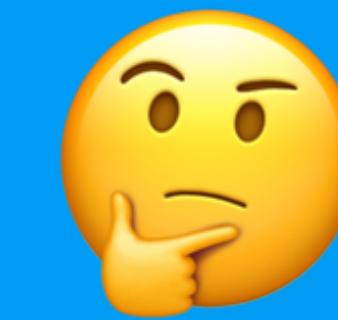
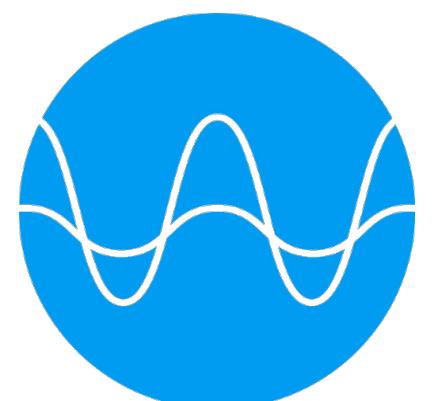


How do  
BCI actually\*  
work ?



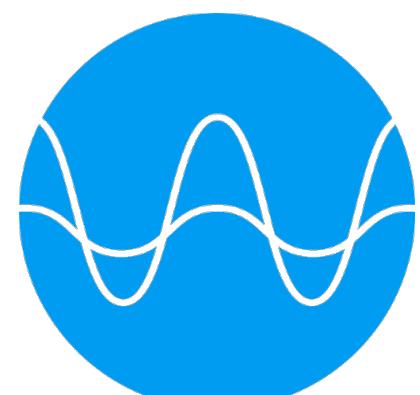
\* Naive explanation



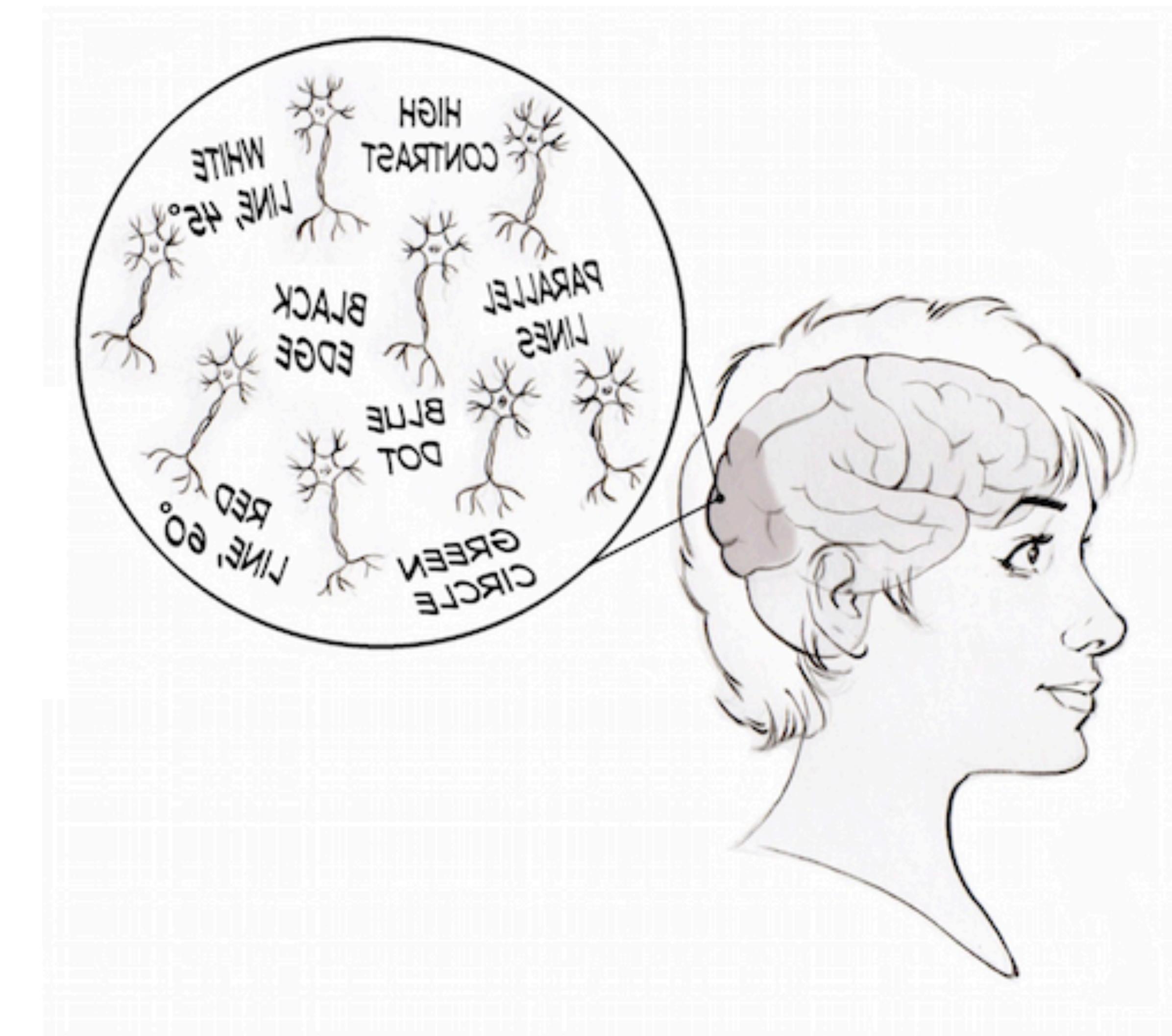
# BCI: Brain

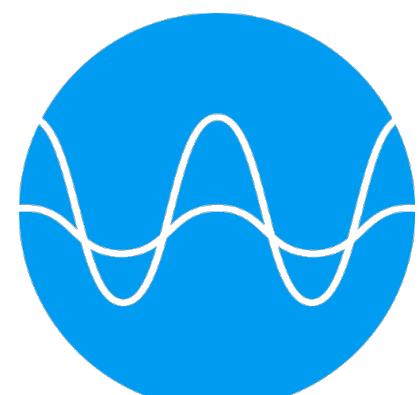


- Electroencephalography (EEG)
- Brainwaves
- Evoked potentials

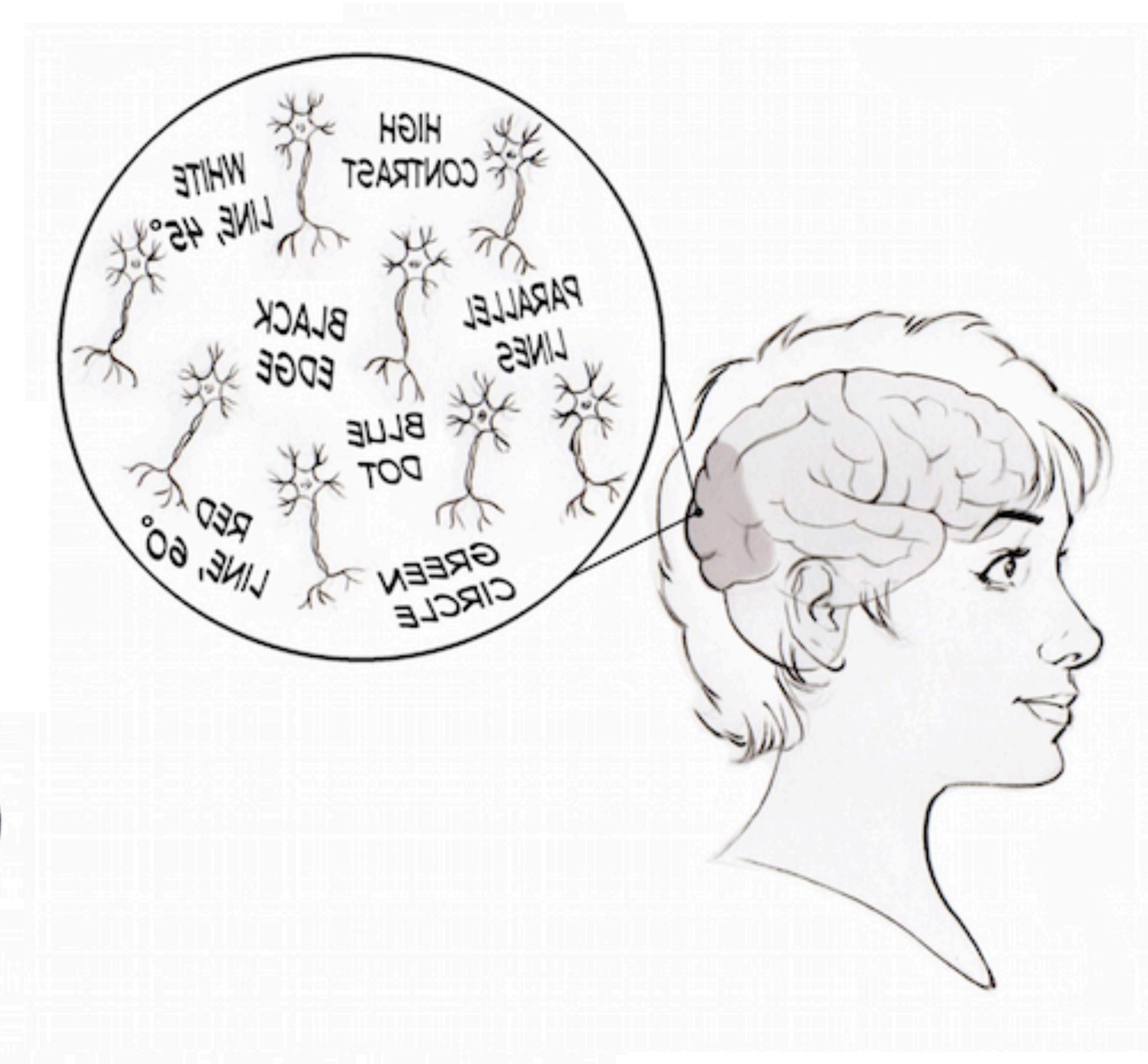


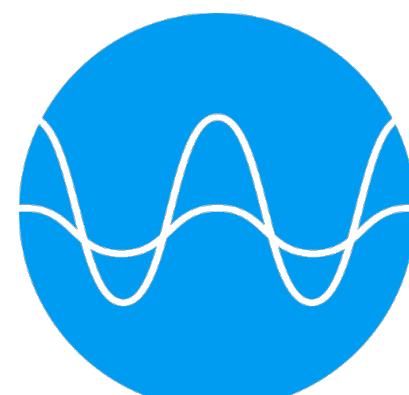
# Electroencephalography (EEG)



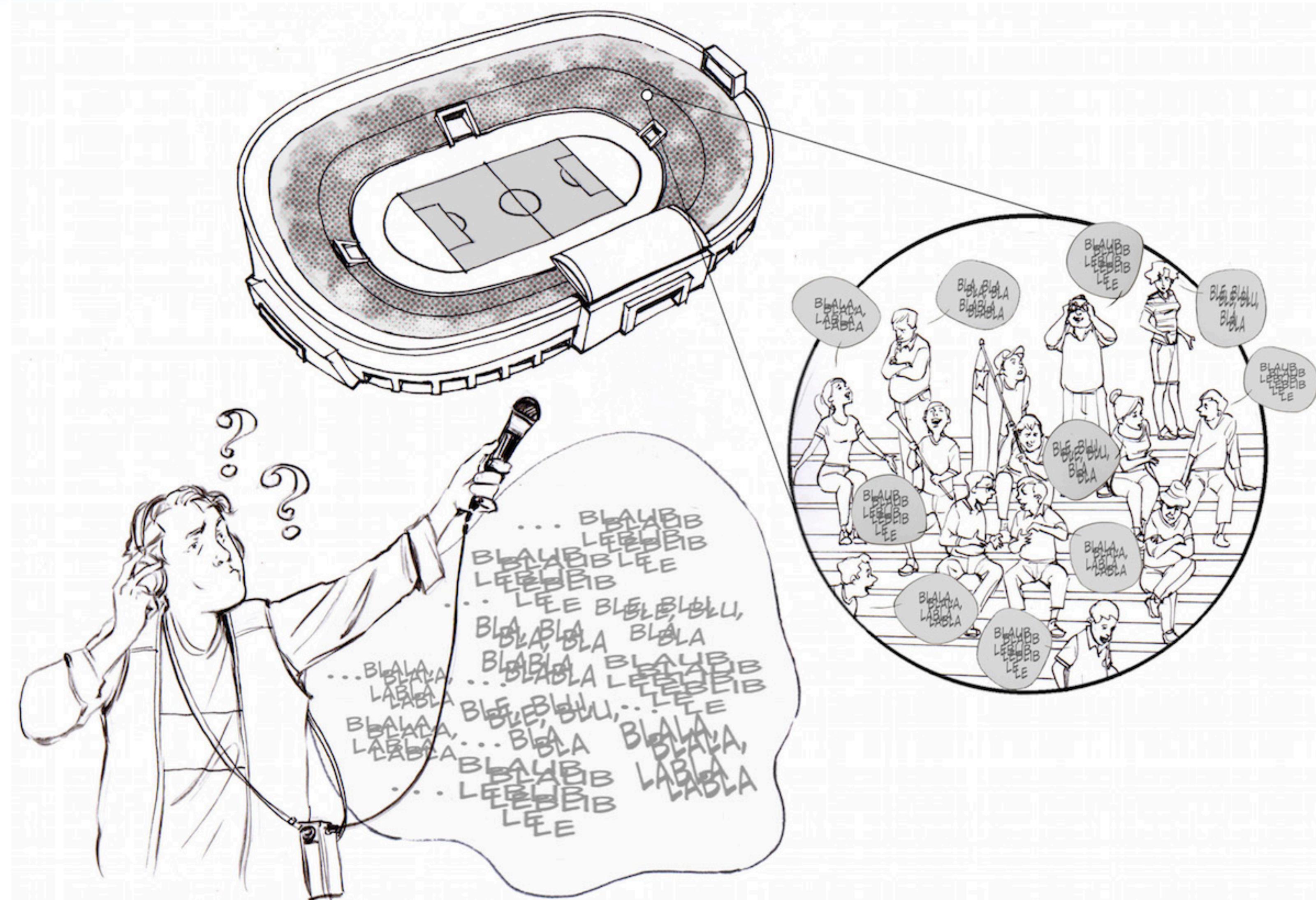


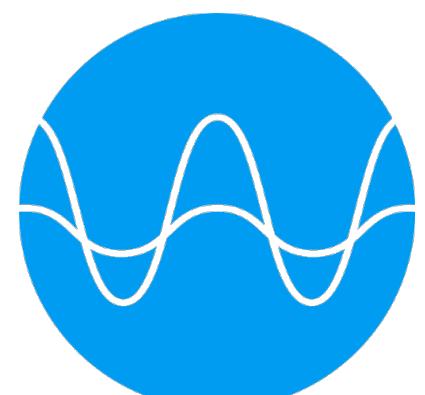
# Electroencephalography (EEG)





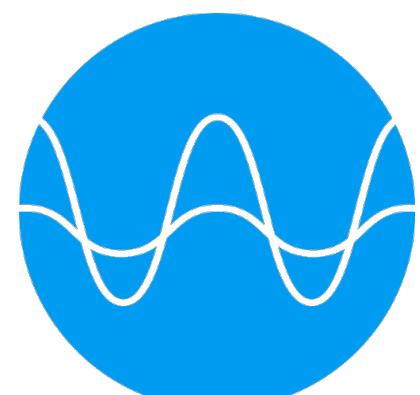
# Electroencephalography (EEG)



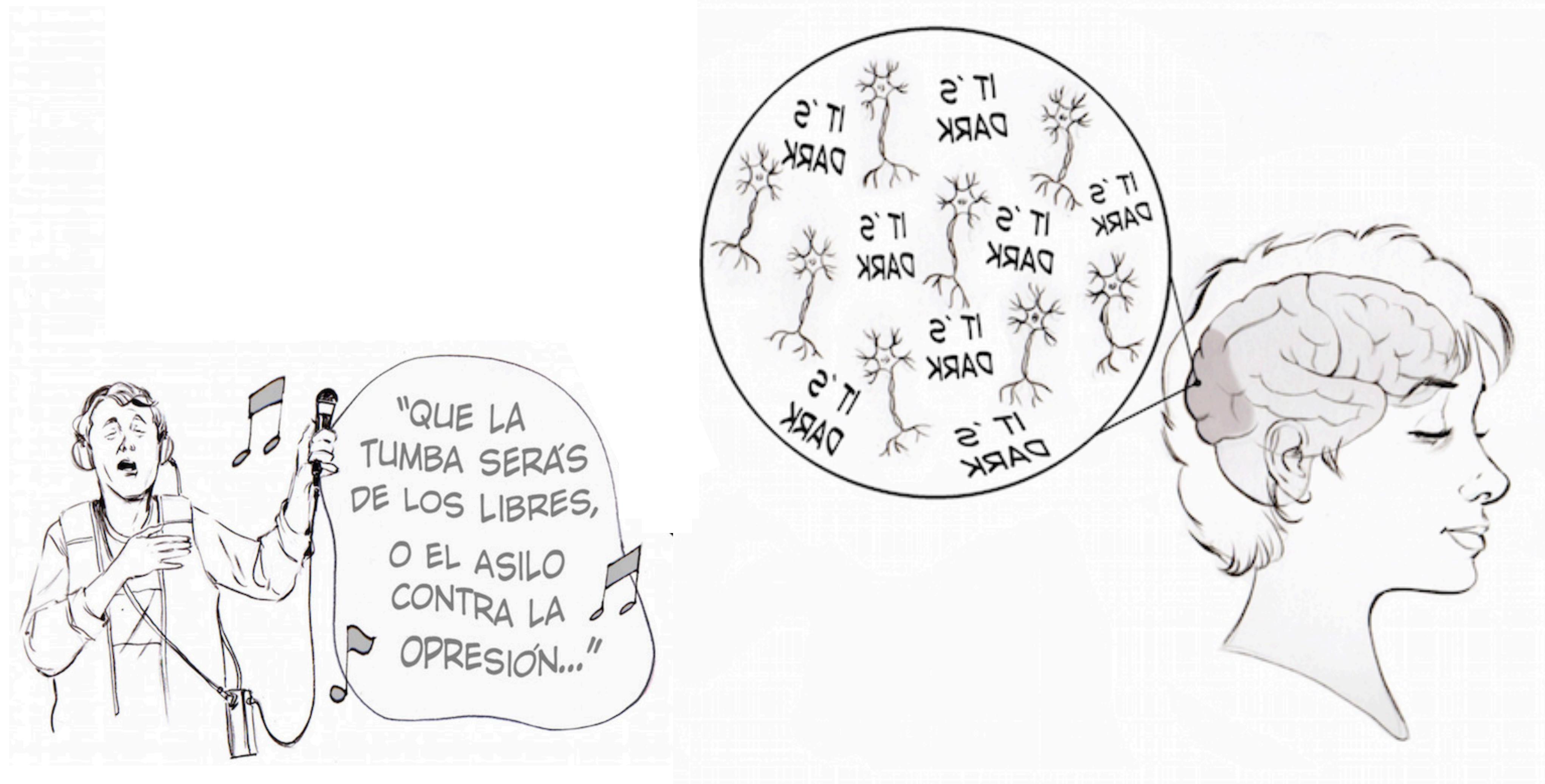


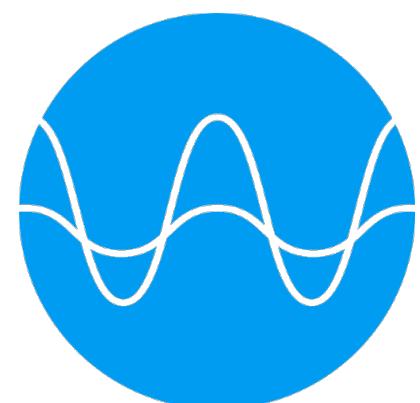
# Electroencephalography (EEG)





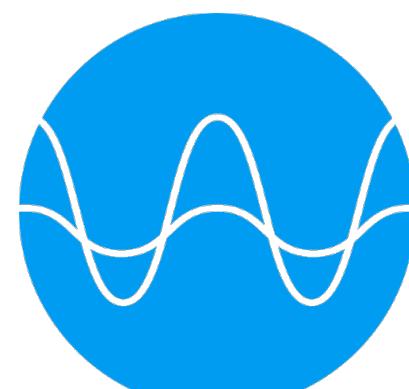
# Electroencephalography (EEG)



