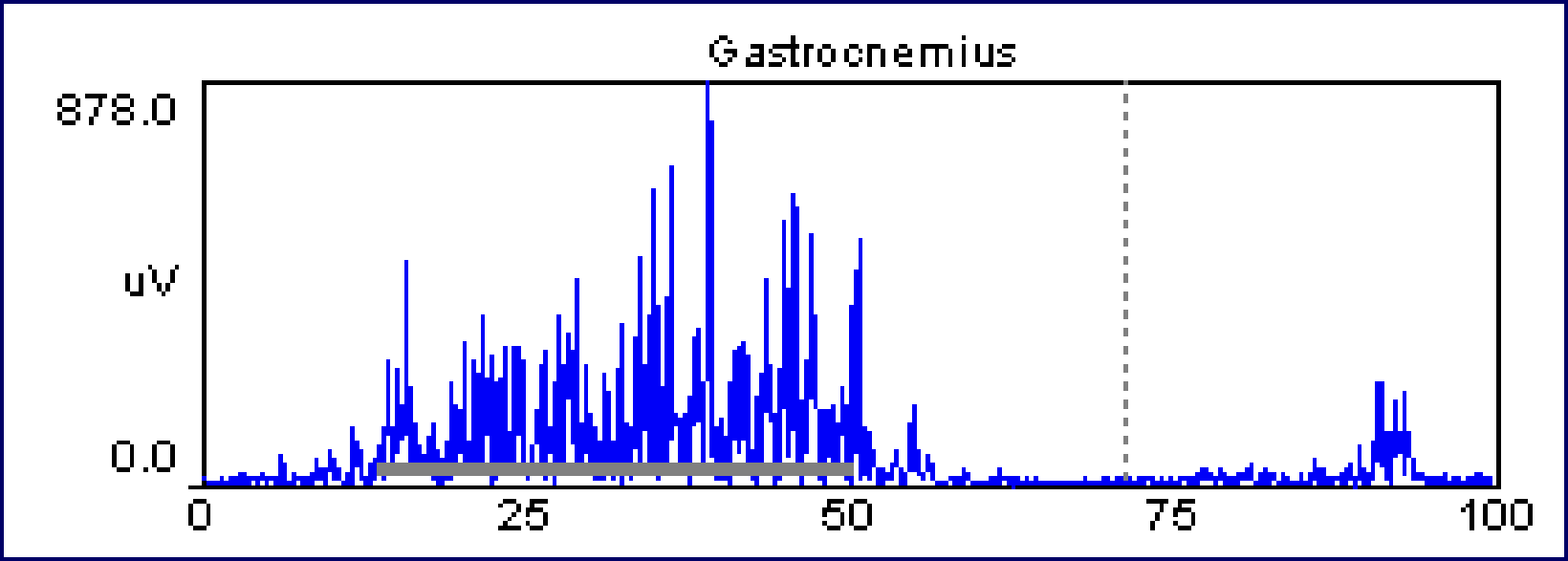


# Bio-Potentials

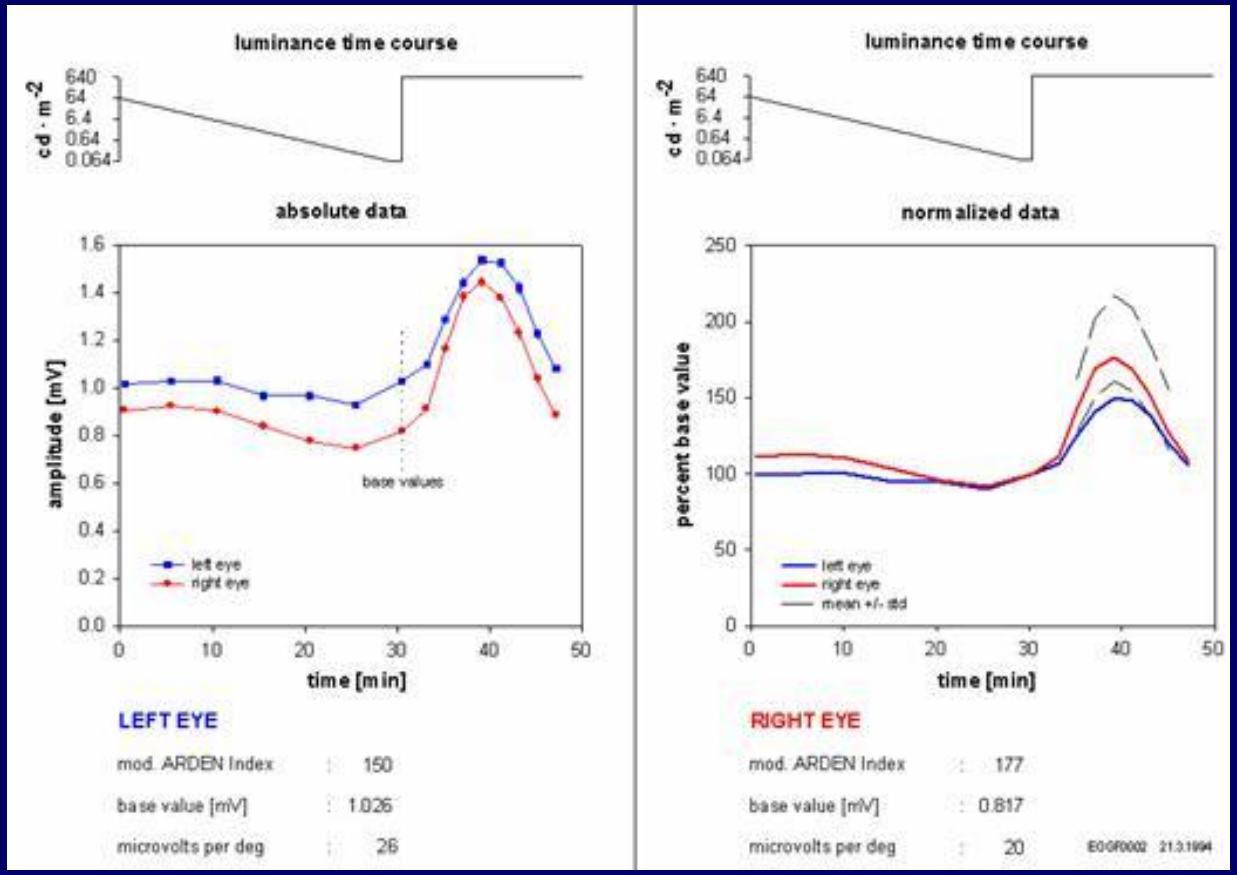
- Electroencephalalography (EEG)
- Electromyography (EMG)
- Electrooculargraphy (EOG)
- Slow Cortical Potentials (SCP)
- Steady-State Visual Evoked Potential (SSVEP)/ Steady State Visual Evoked Responses (SSVER)
- P300
- N400
- Electrocochleography (ECoG)
- Low Frequency Asynchronous Switch Design (LF-ASD)
- Local Field Potential (LFP)
- Neuroprosthetic
- Motor Function

