

# Attivazione cerebrale nella visione

Paolo Antonino Grasso (UNIFI)

16/12  
15.00



**Light on Optics and Optometry**

*Series of scientific, technological and tutorial webinars*

*In streaming on Youtube*

Directed by  
**Giovanna Pacini**

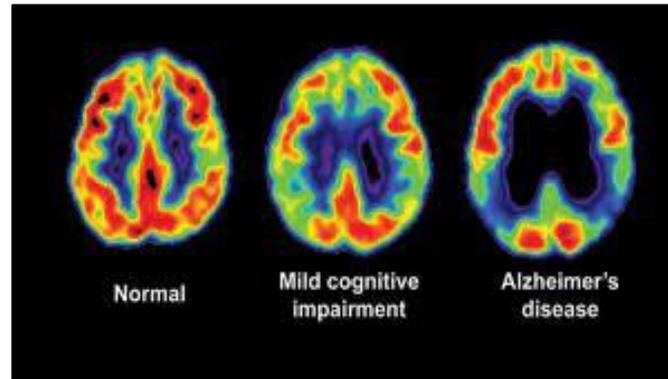


<https://www.youtube.com/user/caffescienza>

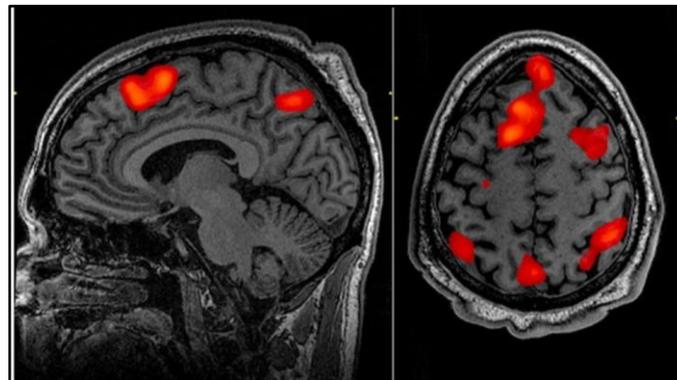
# Metodiche di registrazione dell'attività cerebrale