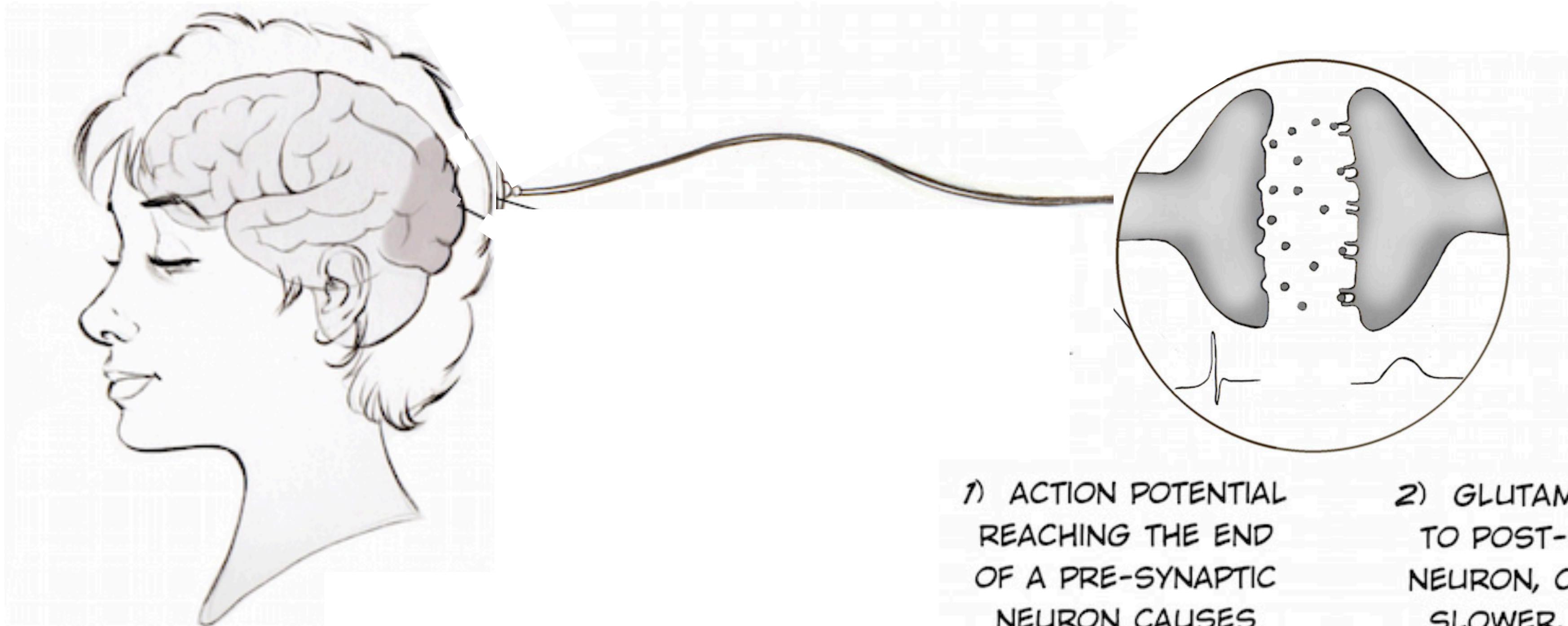


# Electroencephalography (EEG)

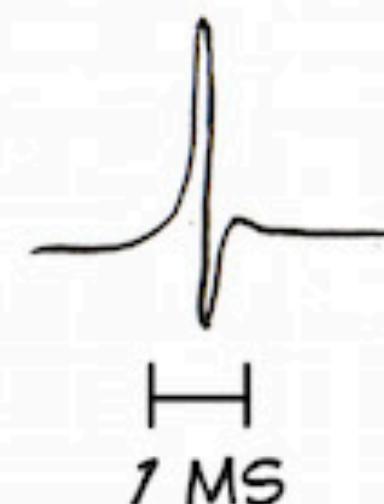




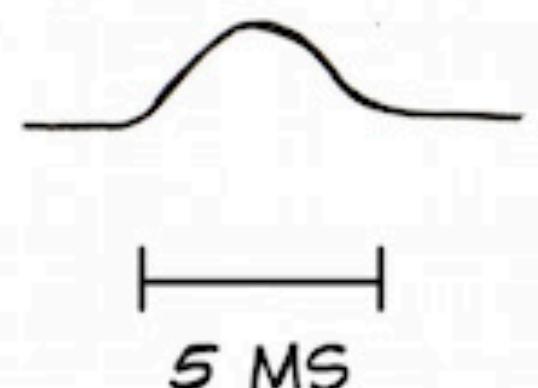
# Electroencephalography (EEG)

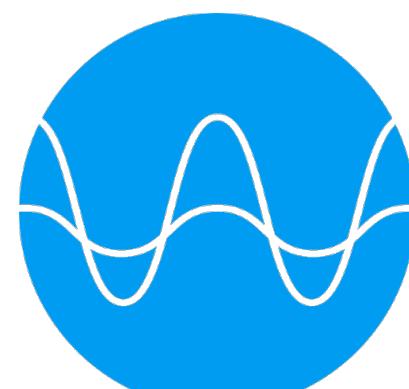


1) ACTION POTENTIAL REACHING THE END OF A PRE-SYNAPTIC NEURON CAUSES RELEASE OF GLUTAMATE.

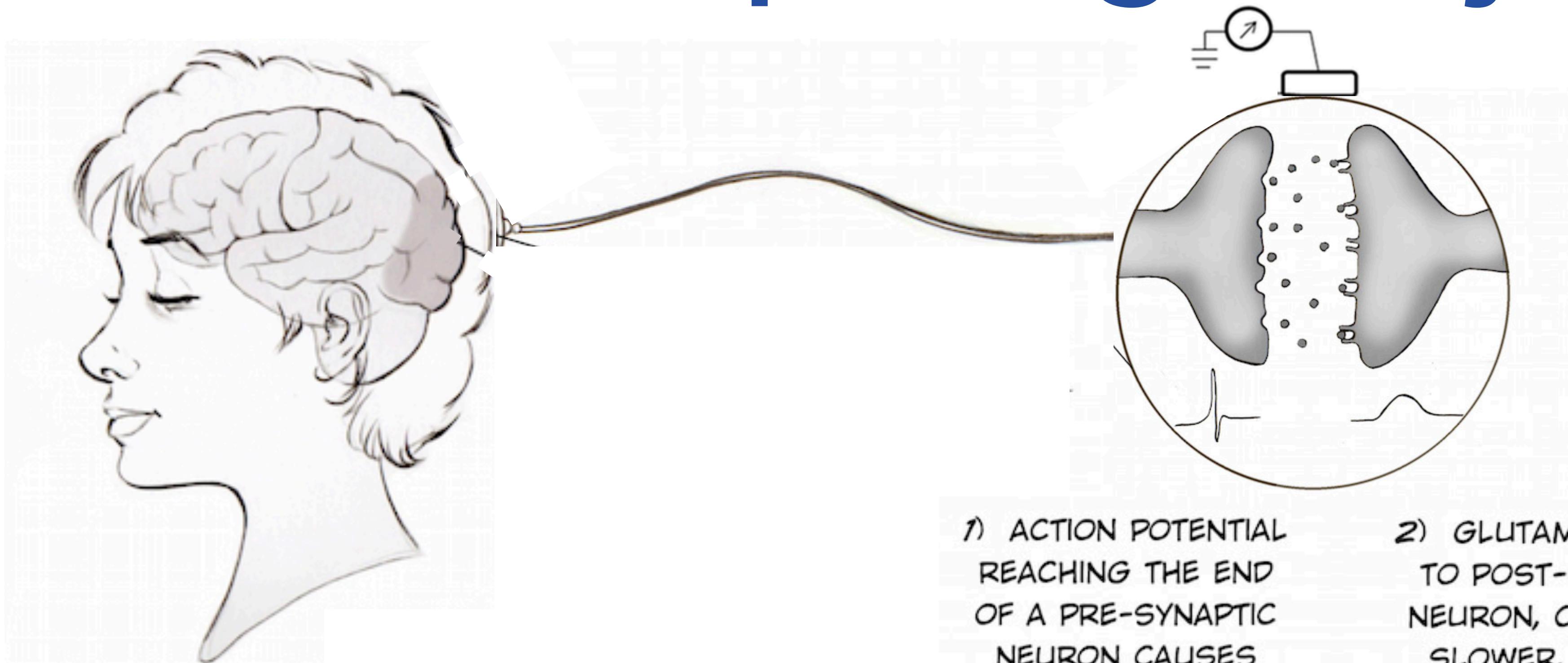


2) GLUTAMATE BINDS TO POST-SYNAPTIC NEURON, CAUSING A SLOWER, LONGER CHANGE IN VOLTAGE CALLED AN EPSP.

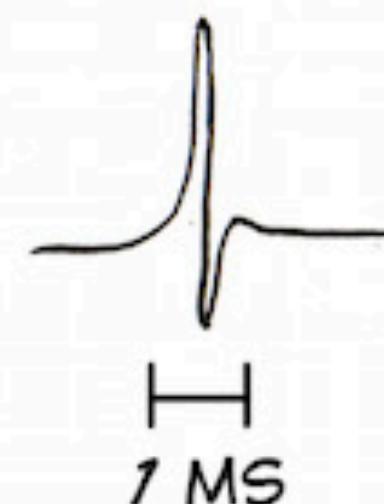




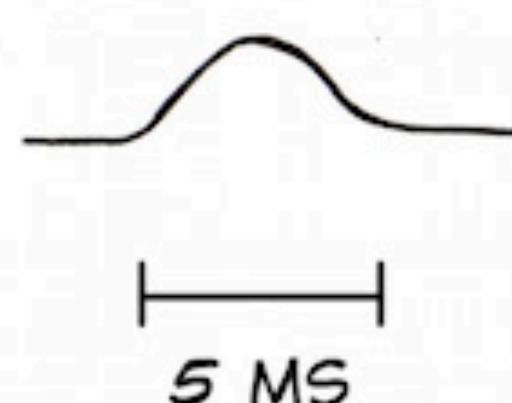
# Electroencephalography (EEG)

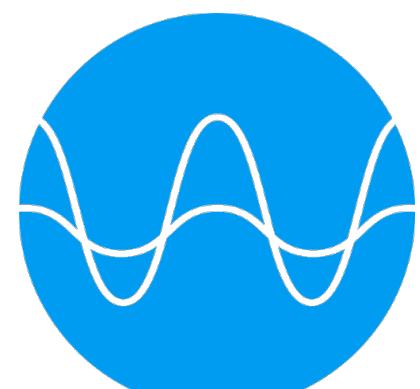


1) ACTION POTENTIAL REACHING THE END OF A PRE-SYNAPTIC NEURON CAUSES RELEASE OF GLUTAMATE.

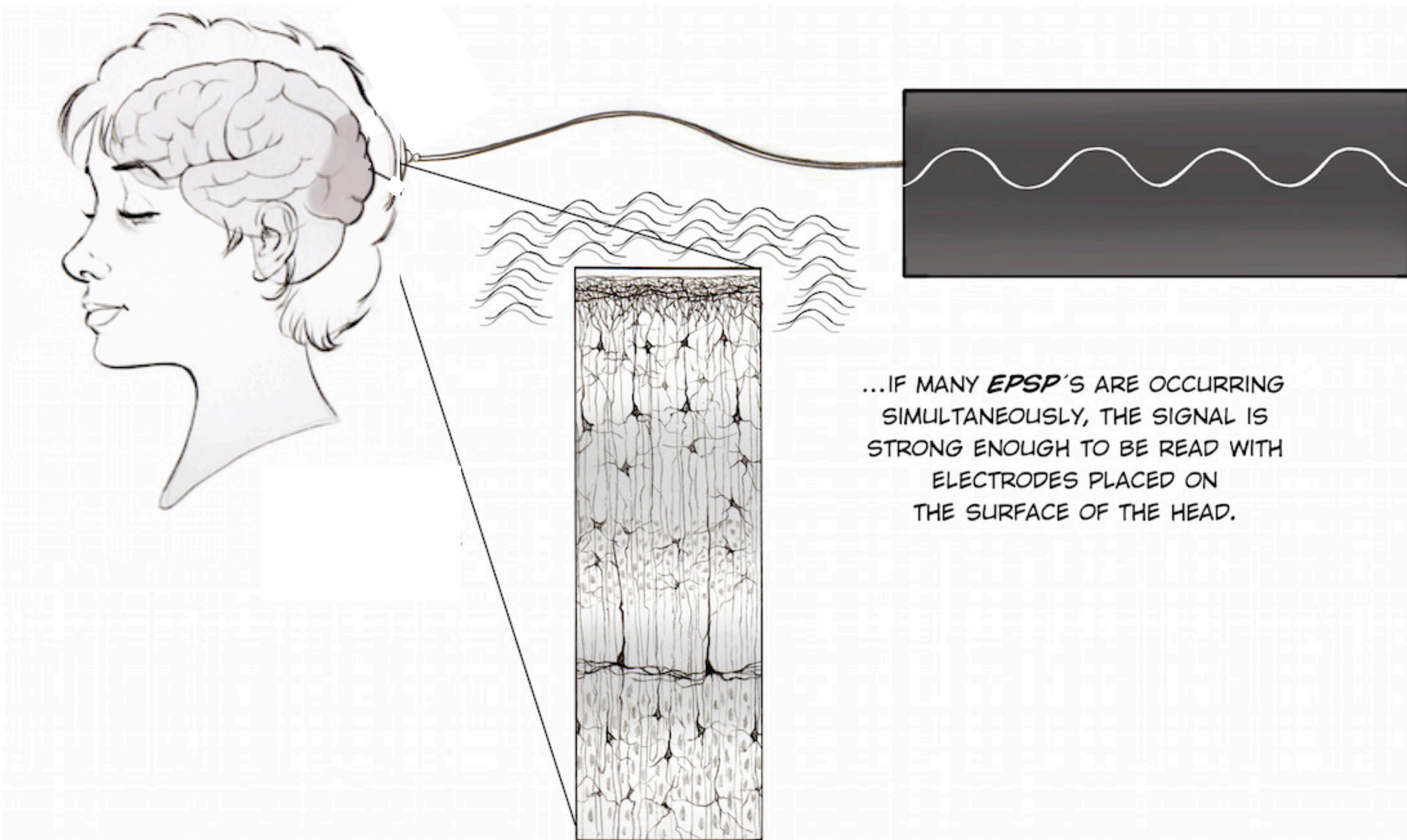


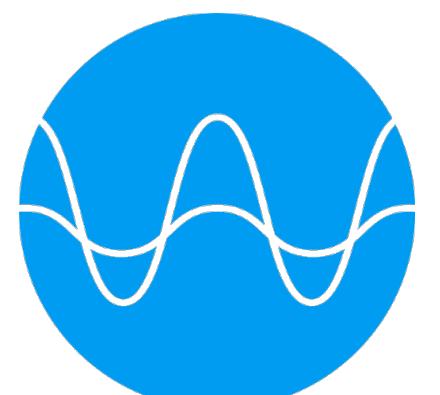
2) GLUTAMATE BINDS TO POST-SYNAPTIC NEURON, CAUSING A SLOWER, LONGER CHANGE IN VOLTAGE CALLED AN EPSP.



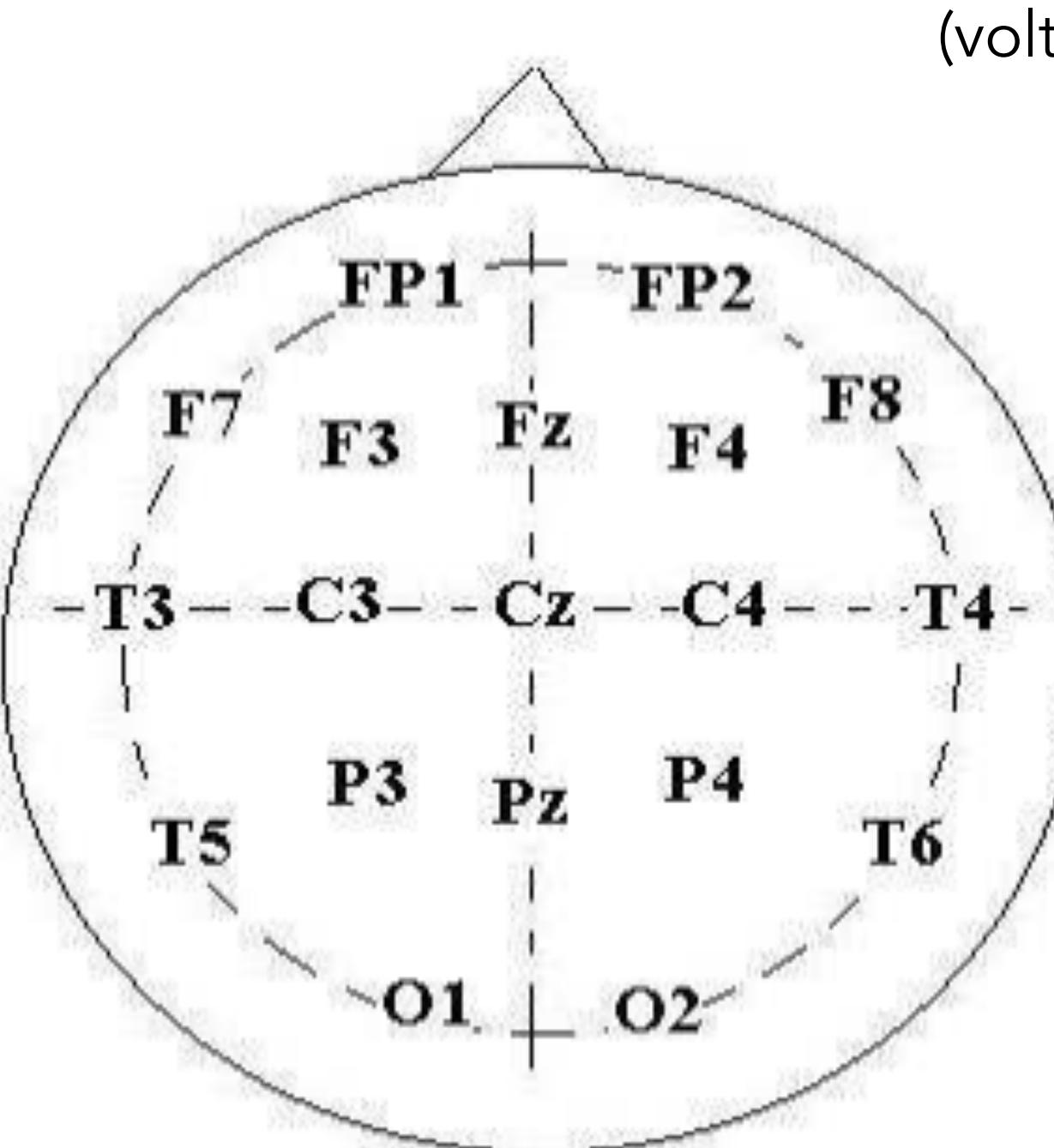


# Electroencephalography (EEG)



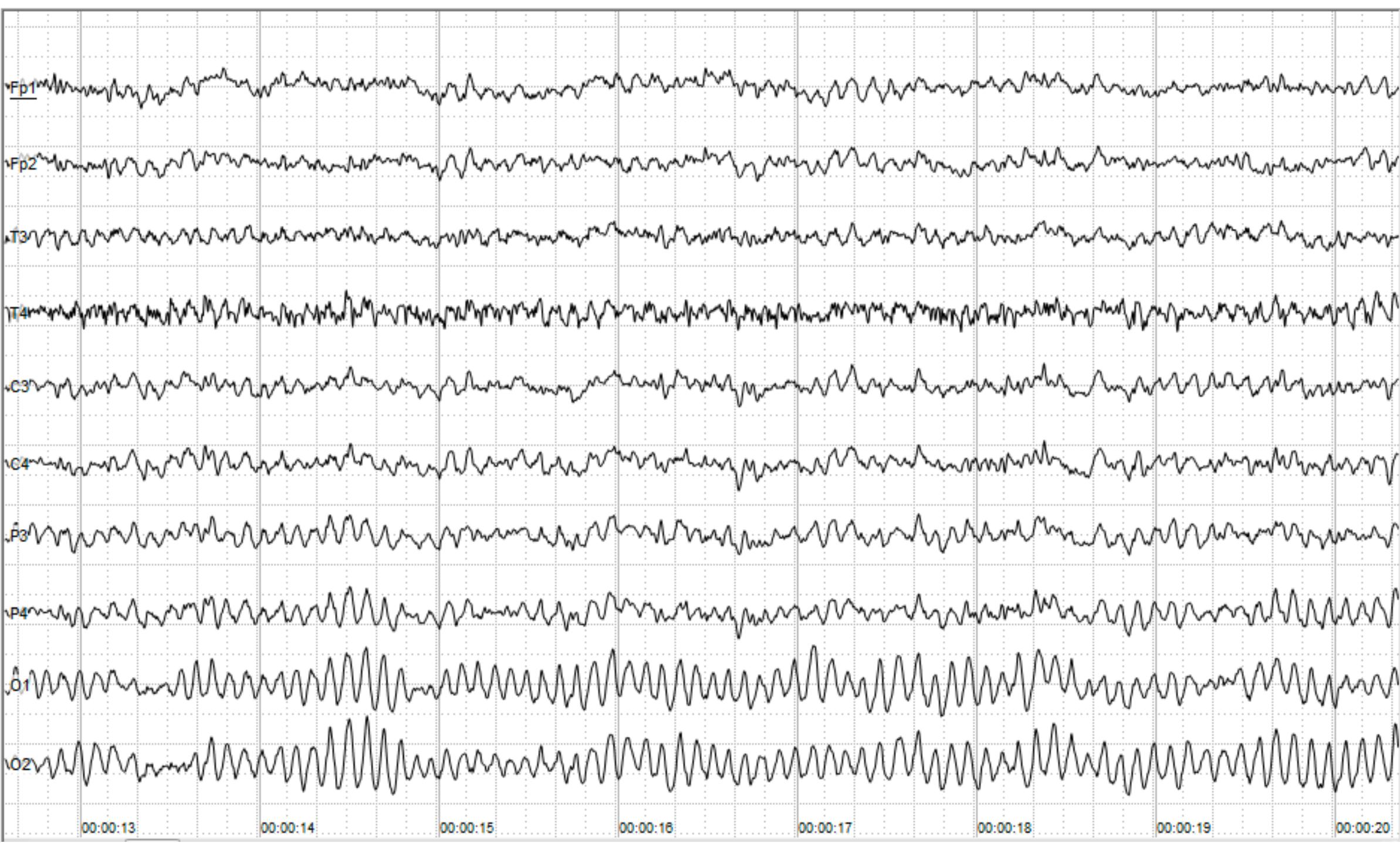


# Electroencephalography (EEG)



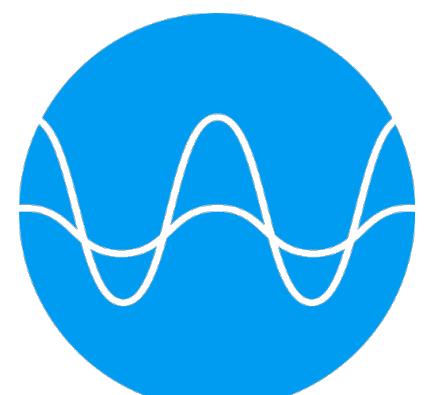
Electrodes

(voltage)