# Electroencephalography (EEG)

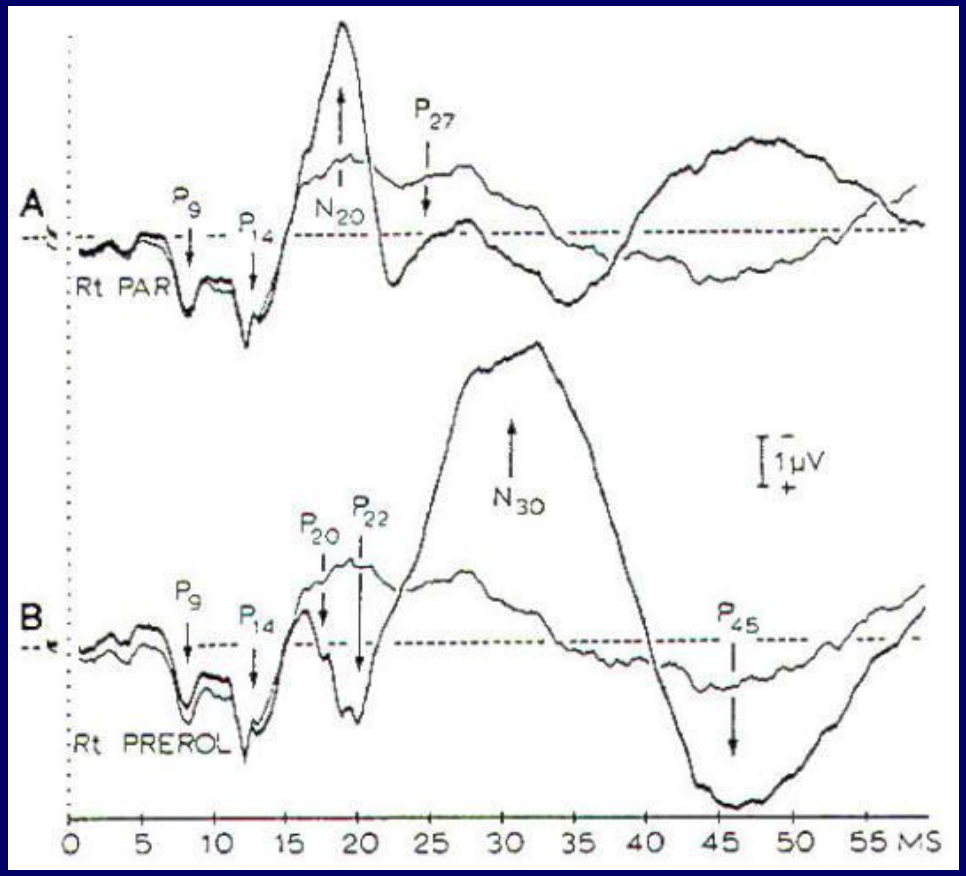
# Electromyography (EMG)