## Metodiche indirette

### PET (Tomografia a Emissione di Positroni)



### fMRI (Risonanza Magnetica Funzionale)



## Metodiche dirette

### EEG (Elettroencefalografia)

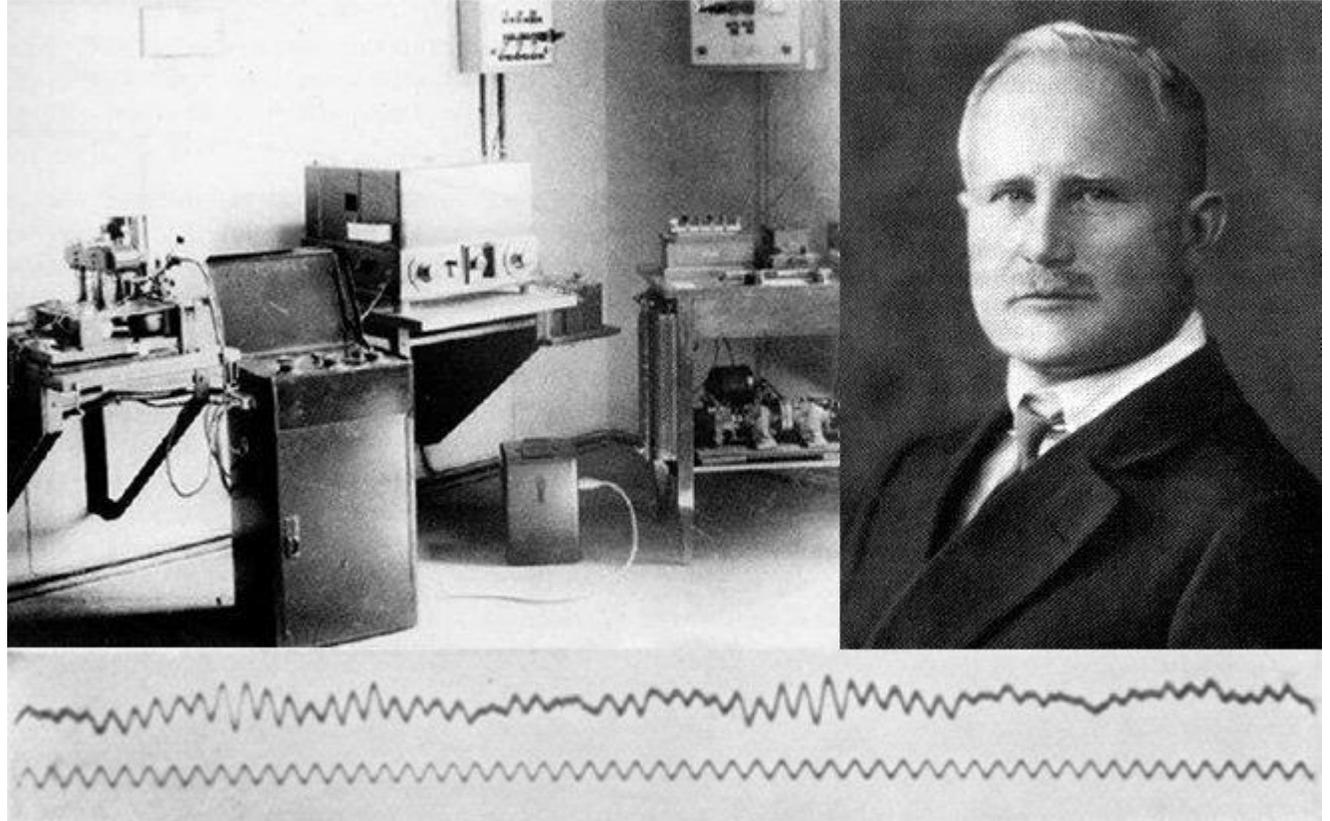


### MEG (Magnetoencefalografia)



## Un po' di storia e curiosità

**Hans Berger** (1929) first showed that the electrical activity of the human brain could be measured by placing an electrode on the scalp, amplifying the signal, and