Time

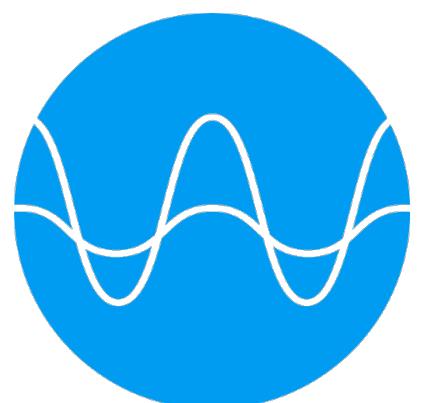
(seconds)



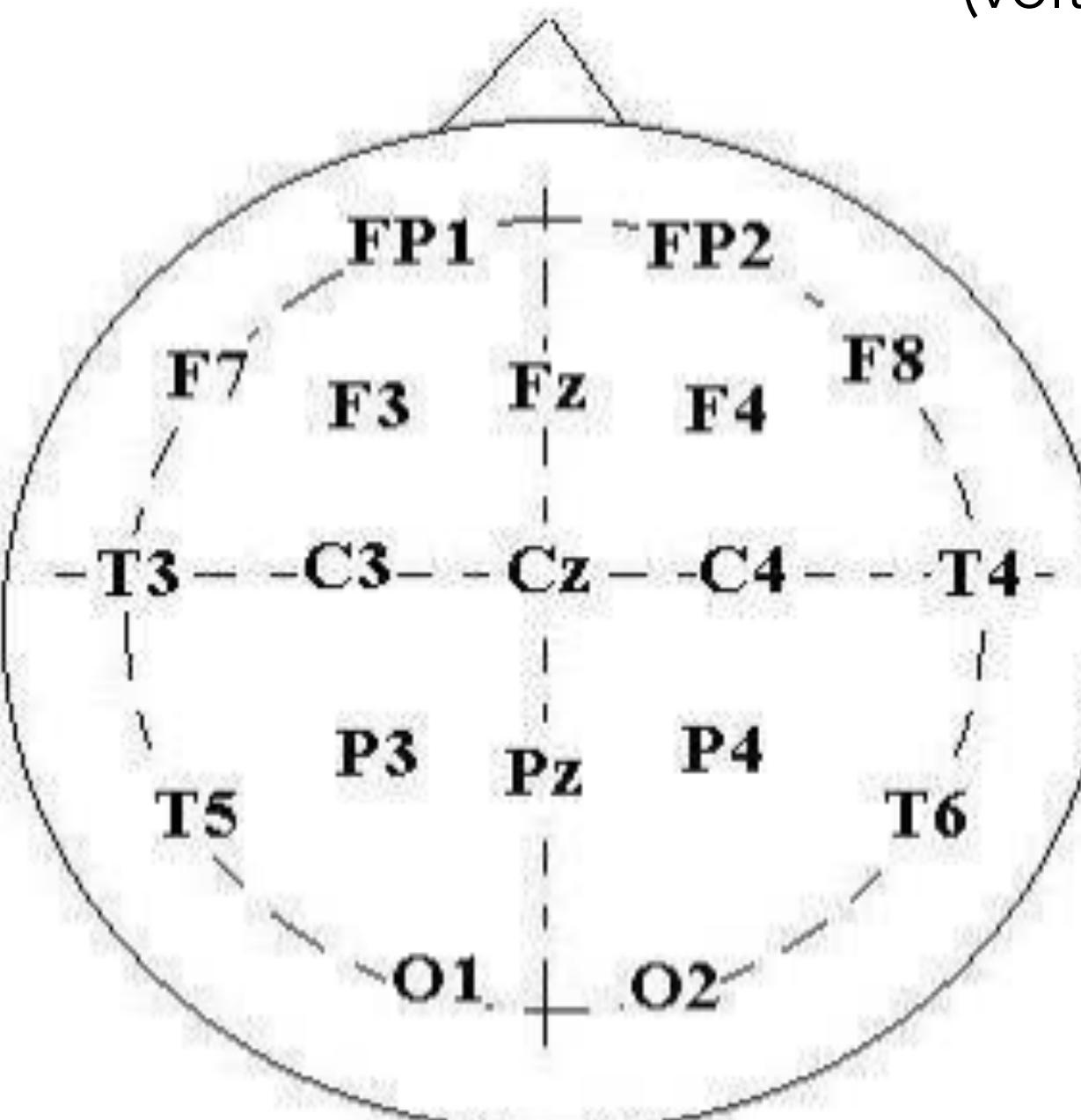
# BCI: Brain



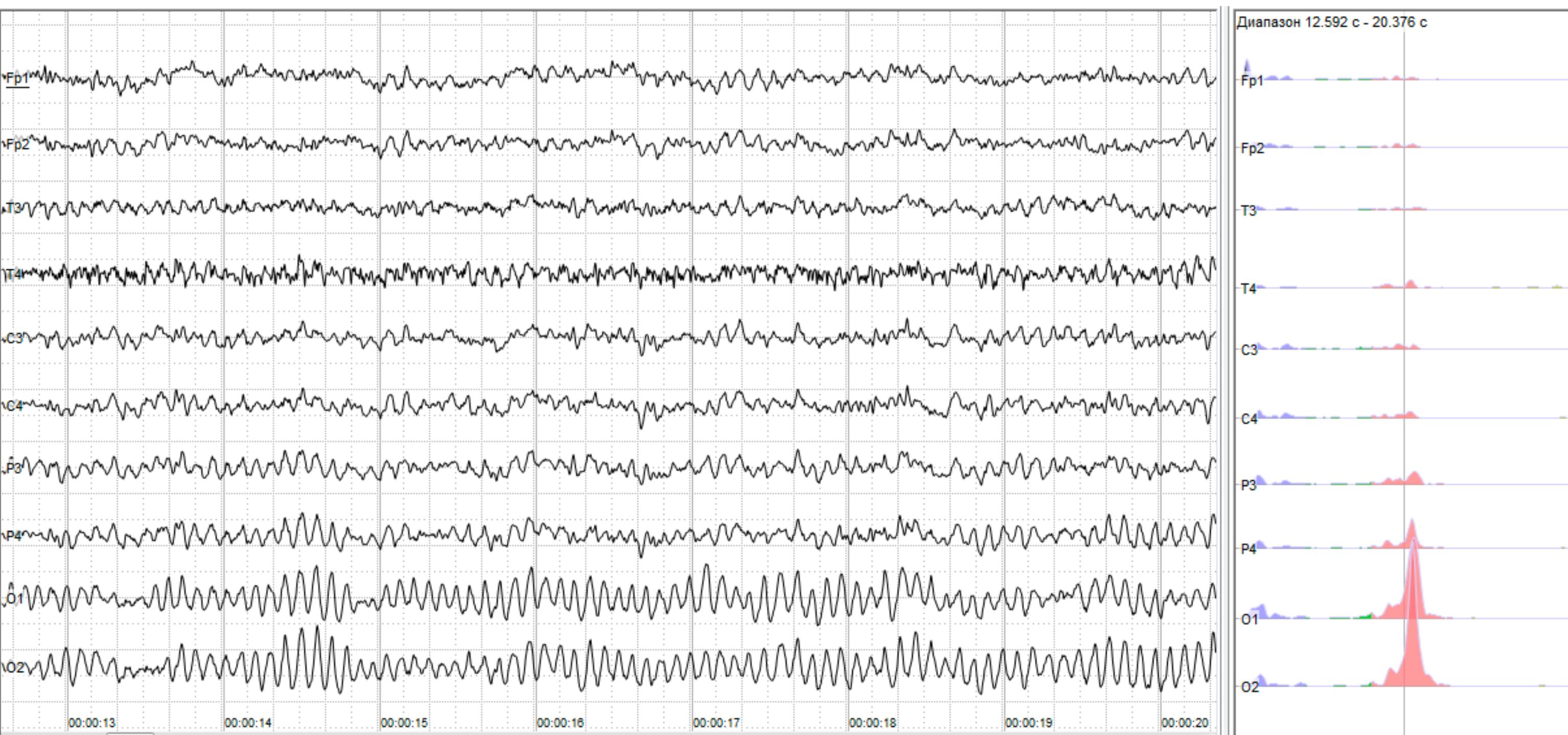
- Electroencephalography (EEG)
- Brainwaves
- Evoked potentials



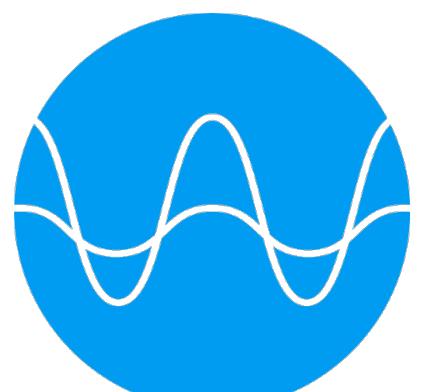
# Brainwaves



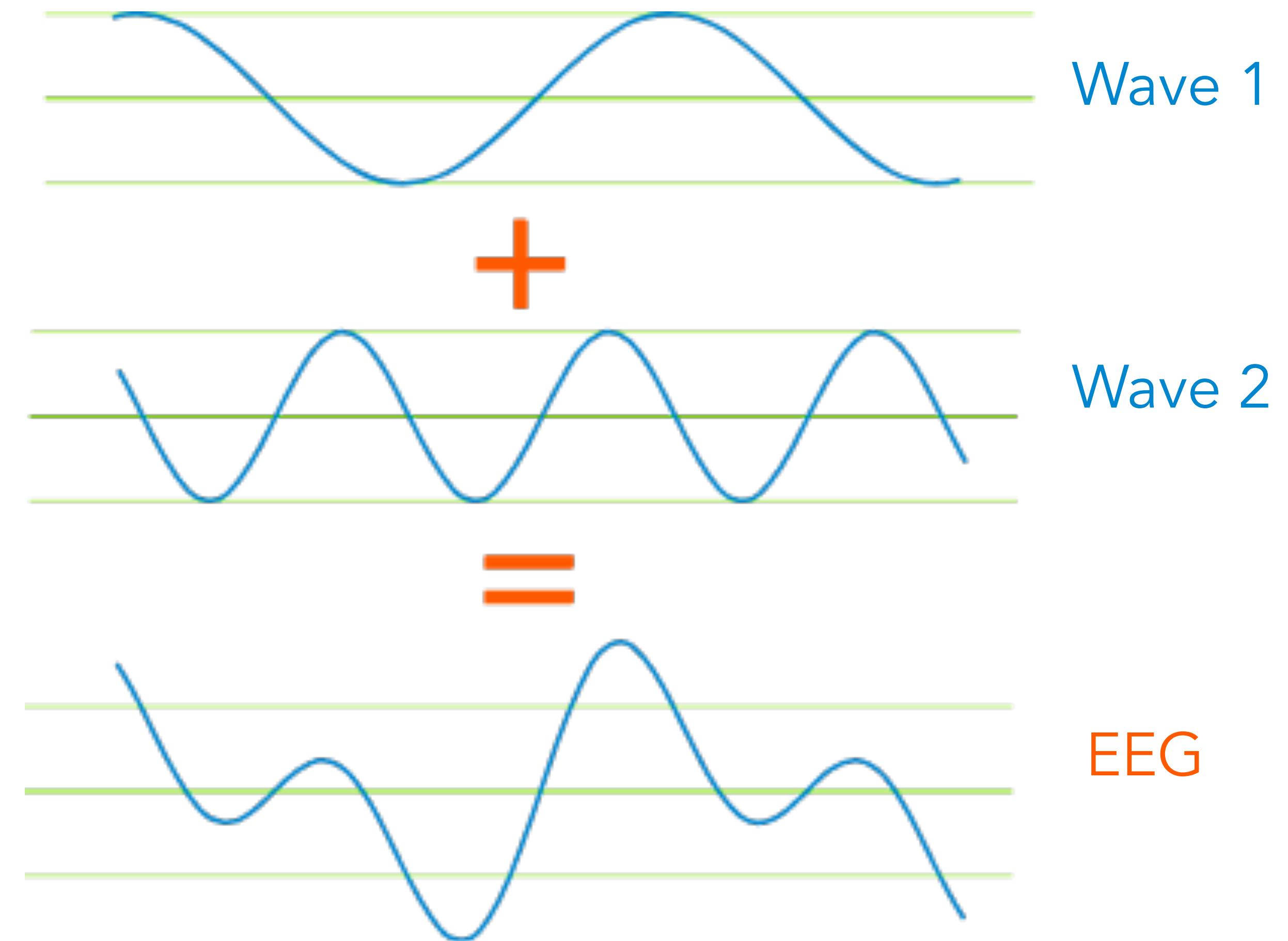
Electrodes  
(voltage)

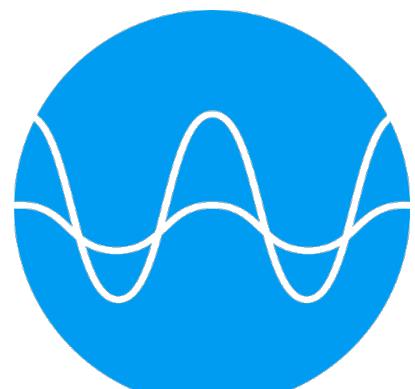


Time (seconds) Frequency (Hz)