# Electrooculargraphy (EOG)



# P and N signals



# Brain-Body Interfaces – Examples (these need some control movement above the neck, some users can use these devices)

- HeadMouse™
- Tonguepoint™
- Eye-tracking

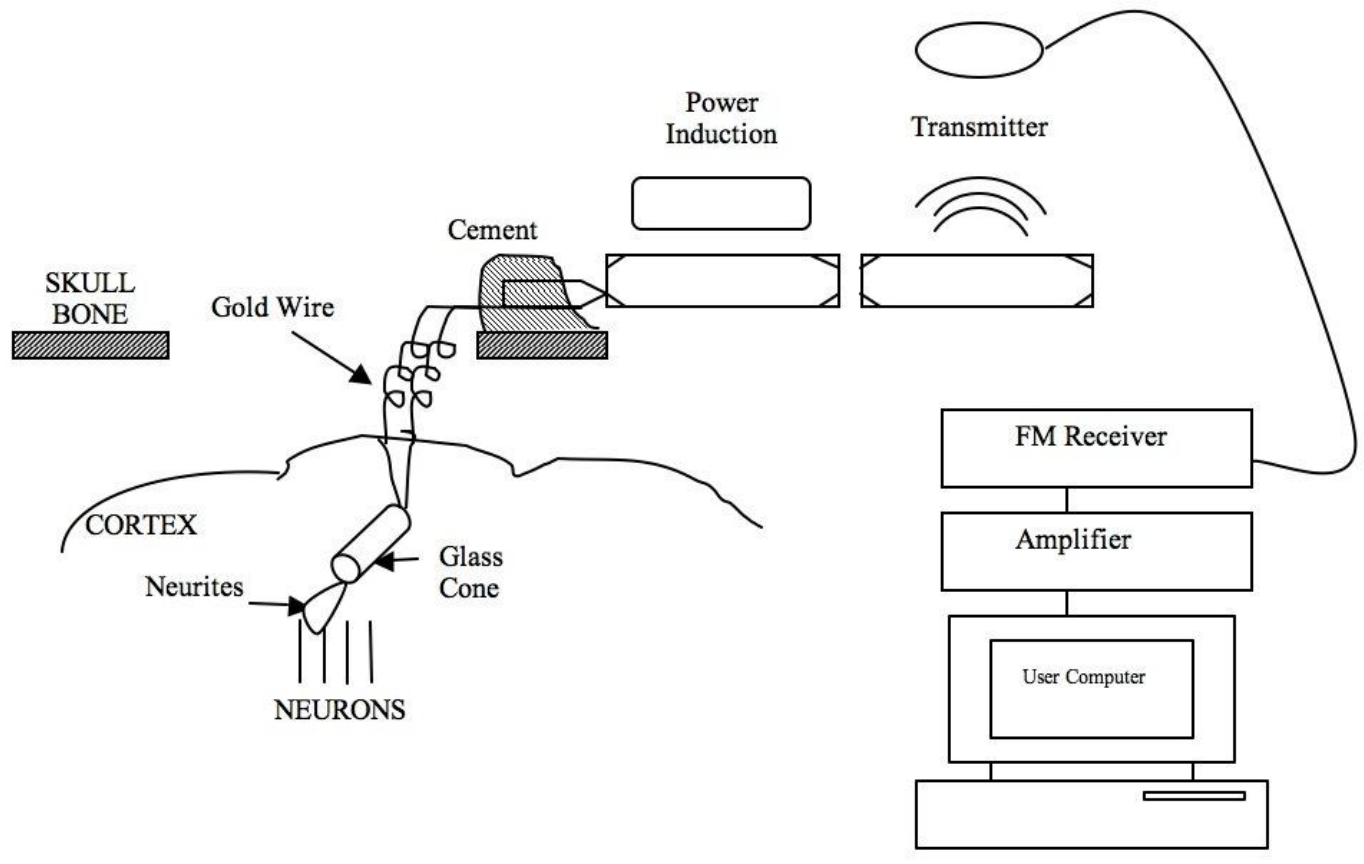
Many traumatic brain-injured are so impaired that they cannot use any devices in this category