plotting the changes in voltage over time



*«E' stato un caso di telepatia spontanea, in cui in un momento di pericolo mortale, e come ho contemplato la morte certa, ho trasmesso i miei pensieri, mentre mia sorella, che è stato particolarmente vicino a me, ha agito come il ricevitore.»*

# Un po' di storia e curiosità

## Über das Elektrenkephalogramm des Menschen.

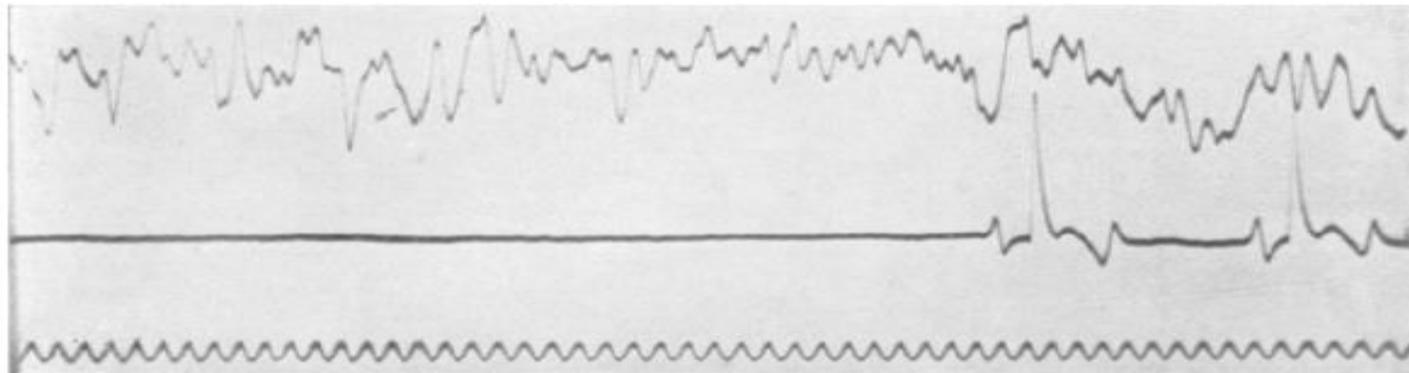
Von

Professor Dr. **Hans Berger**, Jena.