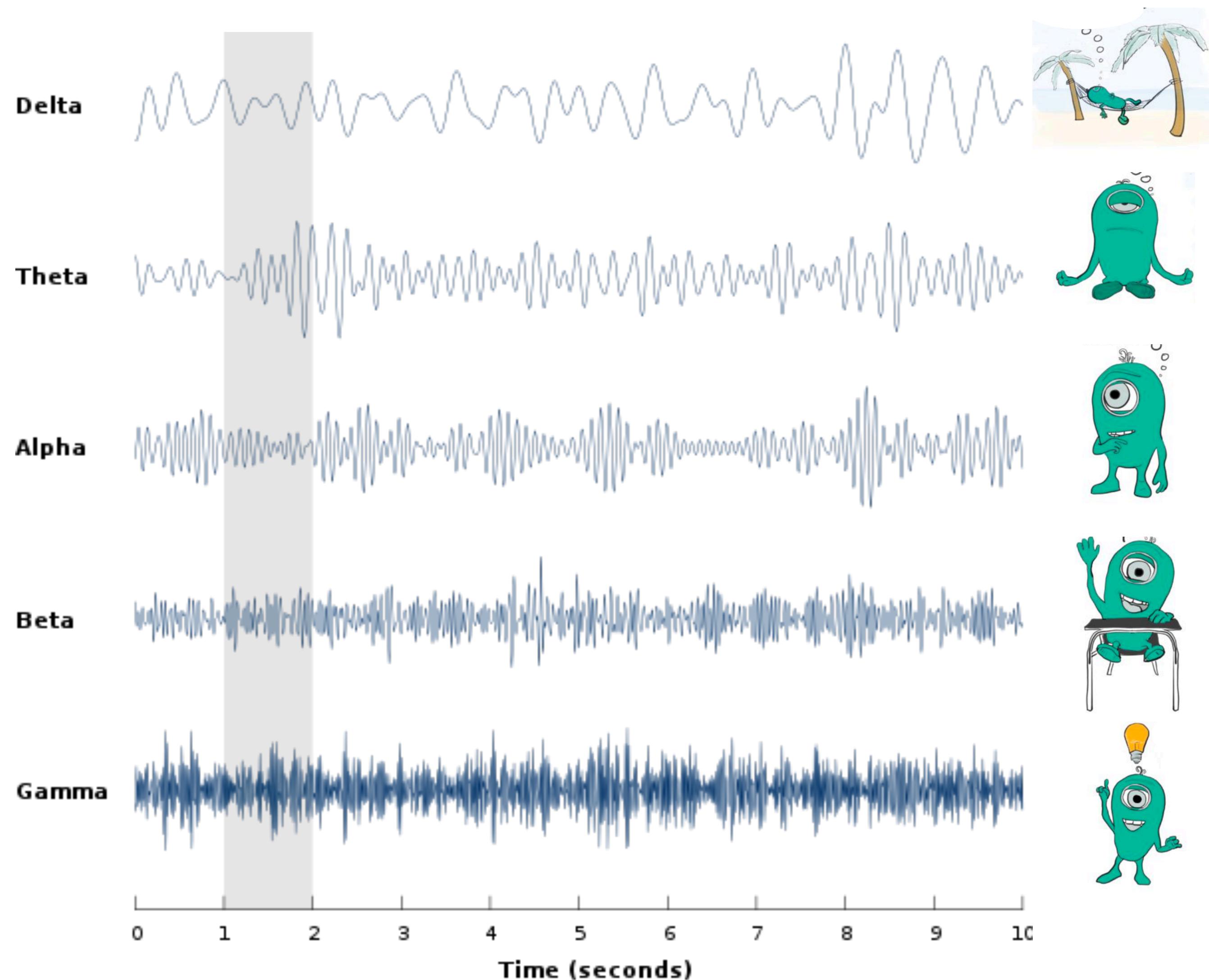


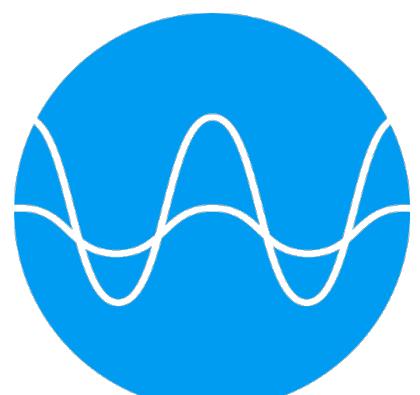
# Brainwaves





# Brainwaves

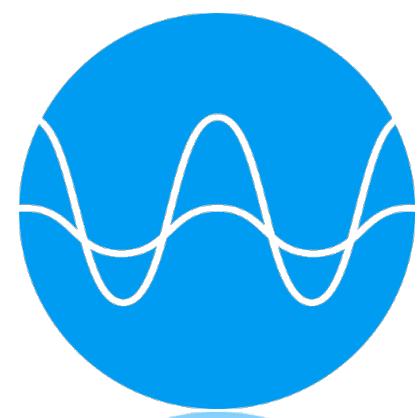




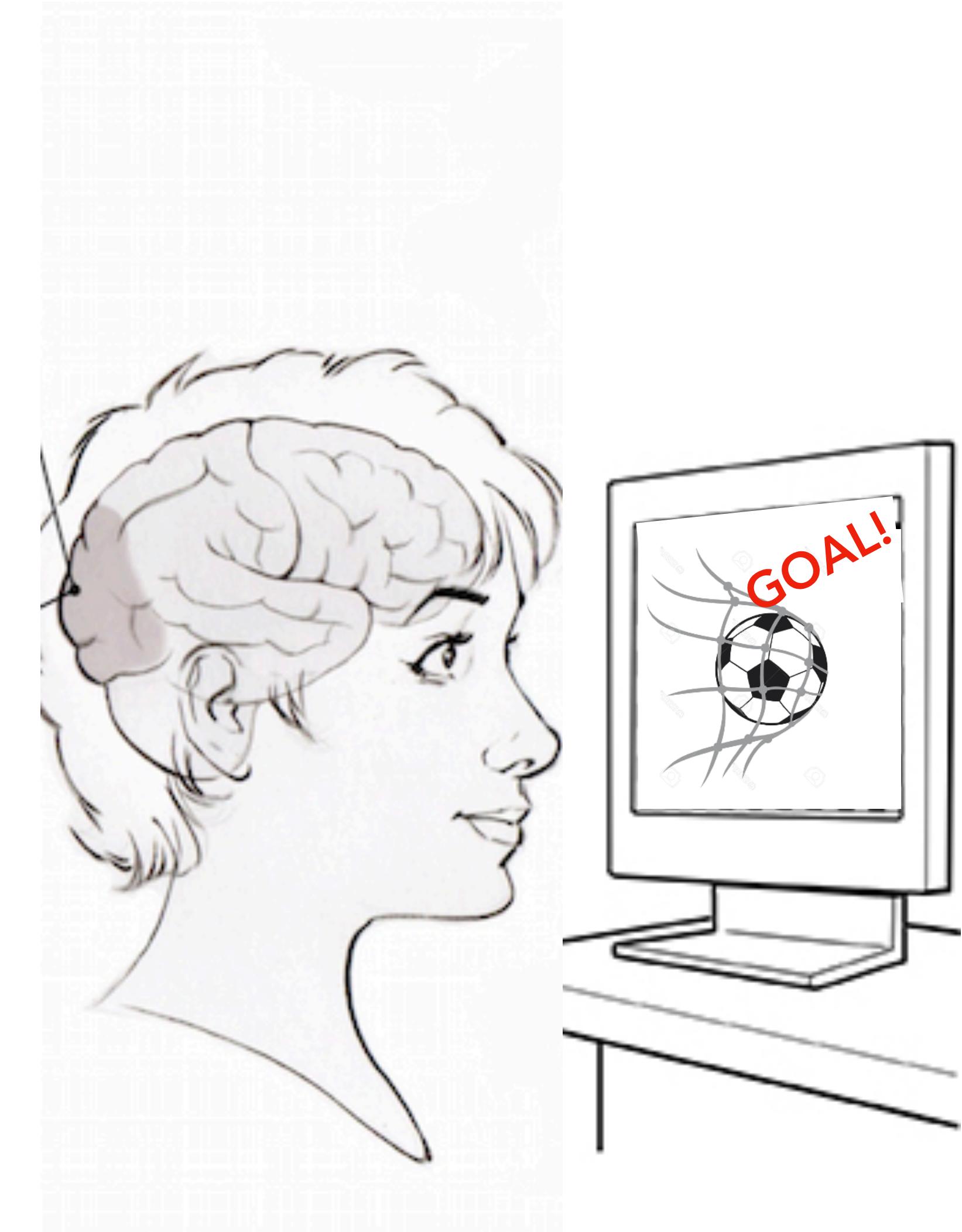
# BCI: Brain

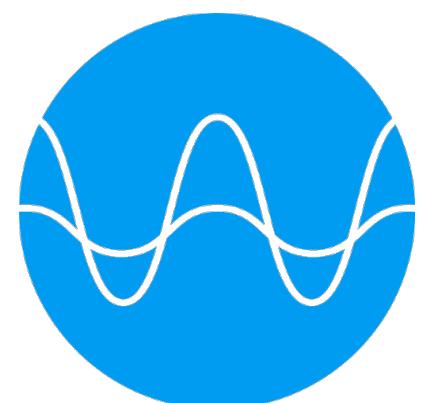


- Electroencephalography (EEG)
- Brainwaves
- Evoked Related Potential (ERP)

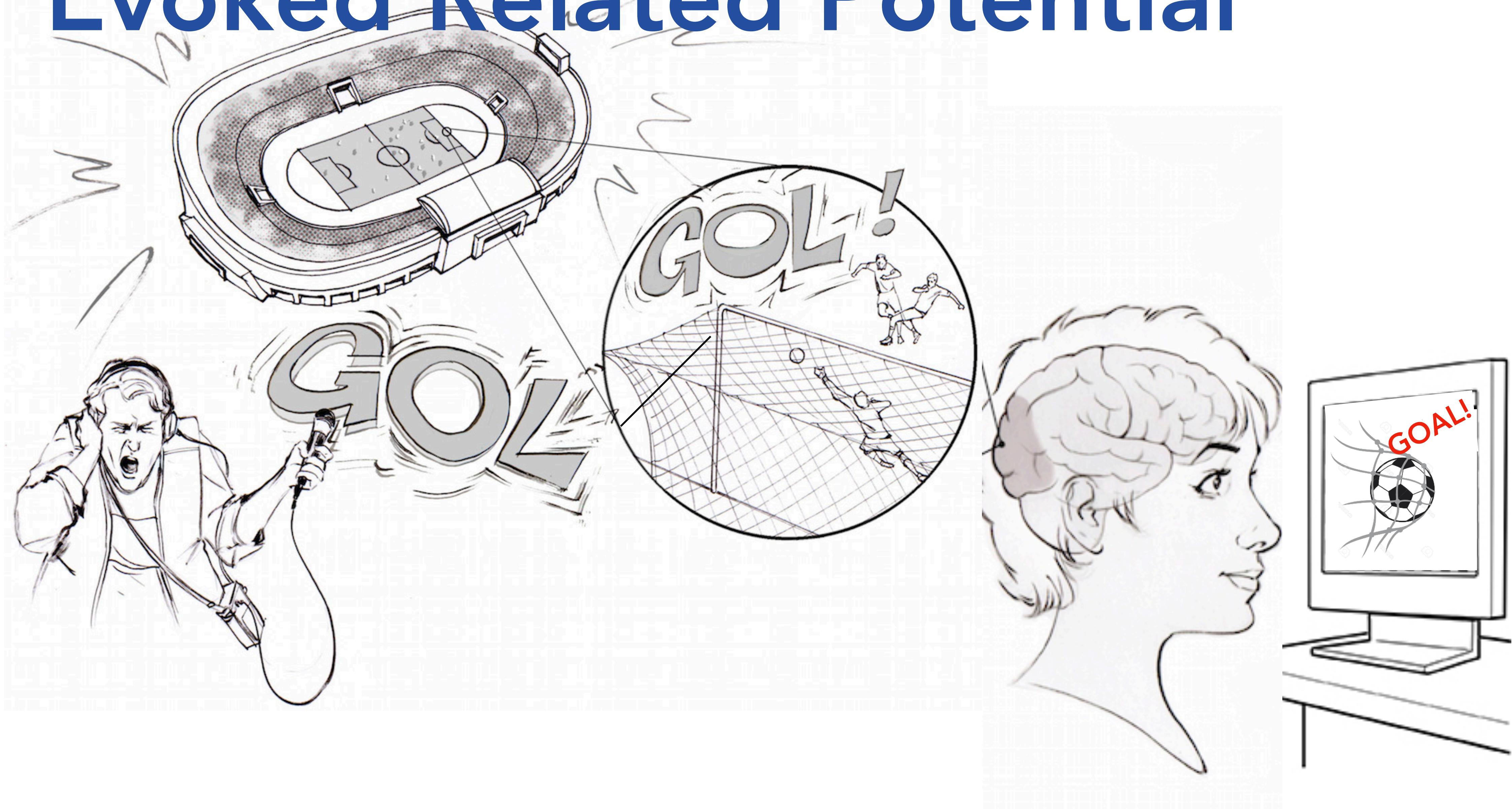


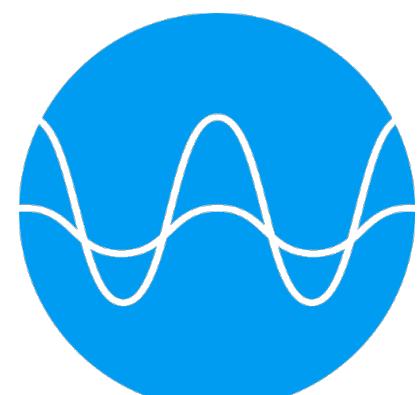
# Evoked Related Potential





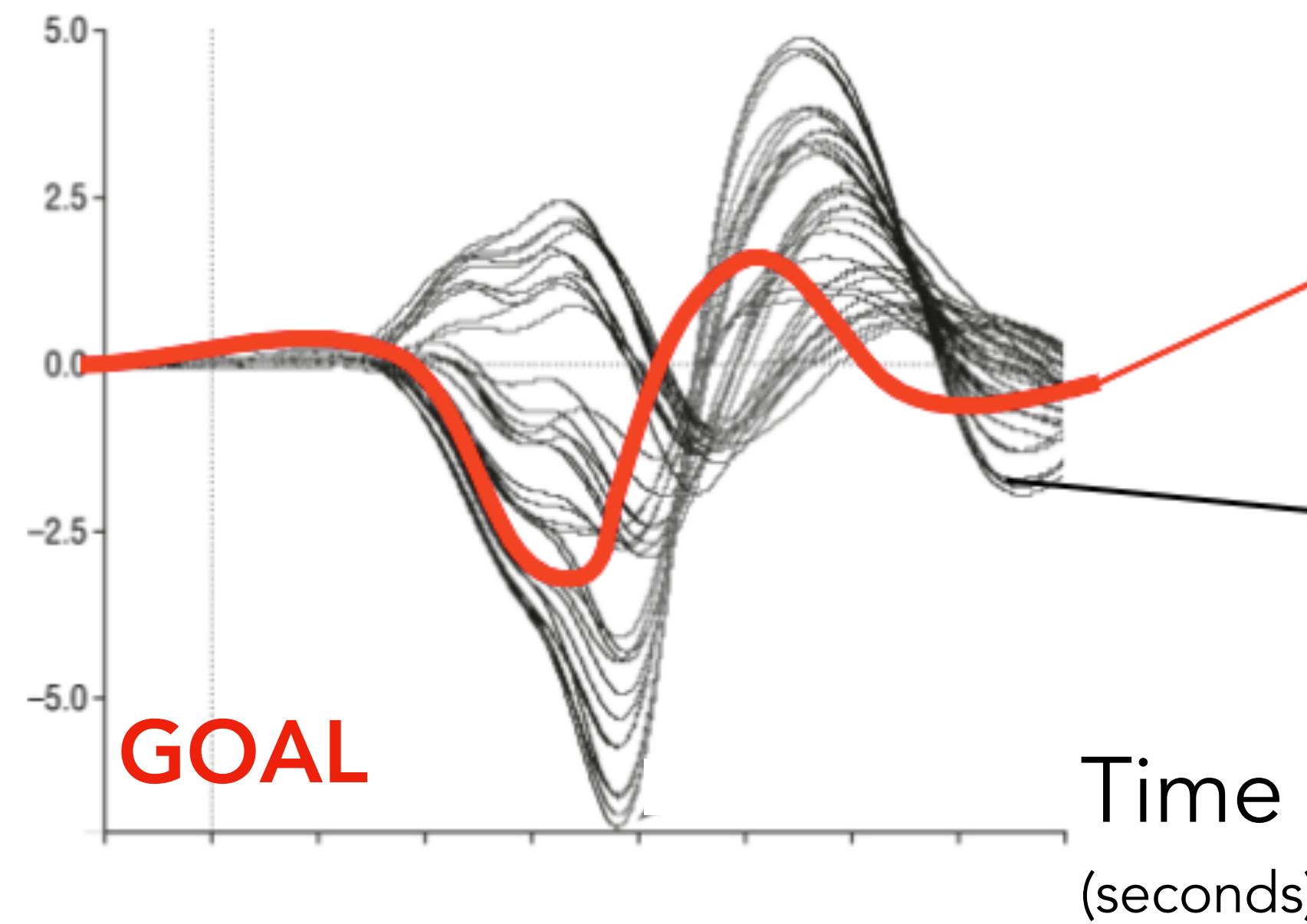
# Evoked Related Potential





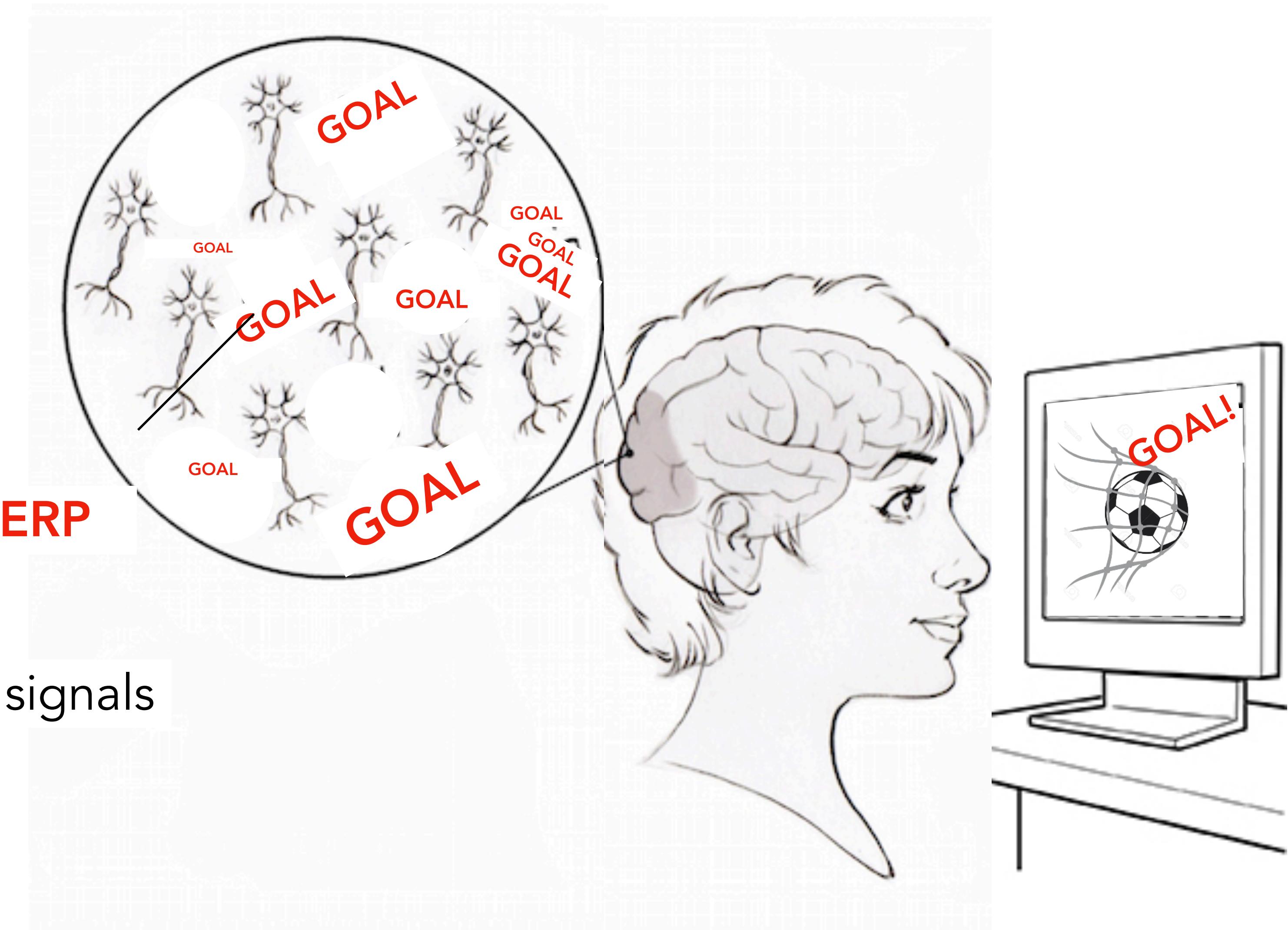
# Evoked Related Potential

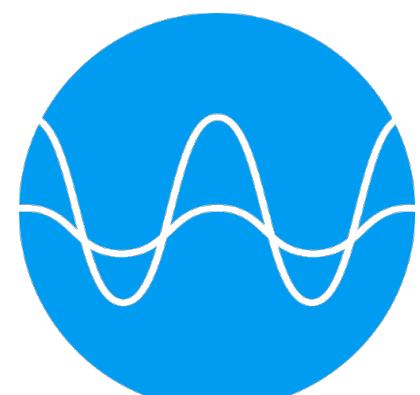
Electrodes  
(voltage)