# Types of Brain-Body Interfaces for Traumatic Brain-Injured

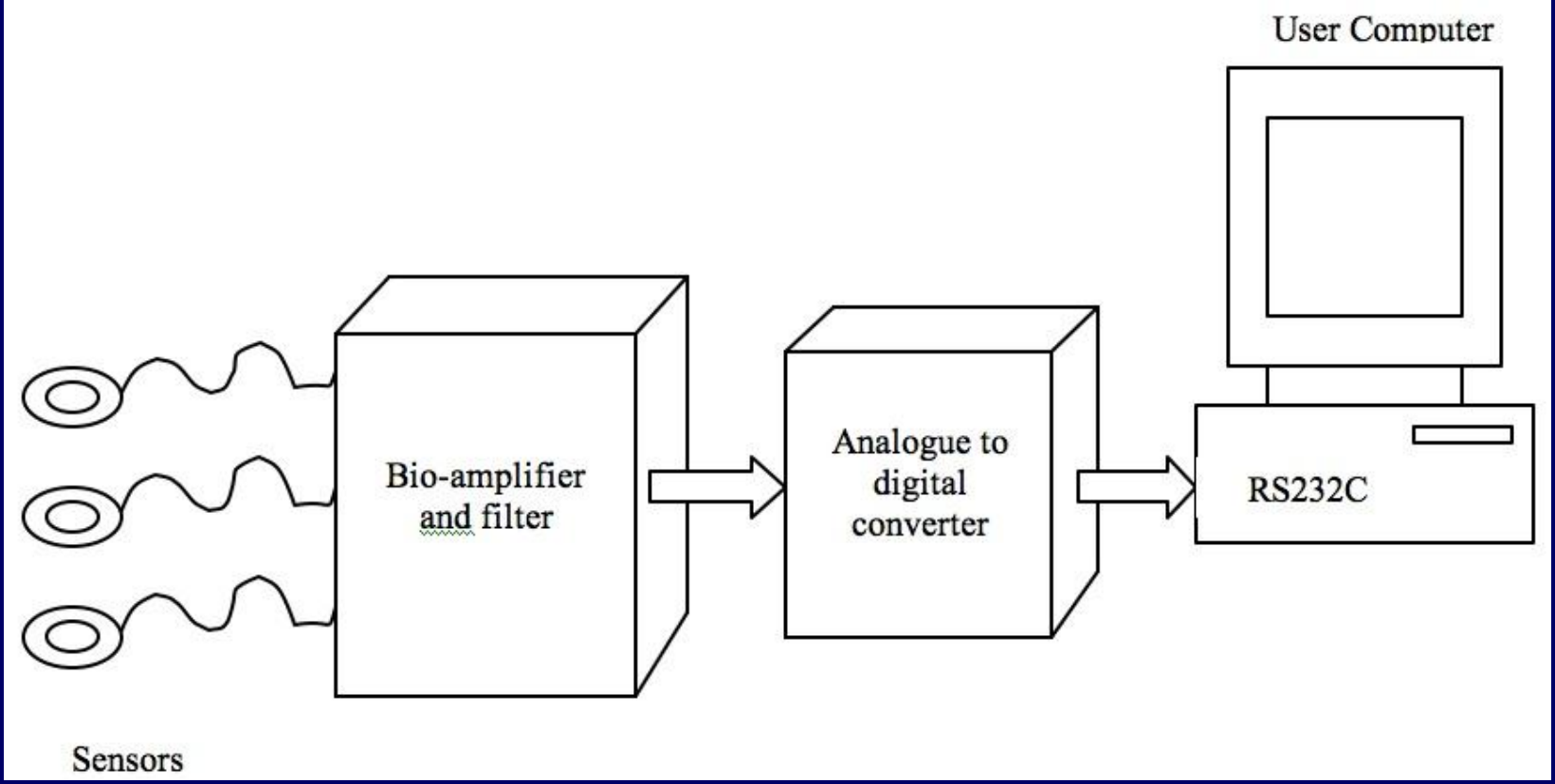
Two types:

- Invasive
- Non-invasive

# Invasive BBI



# Non-Invasive BBI



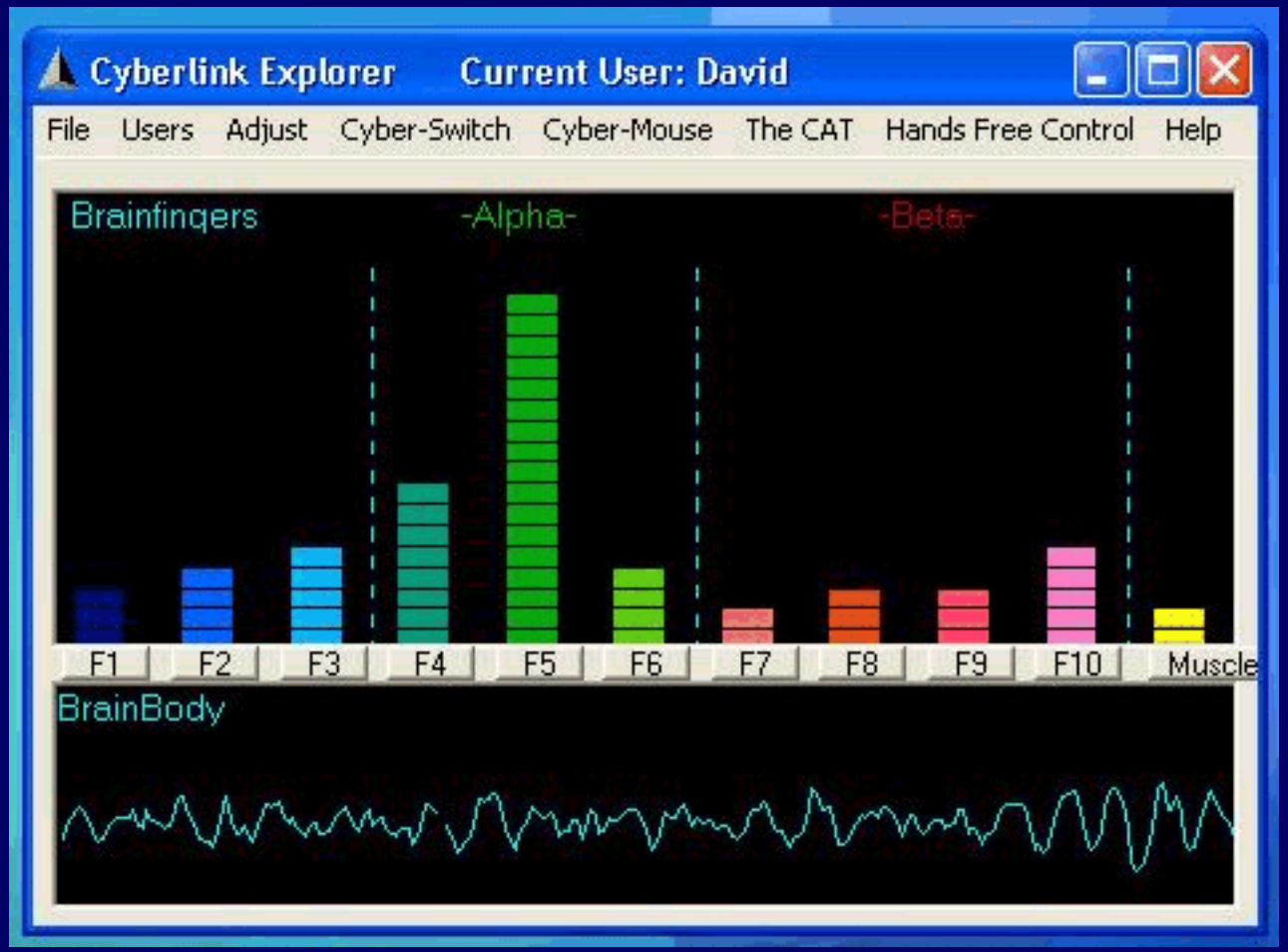
# Cyberlink™

Cyberlink™ used for our research, is a non invasive brain-body actuated control technology that combines eye-movement, facial muscle and brain wave bio-potentials detected at the user's forehead.

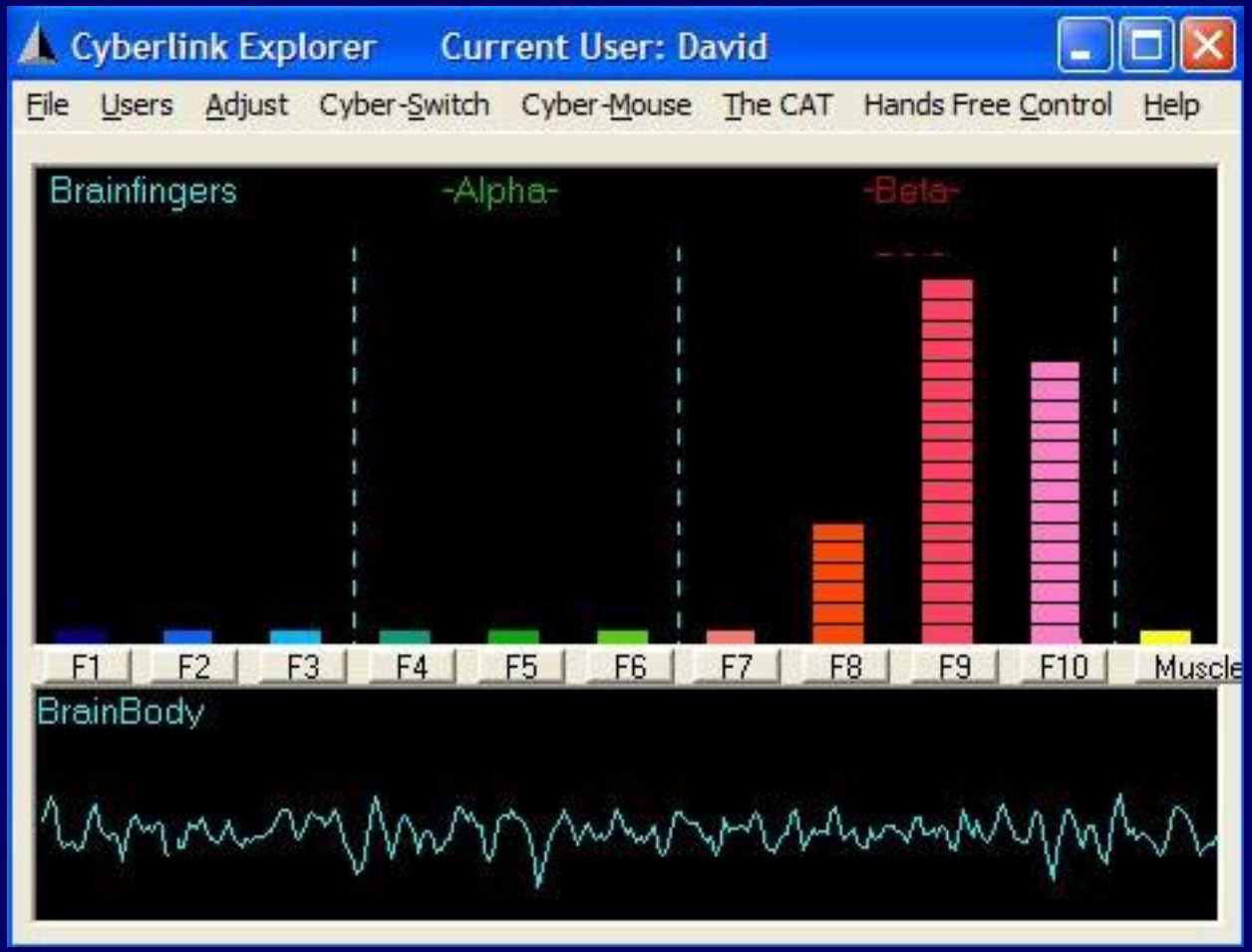
# Cyberlink™ - Chosen as the best device for this research