(Mit 17 Textabbildungen.)

(Eingegangen am 22. April 1929.)

Wie *Garten*<sup>1</sup>, wohl einer der besten Kenner der Elektrophysiologie, mit Recht hervorgehoben hat, wird man kaum fehlgehen, wenn man jeder lebenden Zelle tierischer und pflanzlicher Natur die Fähigkeit zuschreibt, elektrische Ströme hervorzubringen. Man bezeichnet solche Ströme als bioelektrische Ströme, weil sie die normalen Lebenserscheinungen der Zelle begleiten. Sie sind wohl zu unterscheiden von den durch Verletzungen künstlich hervorgerufenen Strömen, die man als Demarkations-, Alterations- oder Längsquerschnittsströme bezeichnet hat. Es war von vornherein zu erwarten, daß auch im Zentralnervensystem, das doch eine gewaltige Zellanhäufung darstellt, bioelektrische Erscheinungen nachweisbar seien, und in der Tat ist dieser Nachweis schon verhältnismäßig früh erbracht worden.

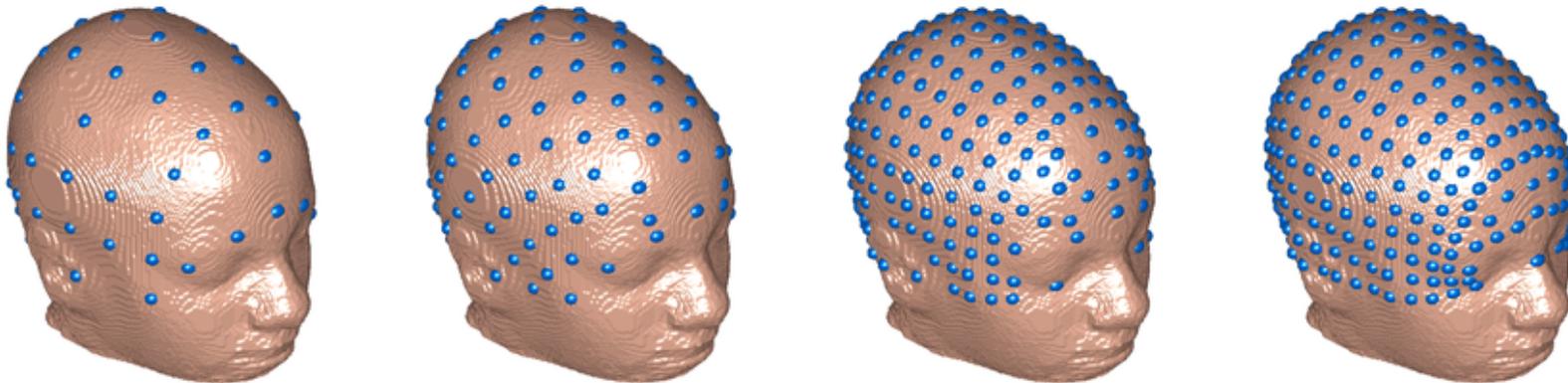
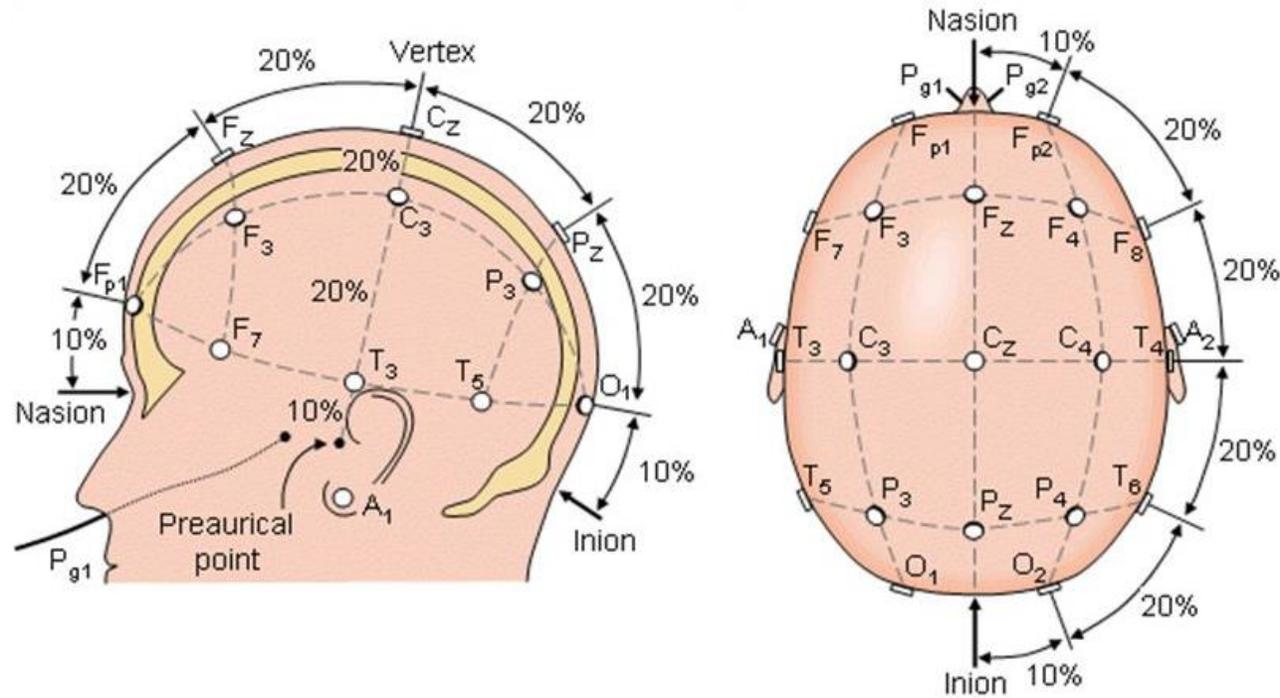