ERP

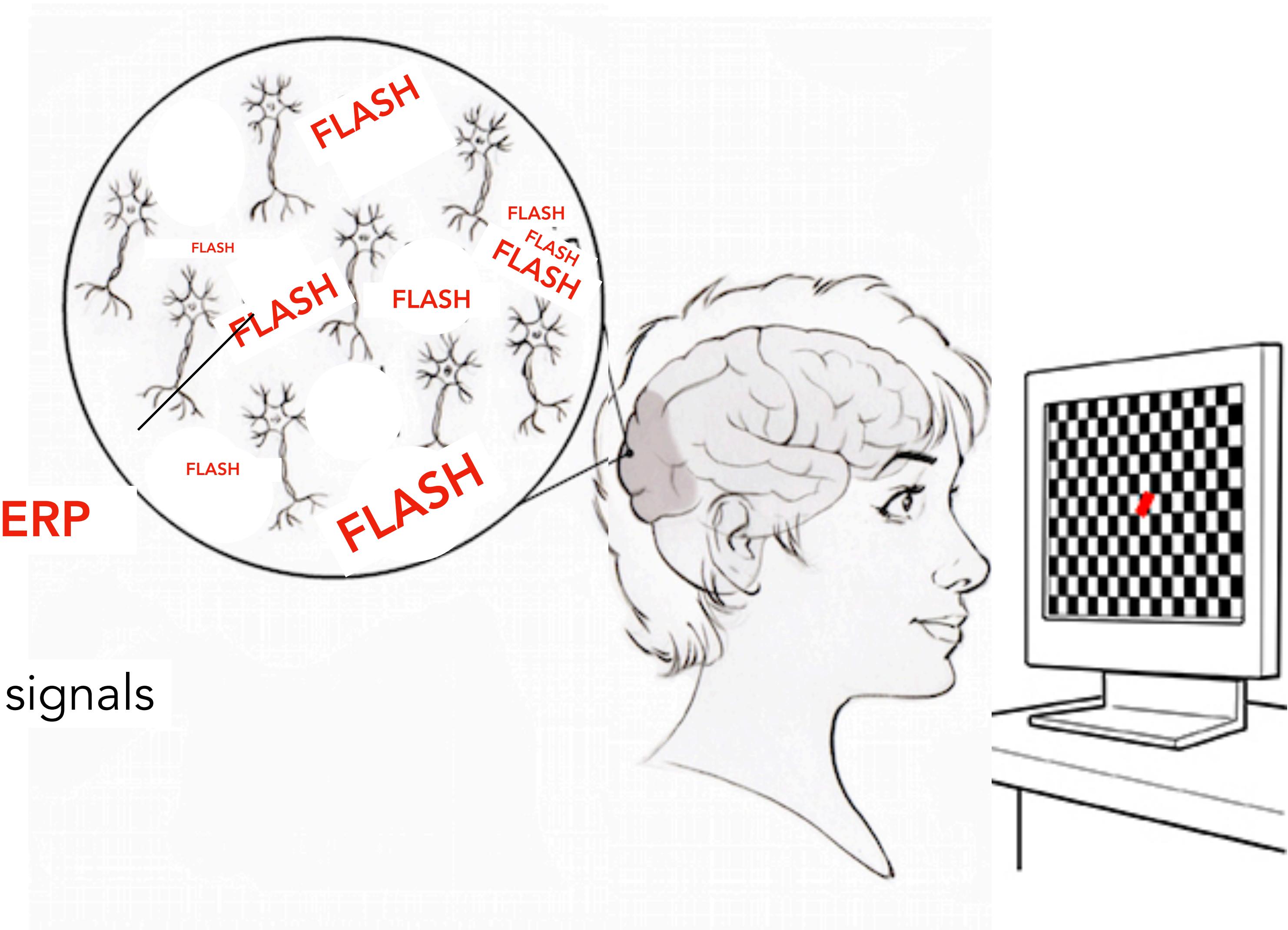
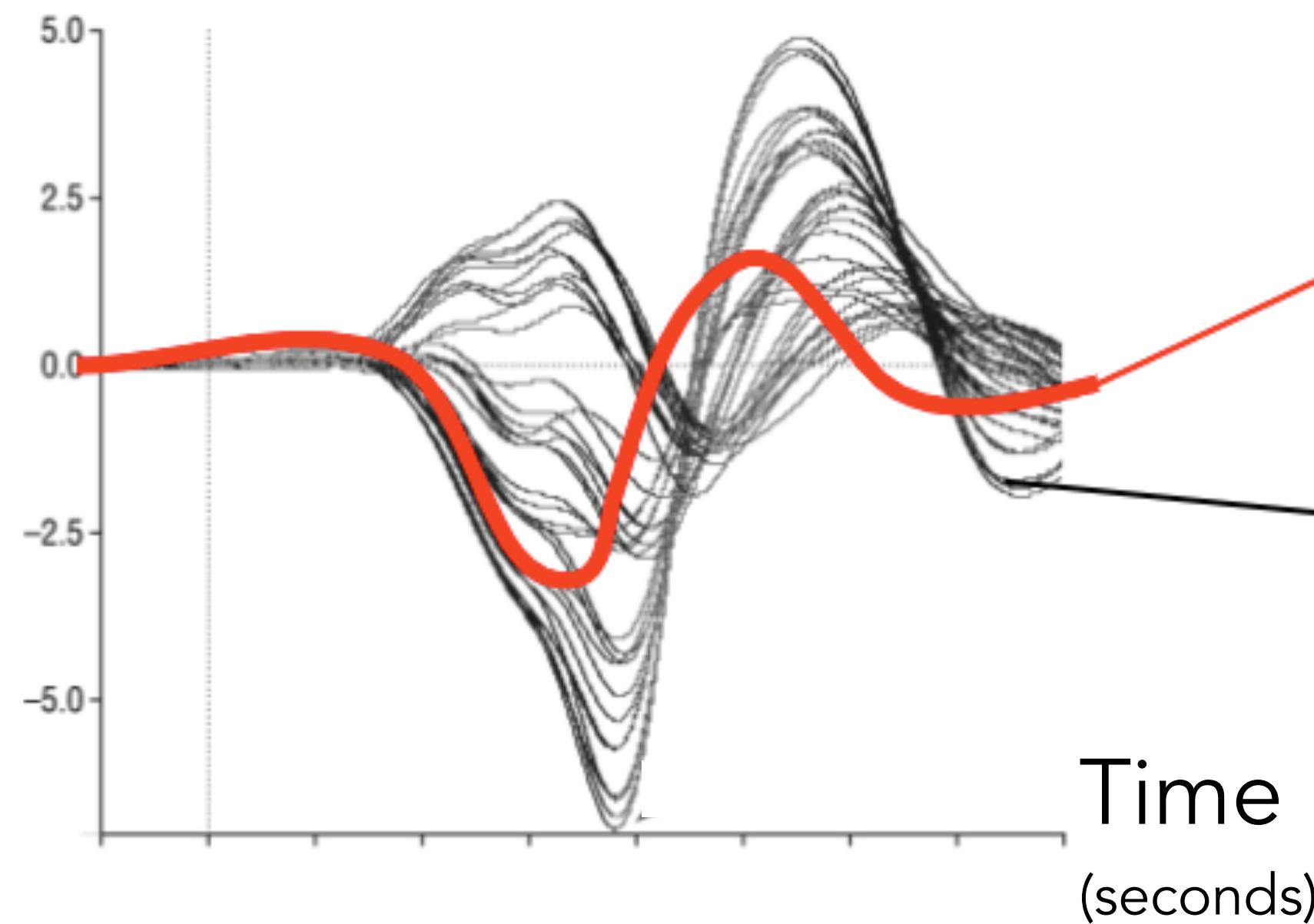
signals

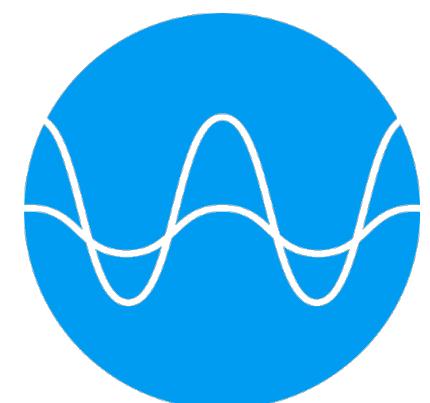




# Evoked Related Potential

Electrodes  
(voltage)



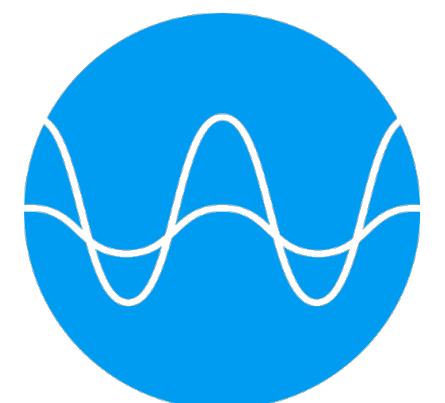


# BCI: Brain Computer

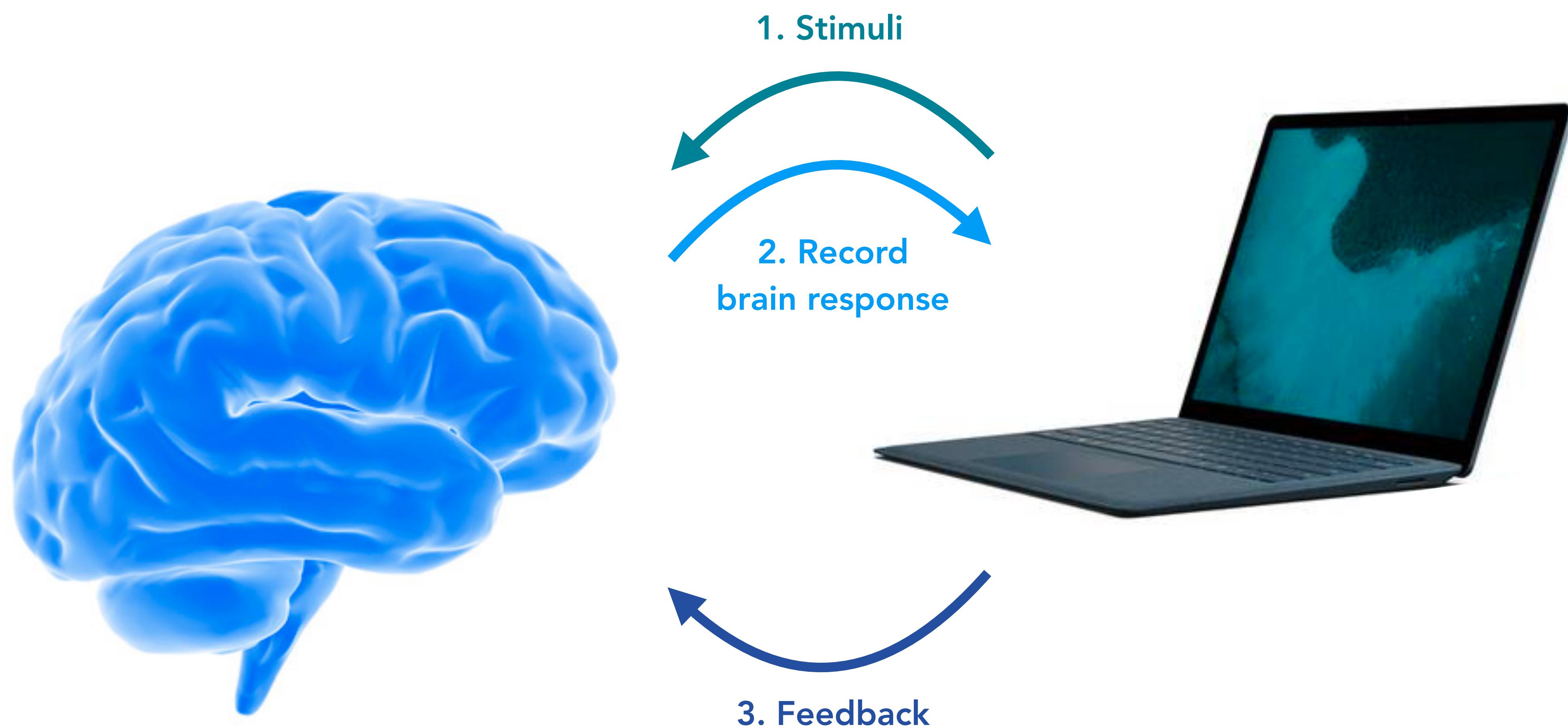


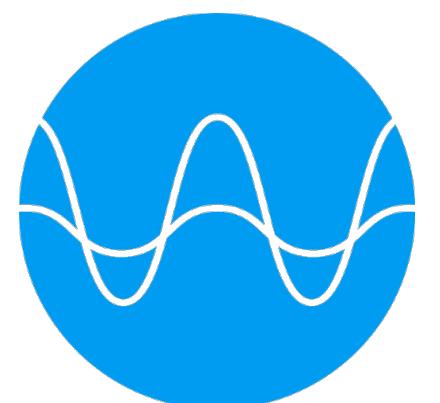
1. Stimuli
  2. Record  
brain response
- 
- Two curved arrows originate from the brain image. The top arrow is teal and points to the word "Stimuli". The bottom arrow is blue and points to the text "Record brain response". Both arrows curve downwards towards the laptop.