# B1 thru B3 -- Eye Movement

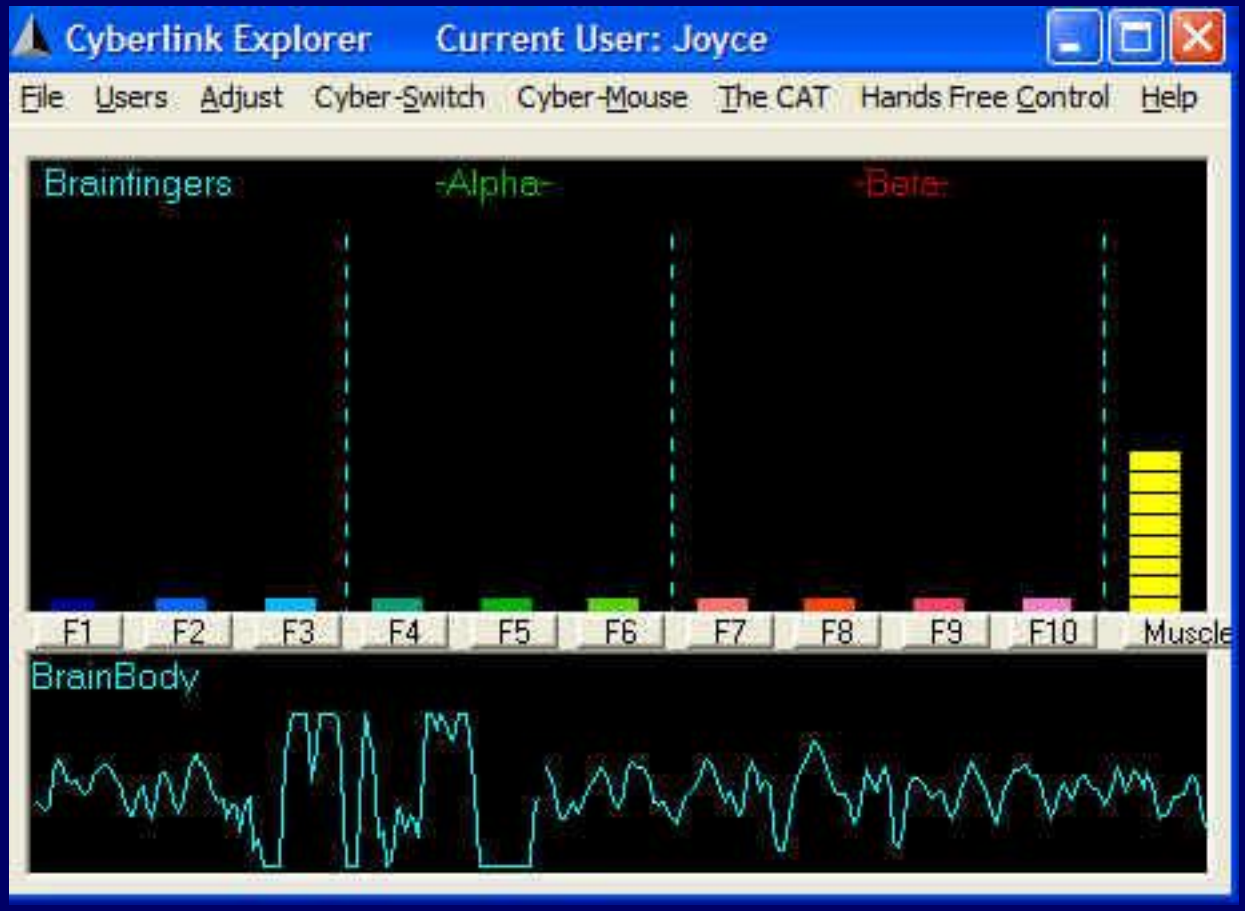
# B4 thru B6 -- Alpha Brain Waves



# B7 thru B10 - Beta Brain Waves



# B11 - Muscle


Cyberlink Explorer
Current User: Joyce
File
Users
Adjust
Cyber-Switch
Cyber-Mouse
The CAT
Hands Free Control
Help
Braintingers
-Alpha-
-Beta-
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
Muscle
BrainBody

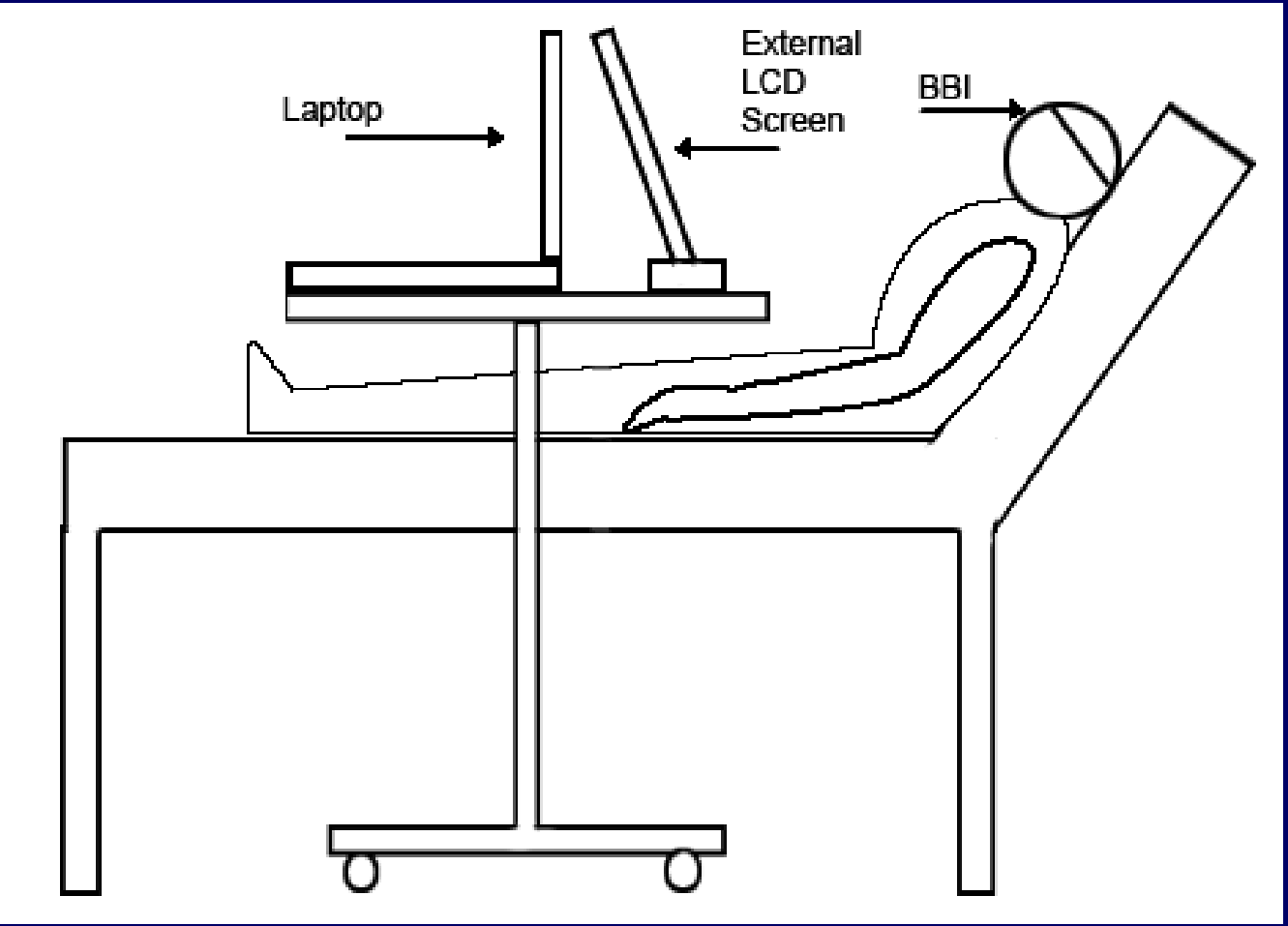
# Traumatic Brain Injury and Brain-body Interfaces (BBI)

- Cyberlink can pick up various unwanted bio-potentials
- Such uncontrollable, erratic movements cause users frustration and fatigue
- Bringing the cursor back under control takes considerable effort, and may be impossible

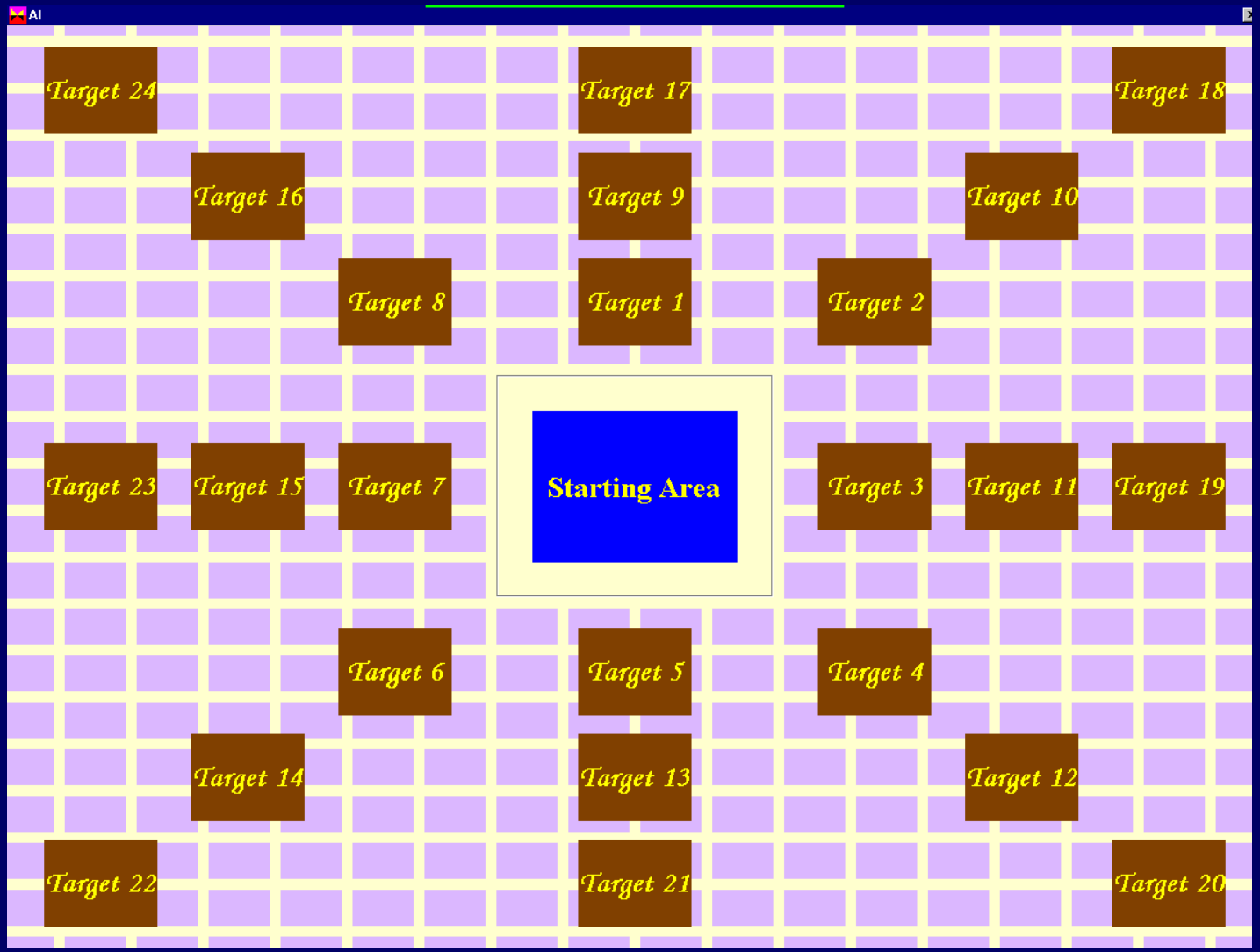
# Research with BBI for the Traumatic Brain-Injured