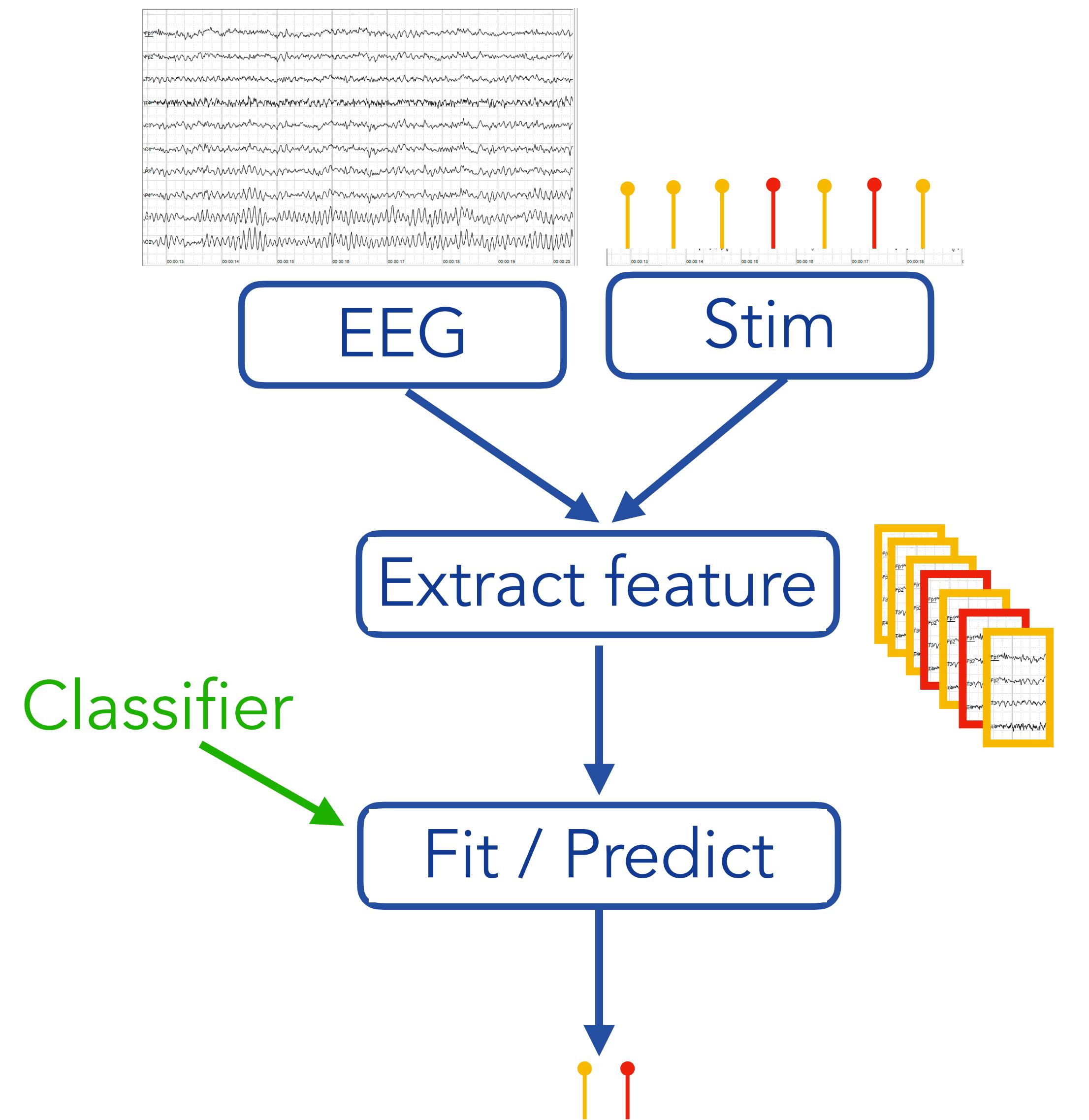


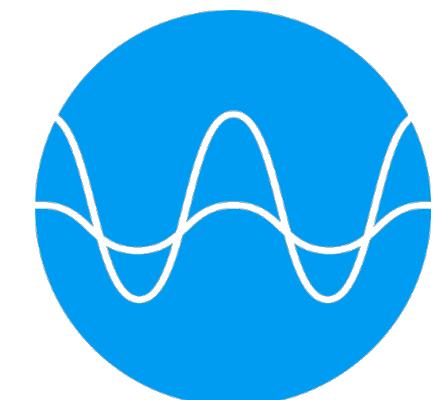
# BCI: Brain Computer Interface





# BCI pipeline

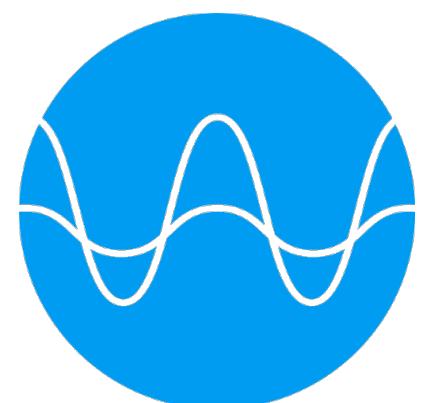




# BCI Paradigms

Induced



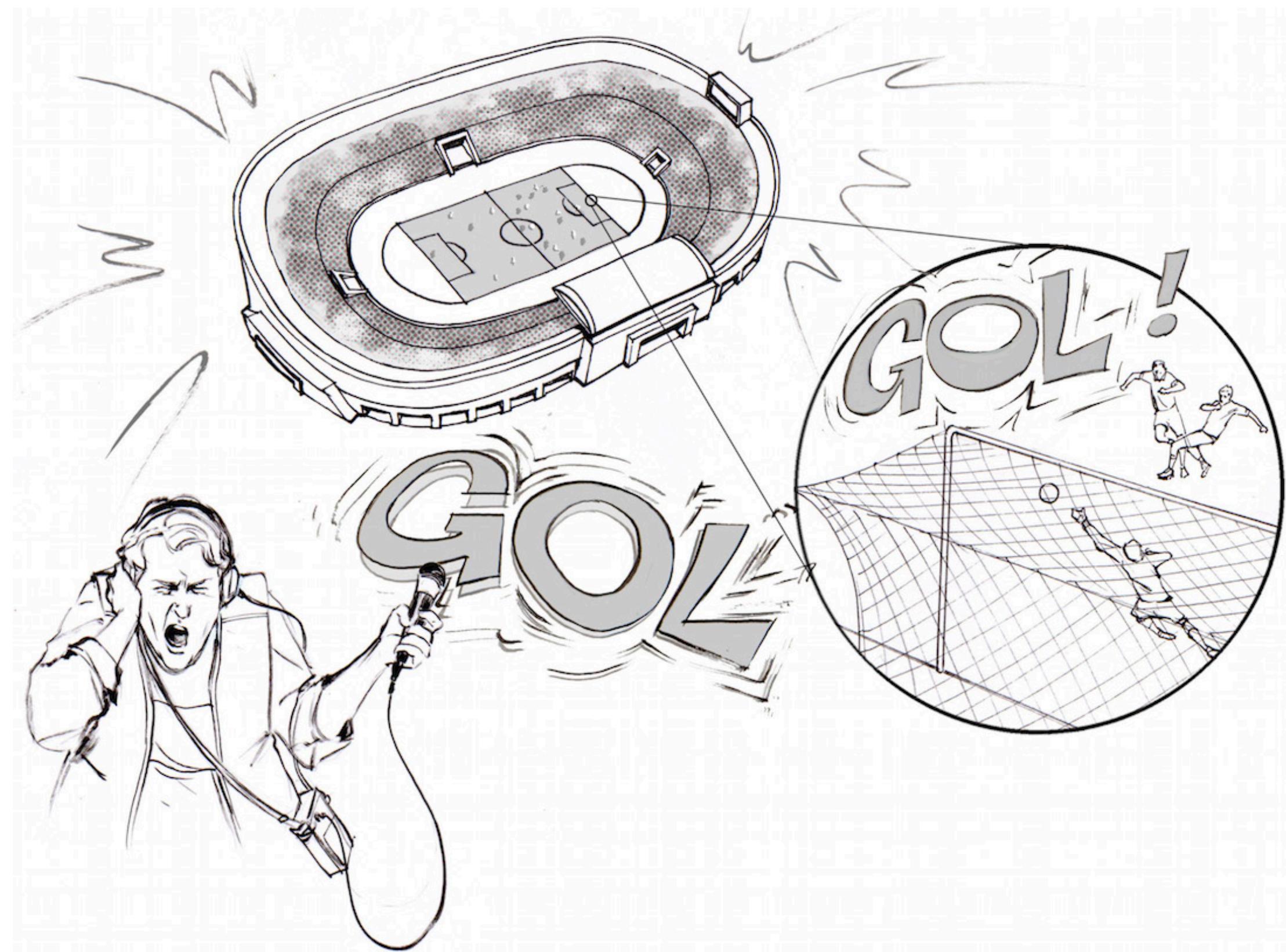


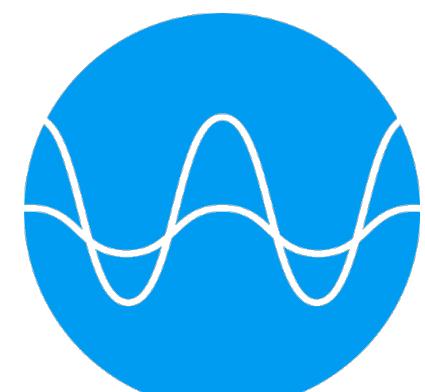
# BCI Paradigms

Induced



Evoked





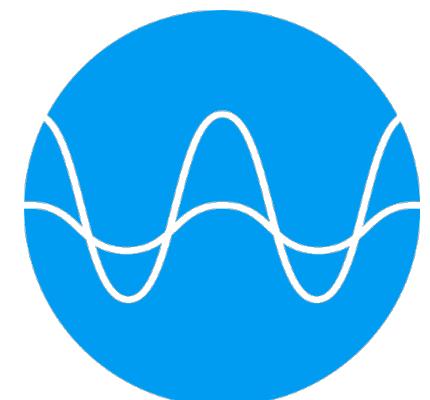
# BCI Paradigms

Passive

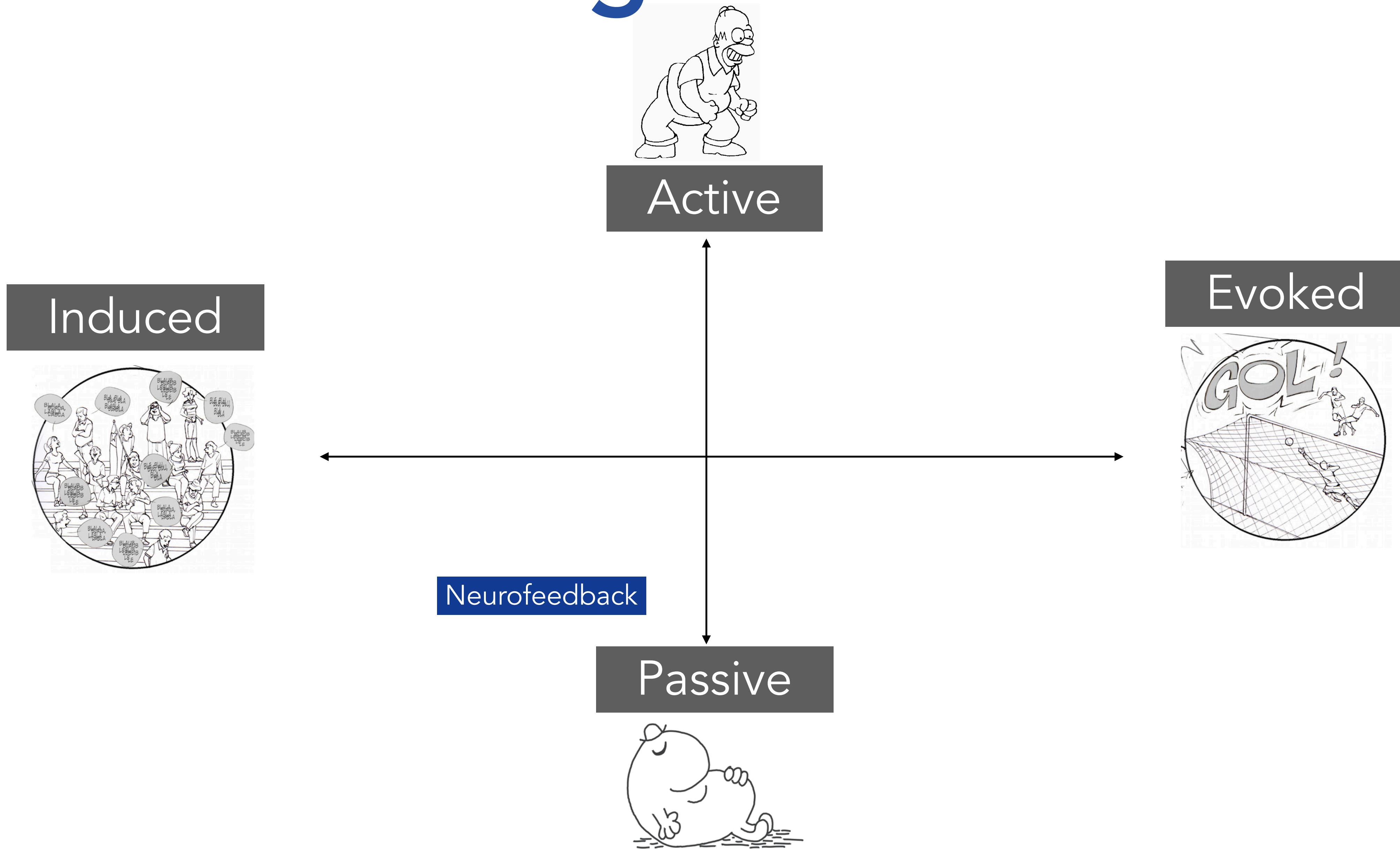


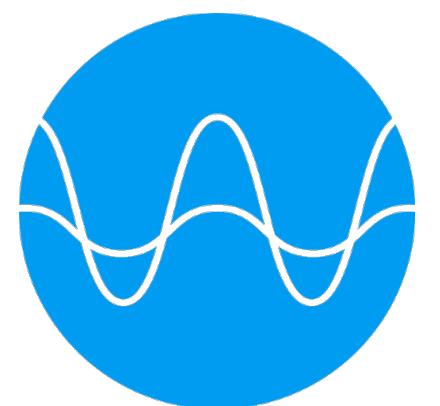
Active





# BCI Paradigms





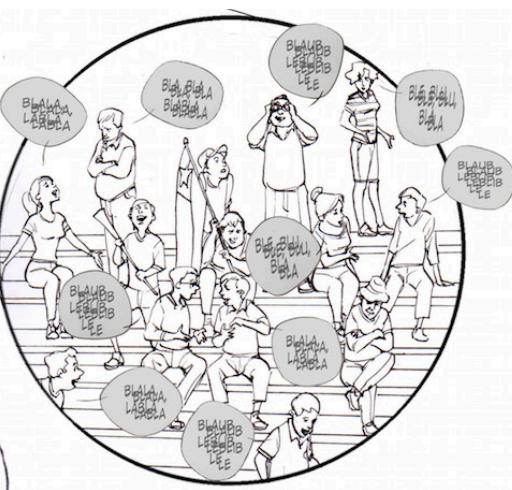
# BCI Paradigms

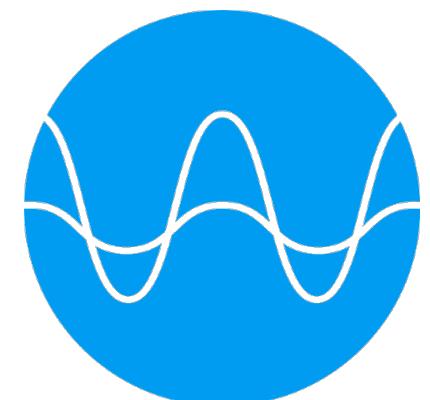
## Neurofeedback



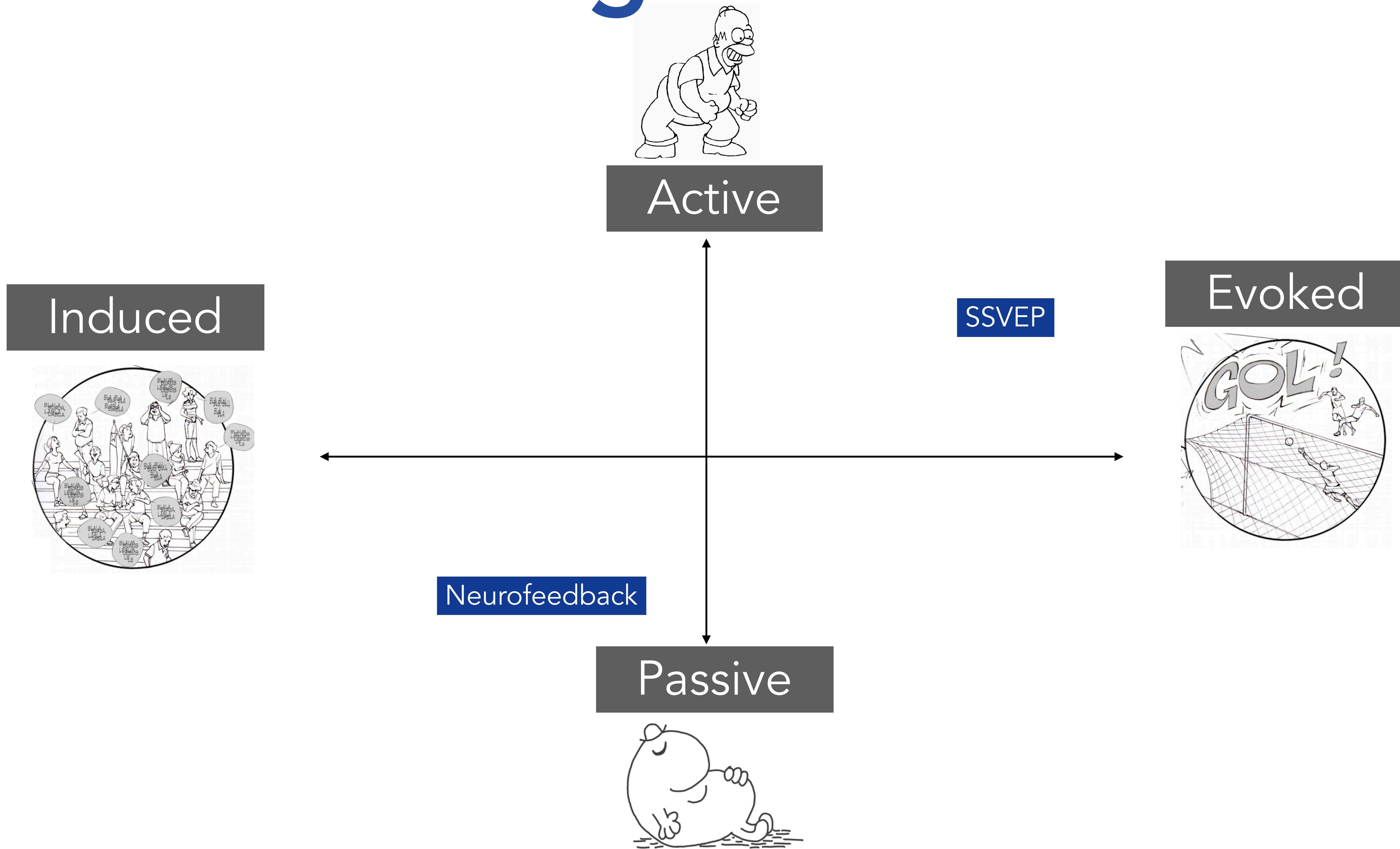
Passive

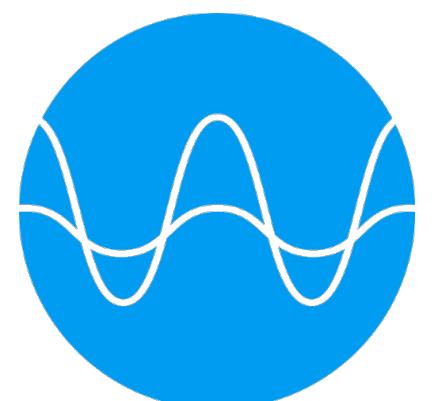
Induced





# BCI Paradigms





# BCI Paradigms

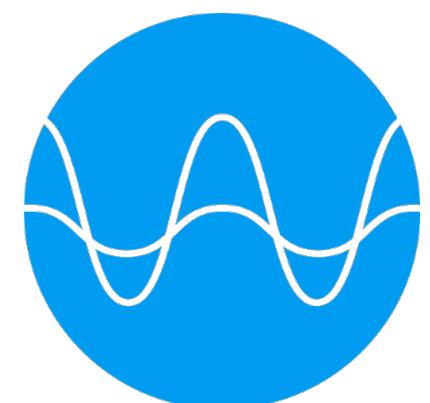
## SSVEP

Active

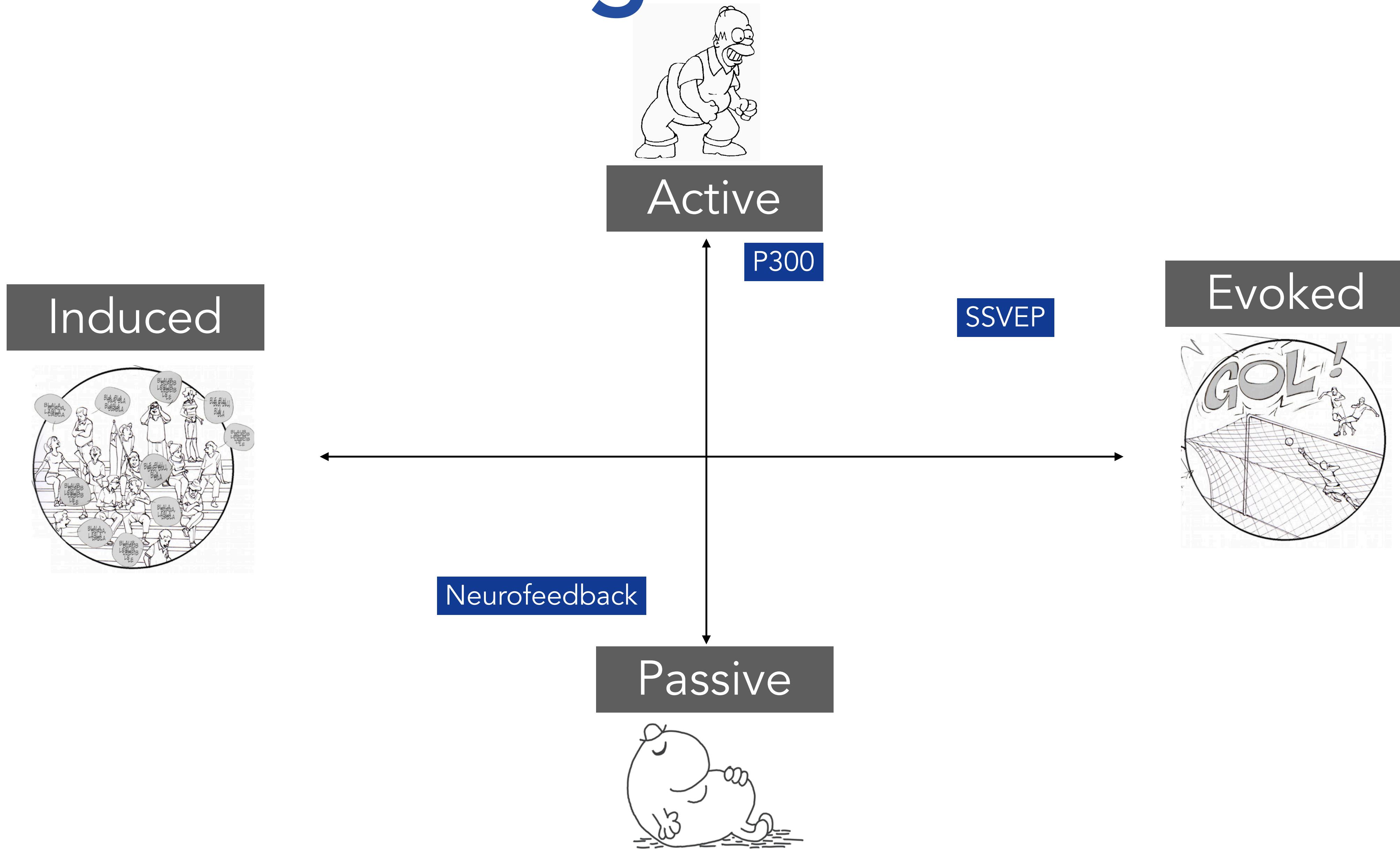
Evoked

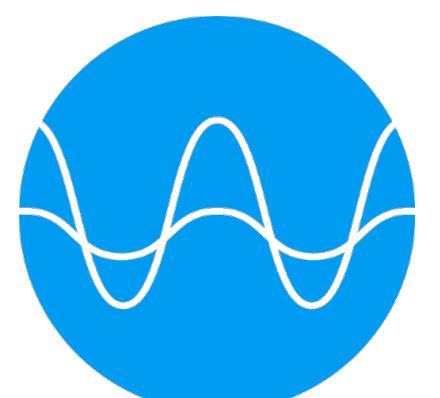


The screenshot shows a web browser window titled "Mind Player" with the URL "localhost:8000/flicker/". The main content area displays a video player interface. On the left, there is a large white play button with a blue border and a double arrow icon. In the center, there is a small video thumbnail showing a circular pattern of colored pencils. Below the thumbnail, the text "Interconnection" is visible. To the right of the thumbnail, the title "Sweet Confusion" is displayed in bold white text. Underneath the title, the subtitle "Salt Peanuts – Interconnection" is shown. At the bottom of the video player, there is a control bar with a double arrow icon, the time "2:50 / 3:41", a volume icon, and a settings icon. On the far right, there is a smaller white play button with a blue border and a double arrow icon.



# BCI Paradigms



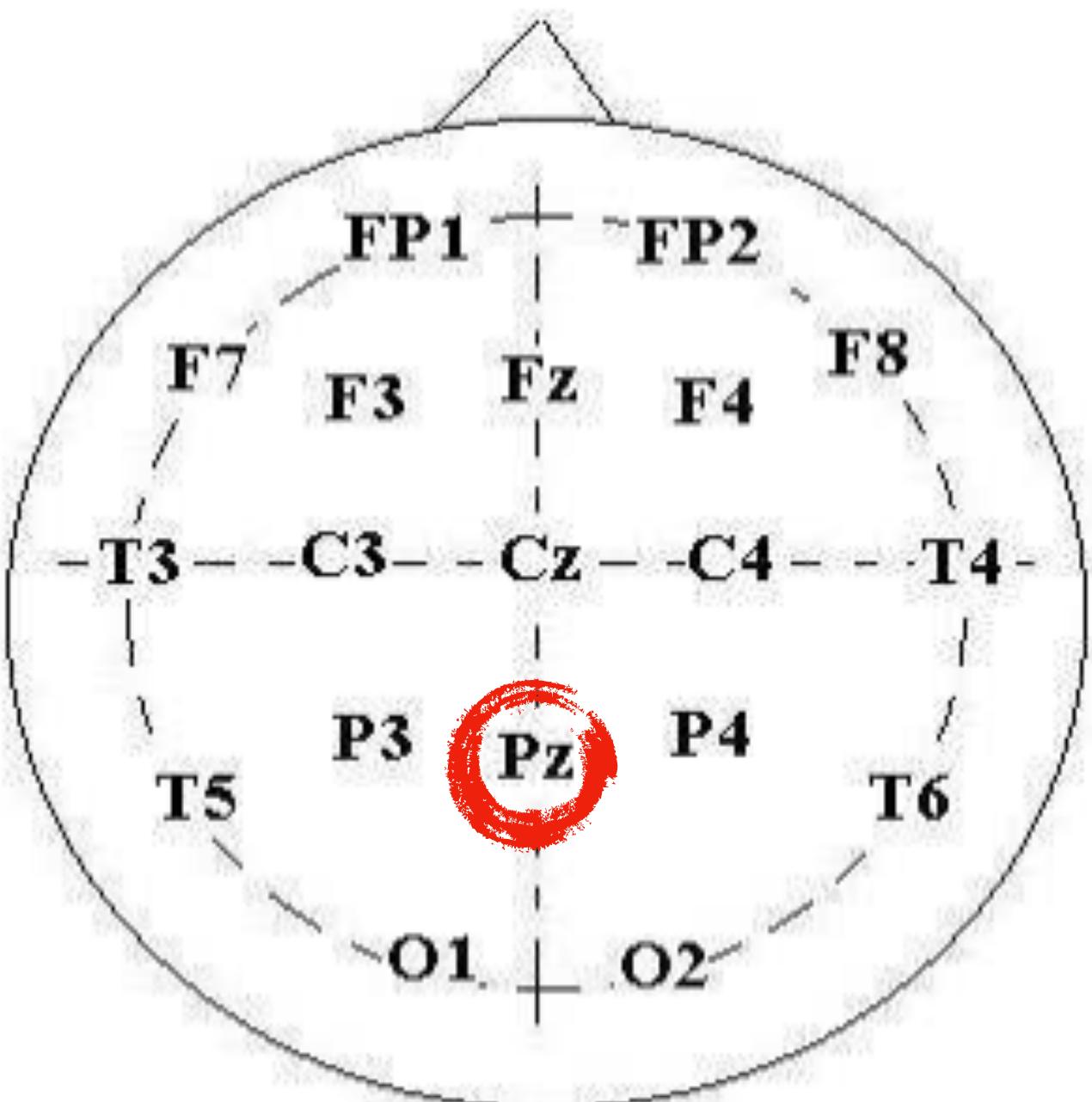


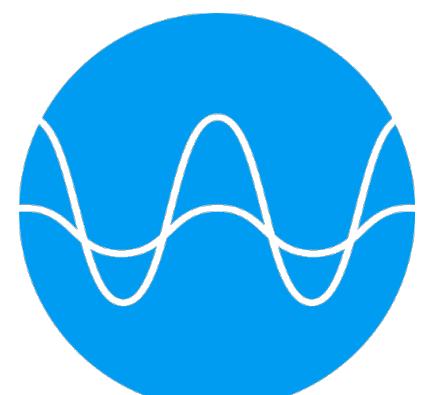
# BCI Paradigms

## P300 Speller

Active

Evoked



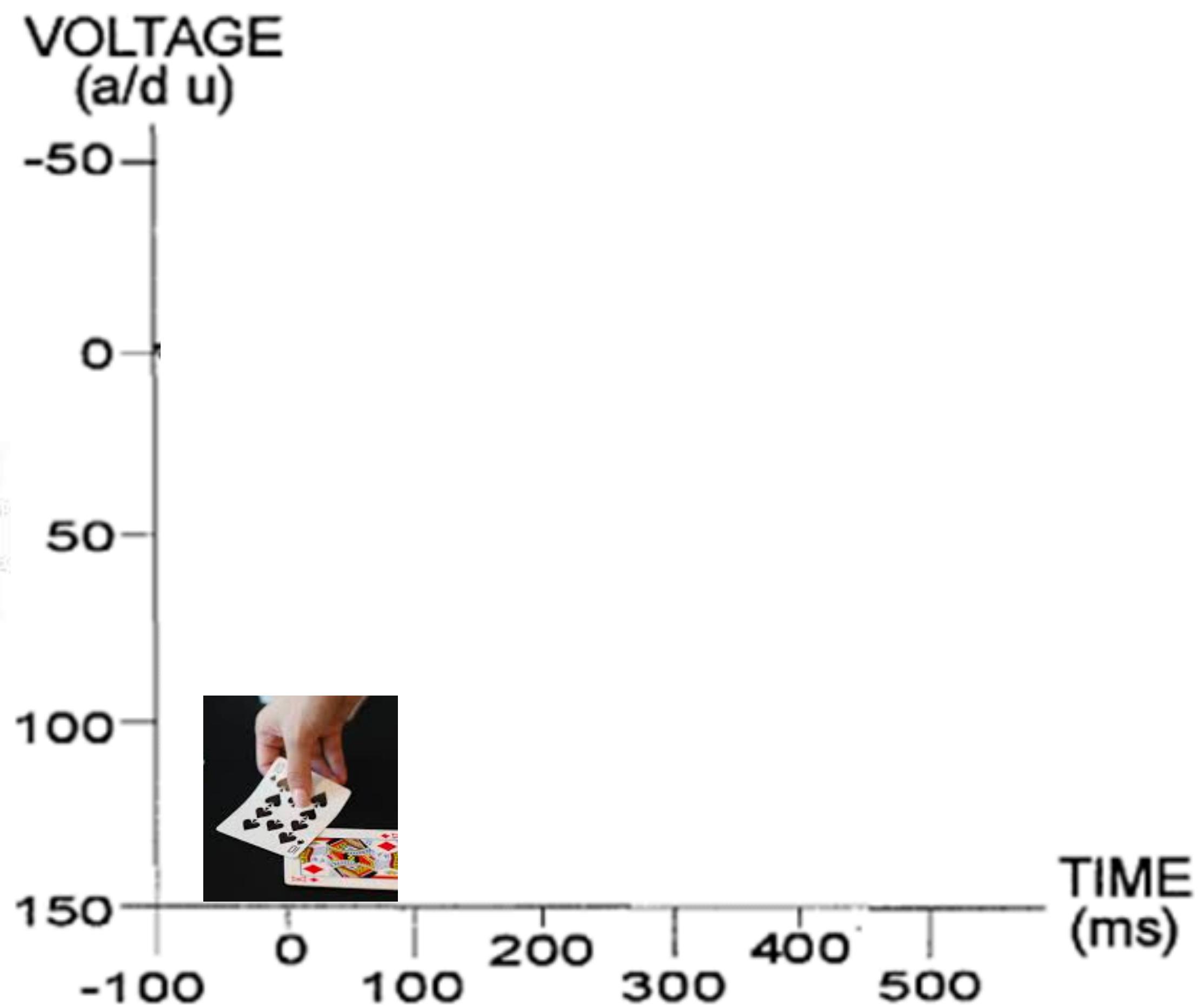
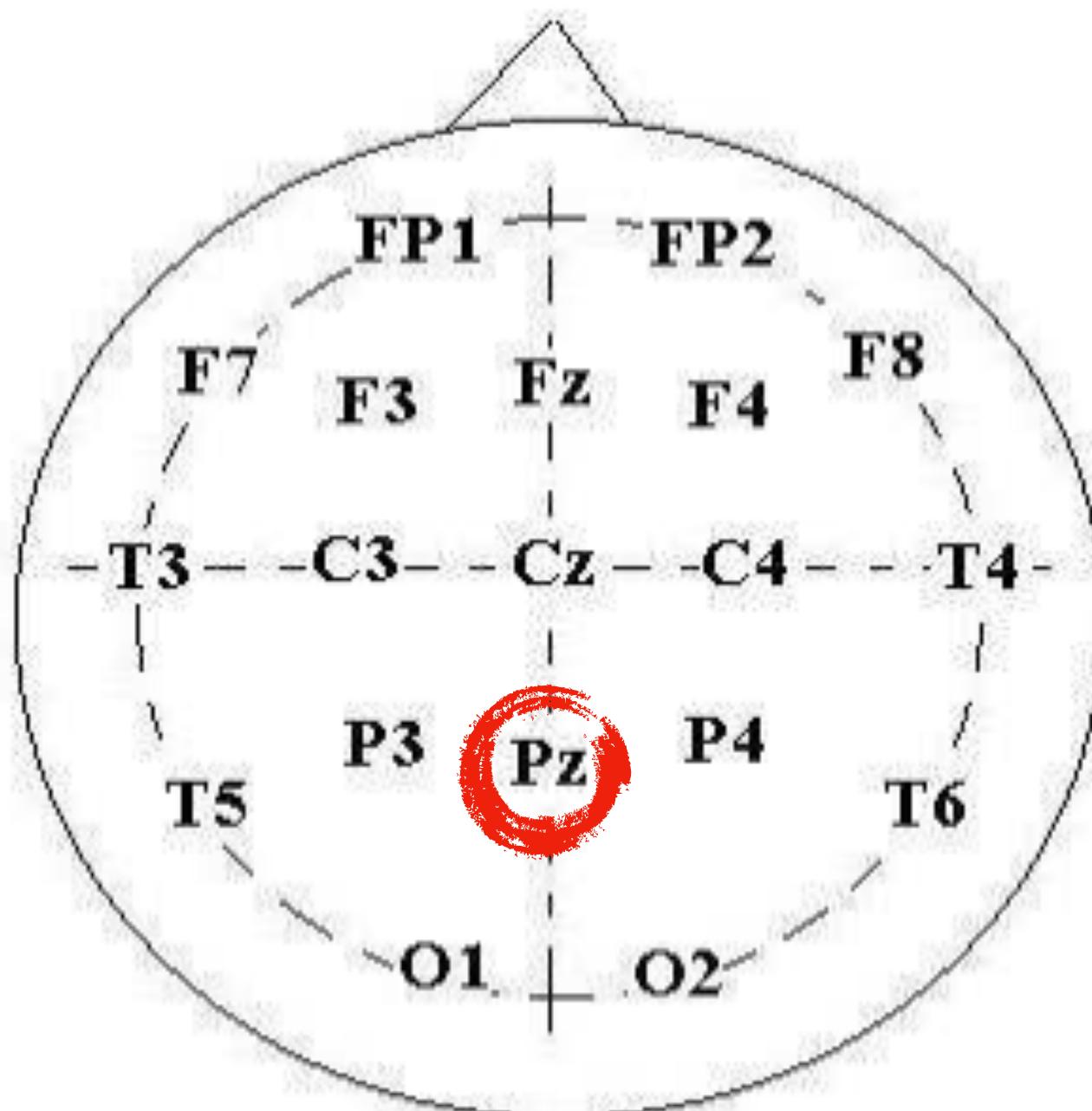


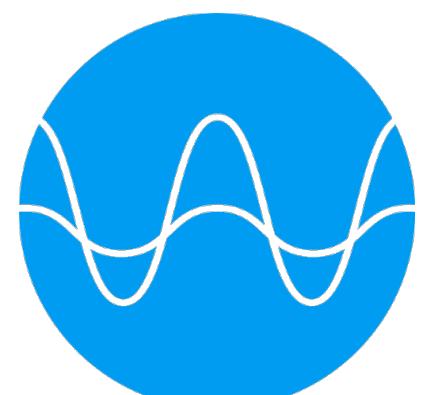
# BCI Paradigms

Active

Evoked

## P300 Speller



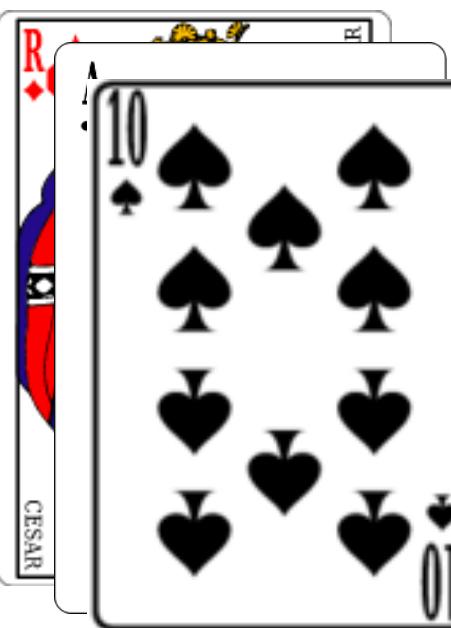
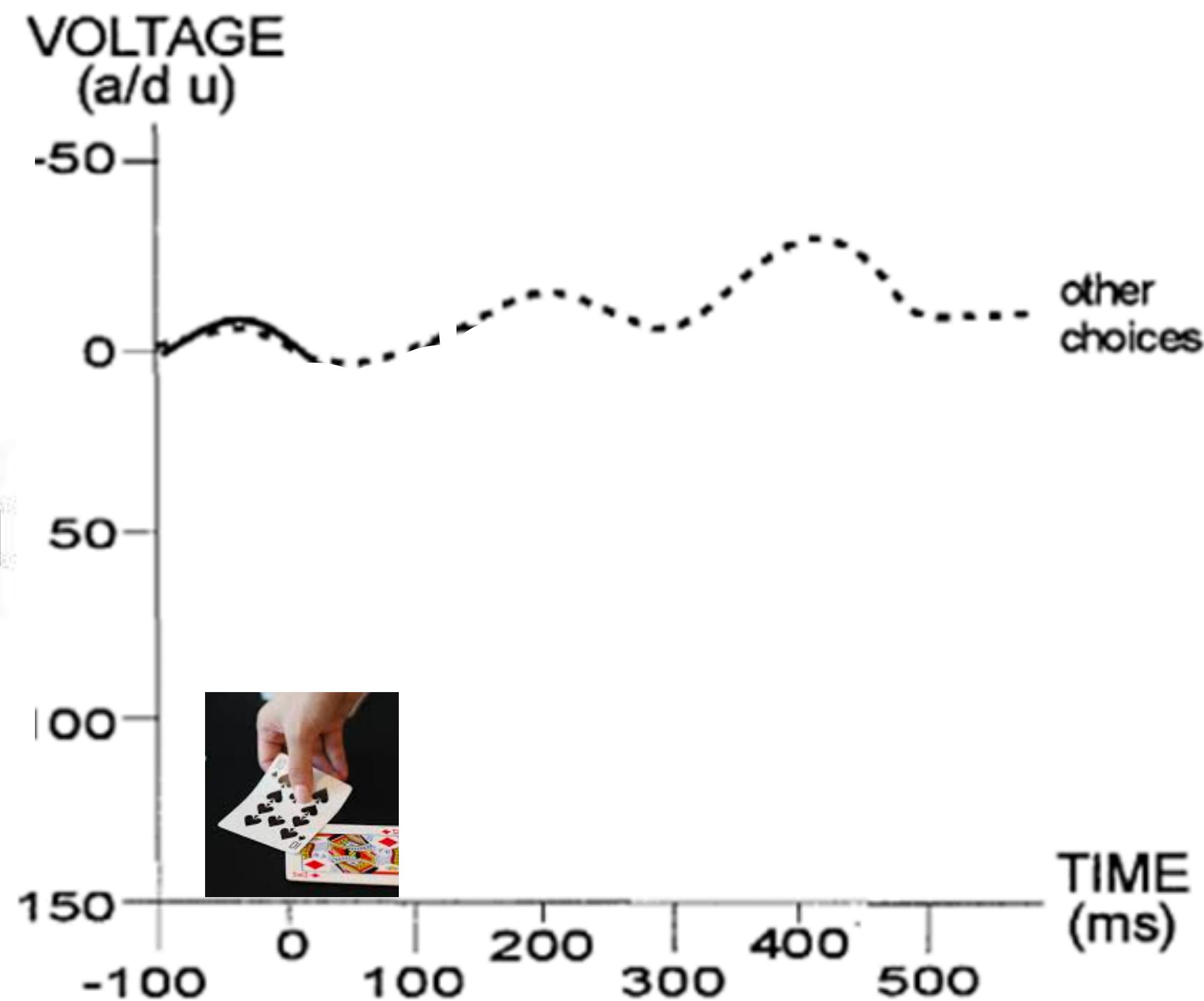
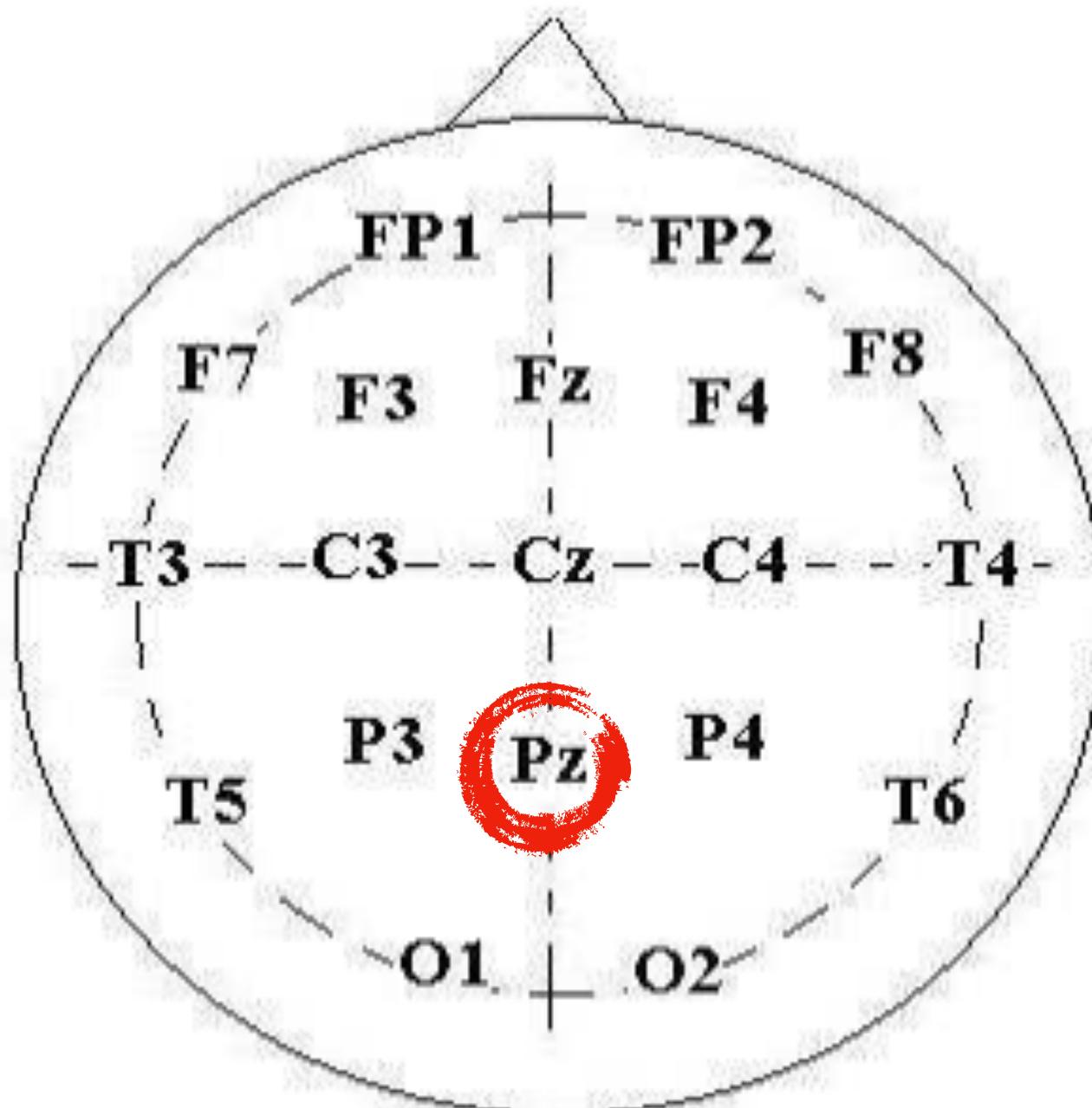


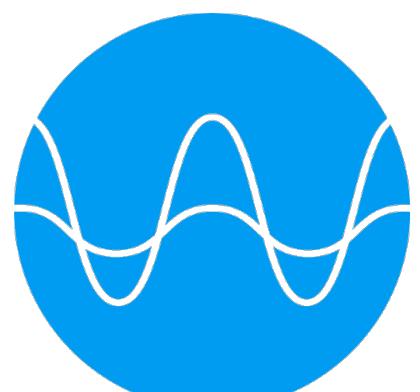
# BCI Paradigms

## P300 Speller

Active

Evoked



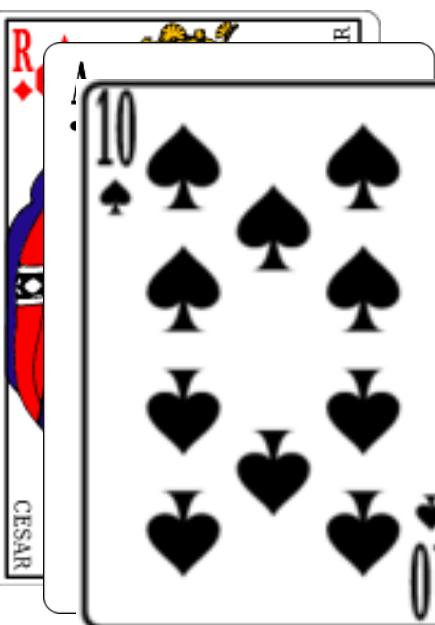
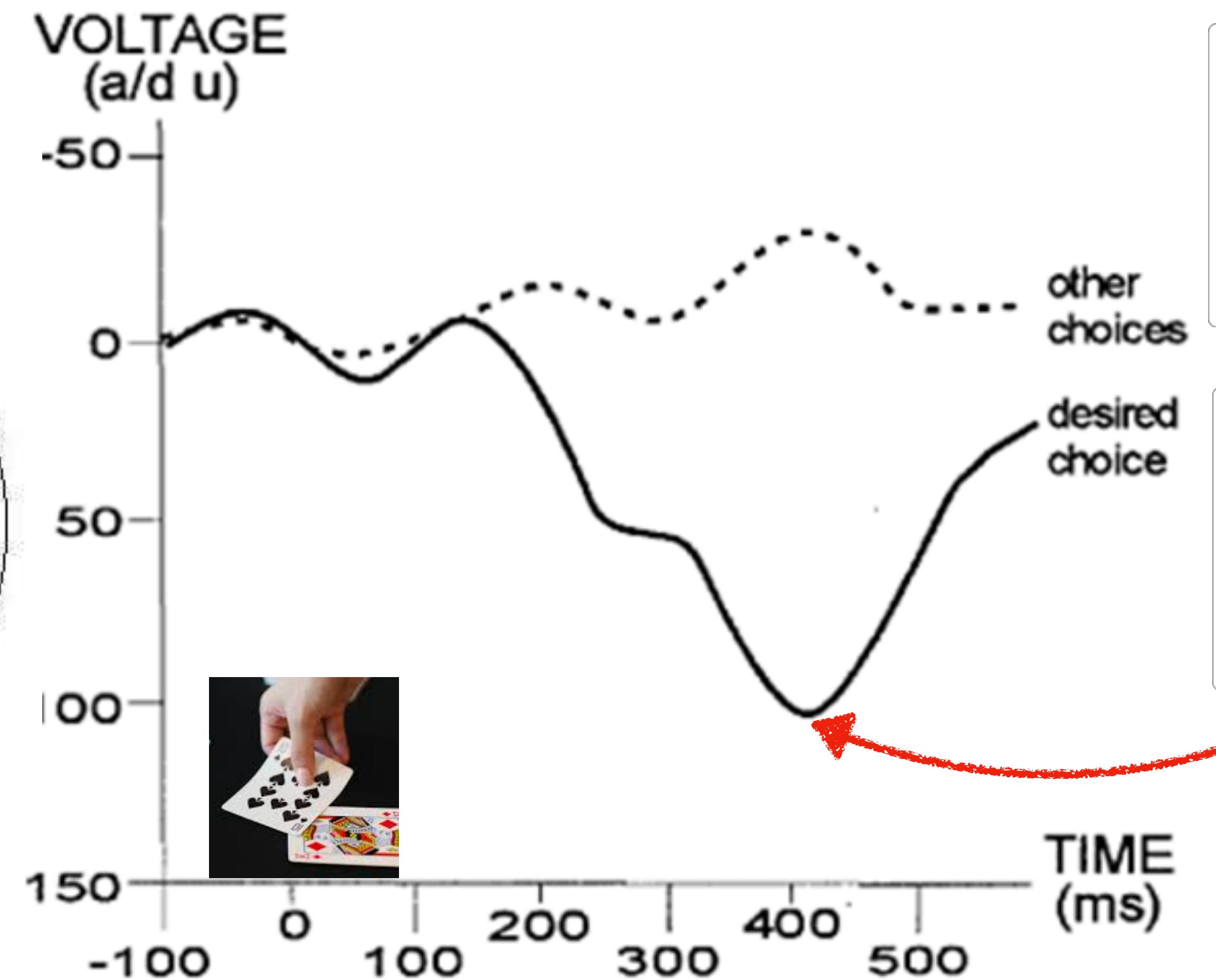
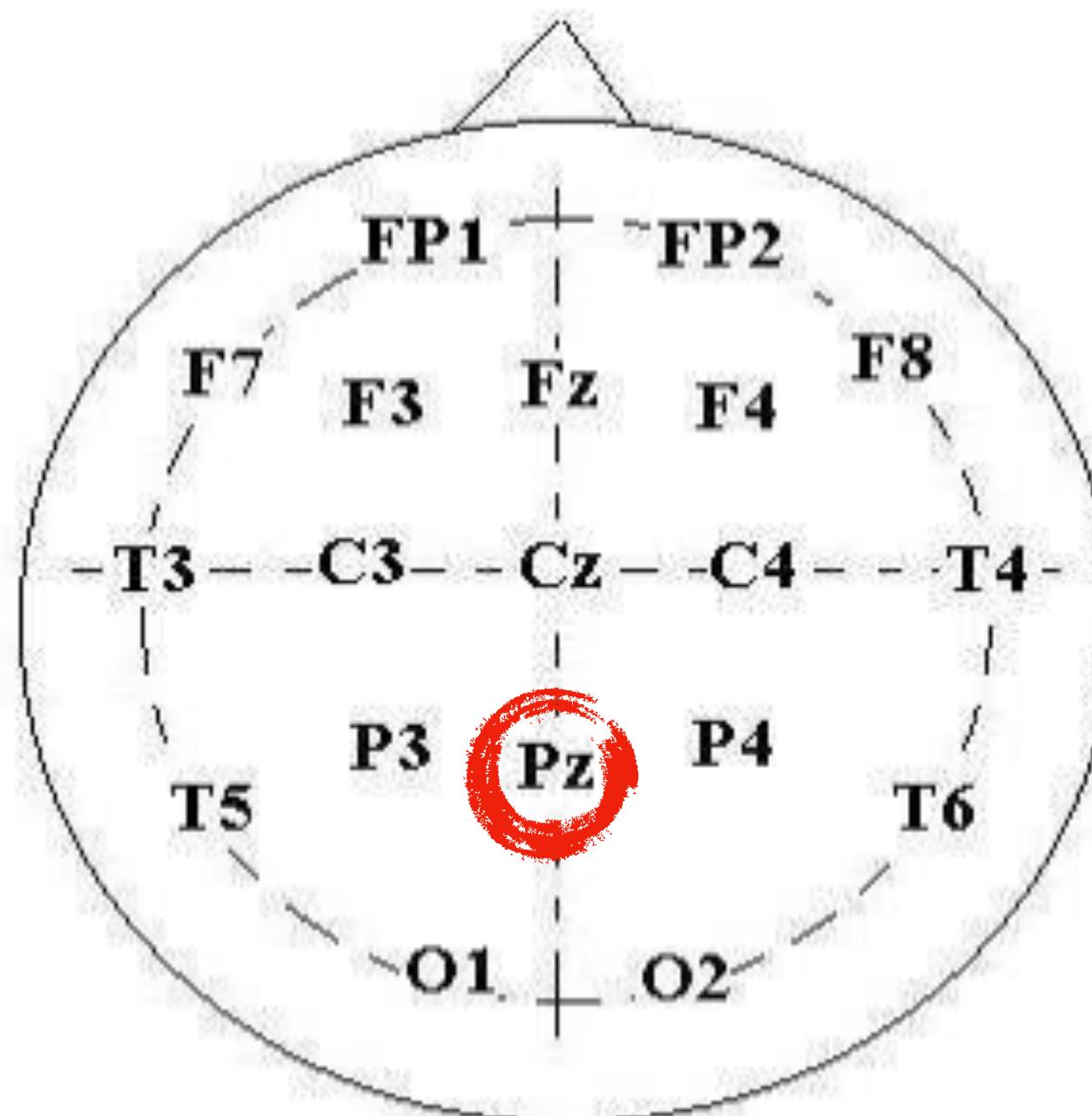