- Issues with Brain-Injured Participants
  - Cognitive abilities are often not assessed
  - Unable to respond or really comatose
  - Difficulty of tracking participants over long periods
  - Etc.,

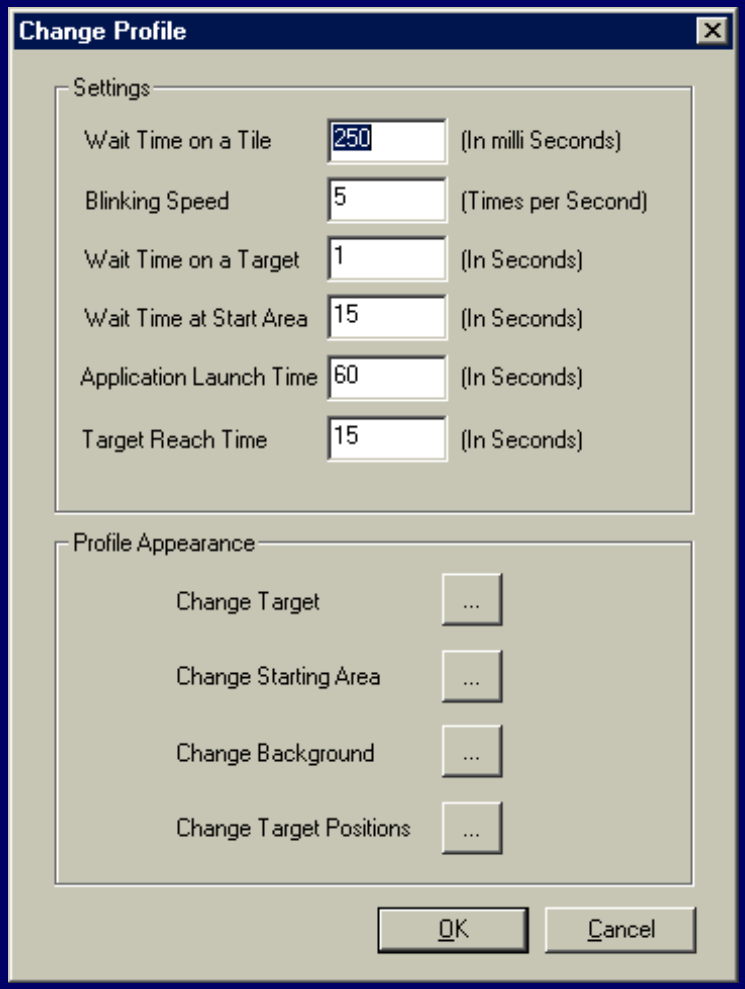
# Apparatus



# Personalised Tiling – Target Test



# Personalisation



# Personalised Discrete Acceleration interface


- Personalised interface
- Discrete Acceleration
- Programmable targets for application launch or switching devices

# Can BBI be used for gaming

A new device called OCZ NIA Neural Impulse Actuator is available in the market now

# OCZ NIA Neural Impulse Actuator

# NIA Neural Impulse Actuator

- Translates electrical bio-signals from your body into computer commands to control computer gaming;
- Rather than being a substitute for a mouse, the NIA can be used in conjunction with your mouse;
- Customise behavioral profiles of your character.
- There is one function that NIA does not do when compared to the Cyberlink™, that is move around the screen using the mouse, so we can only use keyboard and mouse clicks.

# NIA Neural Impulse Actuator

- Any game that uses keyboard and mouse can be programmed for NIA, there is no major conversion on code here;
- Any web application can also be programmed for NIA provided we facilitate access by using keyboard and mouse clicks, we will have to make all links and choices accessible via keyboard and mouse clicks.
- Can you visualise a quadriplegic person playing games using NIA or browsing a website using Cyberlink?

# Any Questions?

# Any Ideas for future games or web applications?

# Demo and audience participation