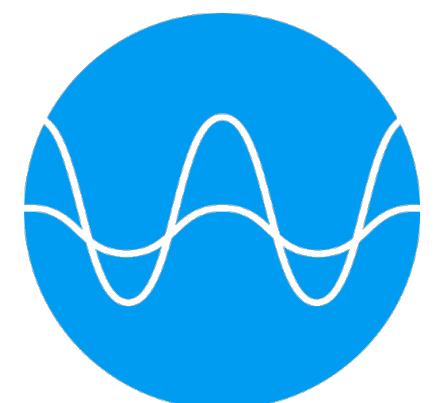
# BCI Paradigms

## P300 Speller

Active

Evoked



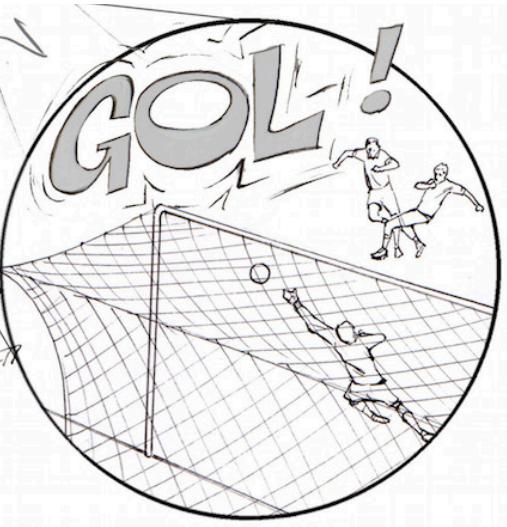


Active

Evoked

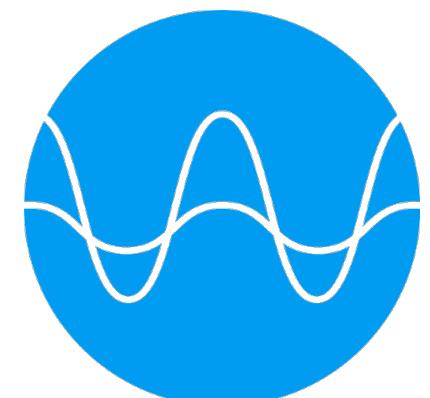
# BCI Paradigms

## P300 Speller

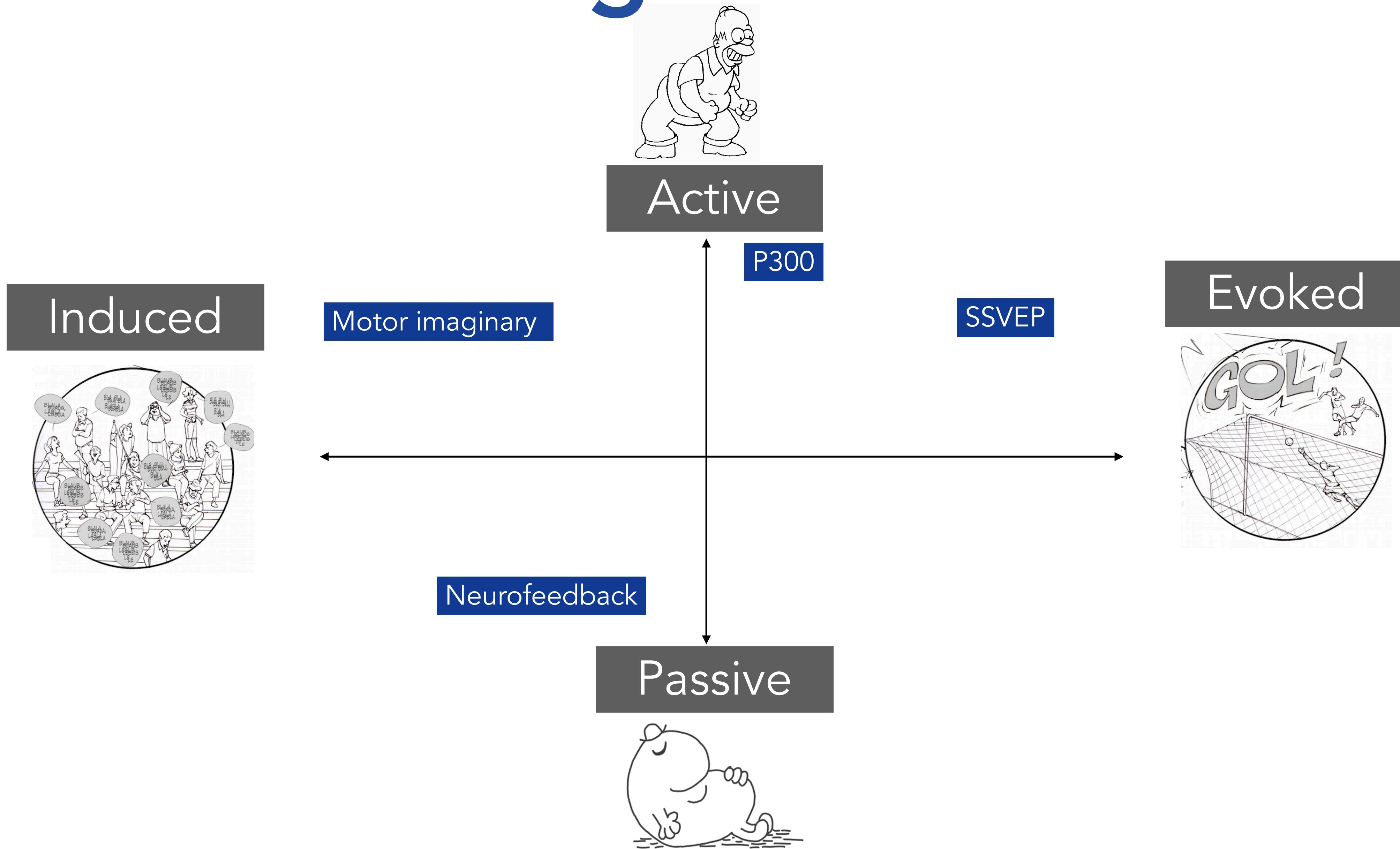


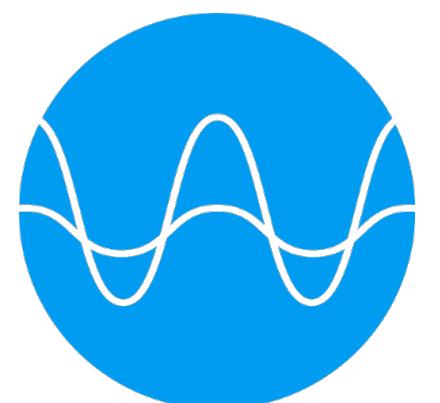
Screenshot of a P300 Speller interface in a web browser (localhost:8000/speller/). The interface displays a 6x6 grid of letters and numbers used for spelling words. The letters are arranged in two rows of three columns each. The first row contains A, B, C, D, E, and F. The second row contains G, H, I, J, K, and L. The third row contains M, N, O, P, Q, and R. The fourth row contains S, T, U, V, W, and X. The fifth row contains Y, Z, 1, 2, 3, and 4. The bottom row contains 5, 6, 7, 8, 9, and 0. A 'Calibration' button is located in the bottom right corner.

A	B	C	D	E	F
G	H	I	J	K	L
M	N	O	P	Q	R
S	T	U	V	W	X
Y	Z	1	2	3	4
5	6	7	8	9	0



# BCI Paradigms



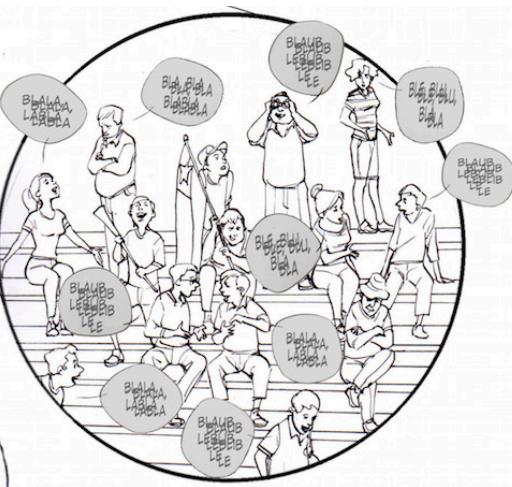


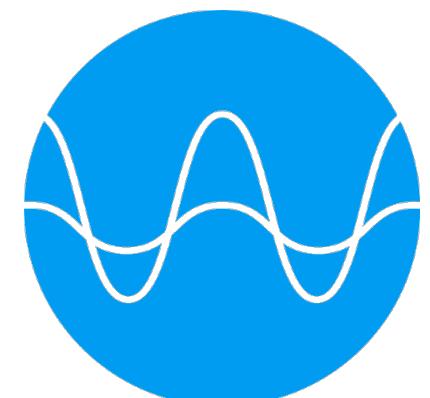
# BCI Paradigms

Active

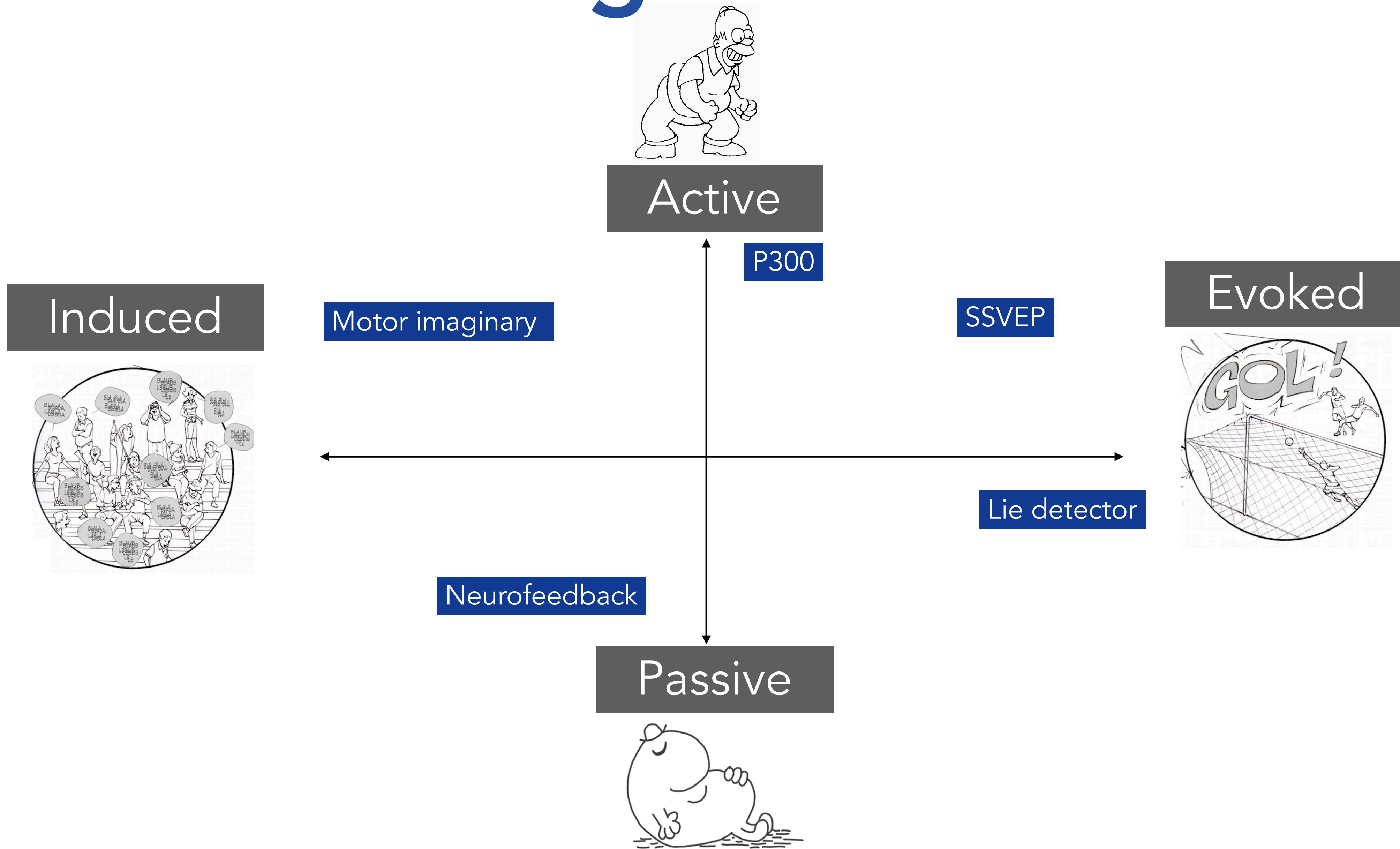
Induced

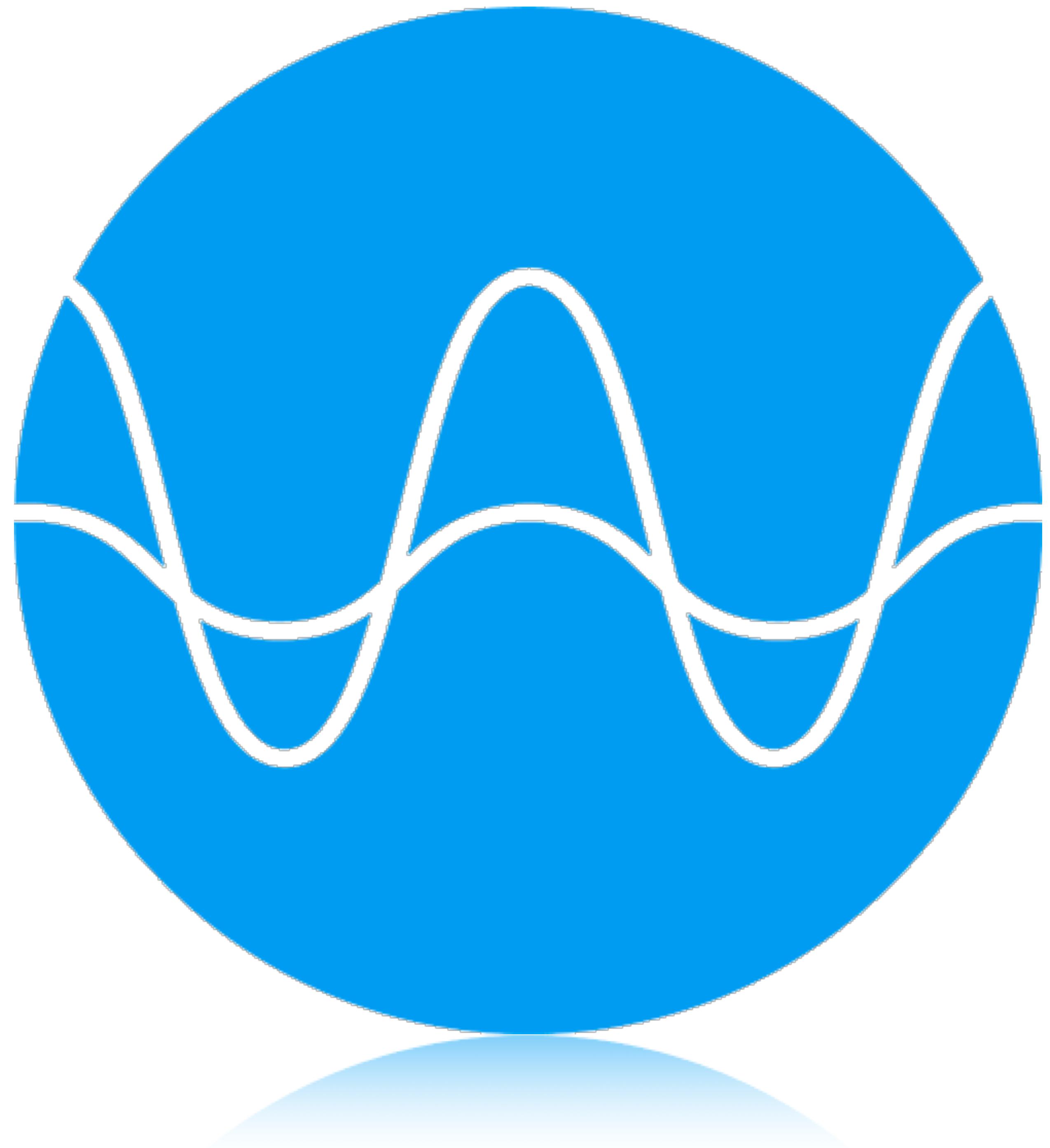
## Motor imaginary





# BCI Paradigms





Thank you