# Cos'è l'elettroencefalografia?

**Elettro - encefalo - grafia (EEG)** registrazione dell'attività elettrica dell'encefalo



# Sistema 10-20



# Sistema 10-20

## Elettrodi

Dispari: Emisfero Sinistro

Pari: Emisfero Destro

z: linea mediana

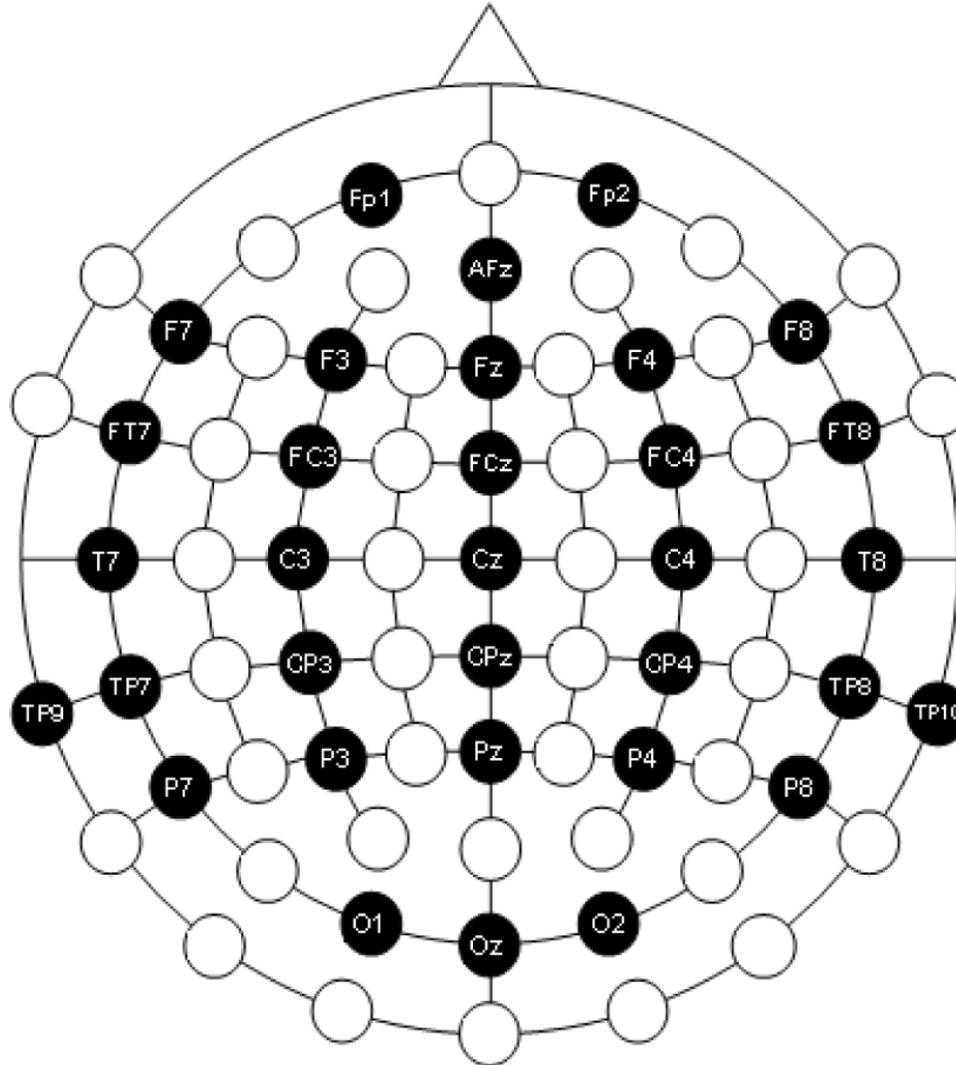
F: Frontale

C: Centrale

T: Temporale

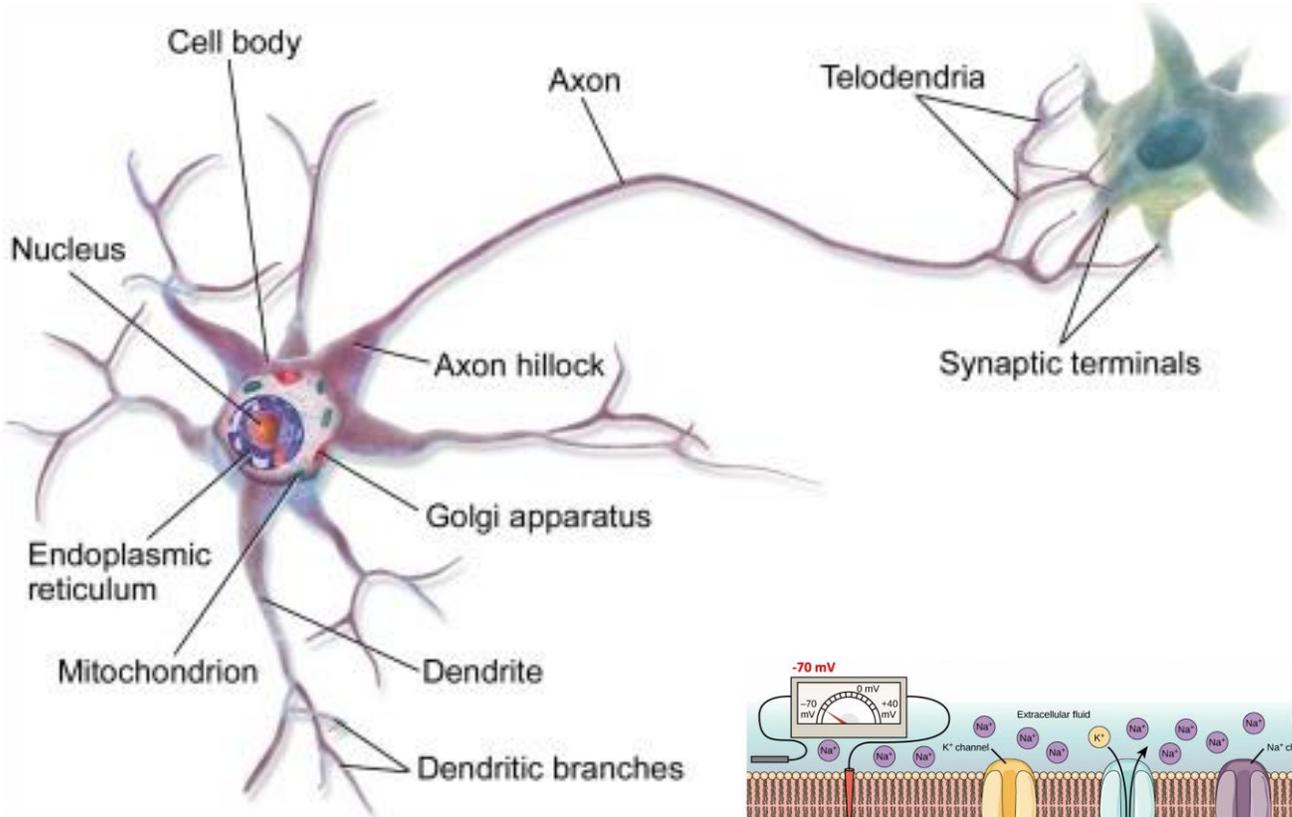
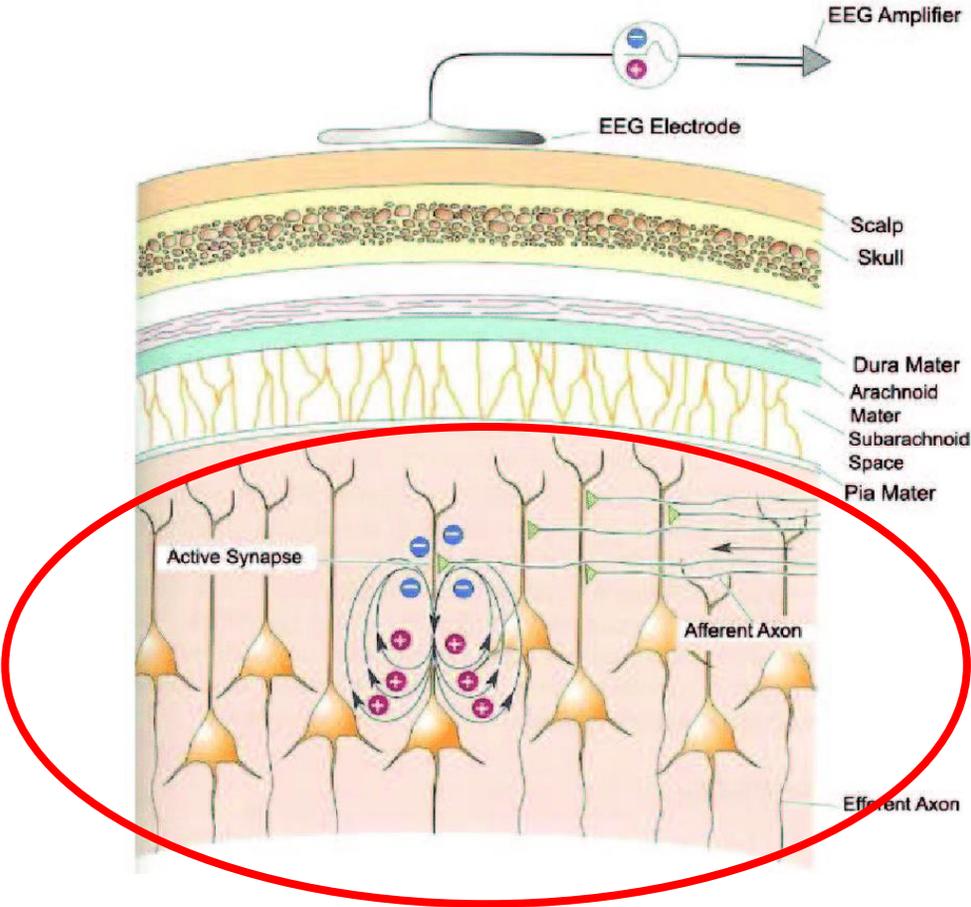
P: Parietale

O: Occipitale



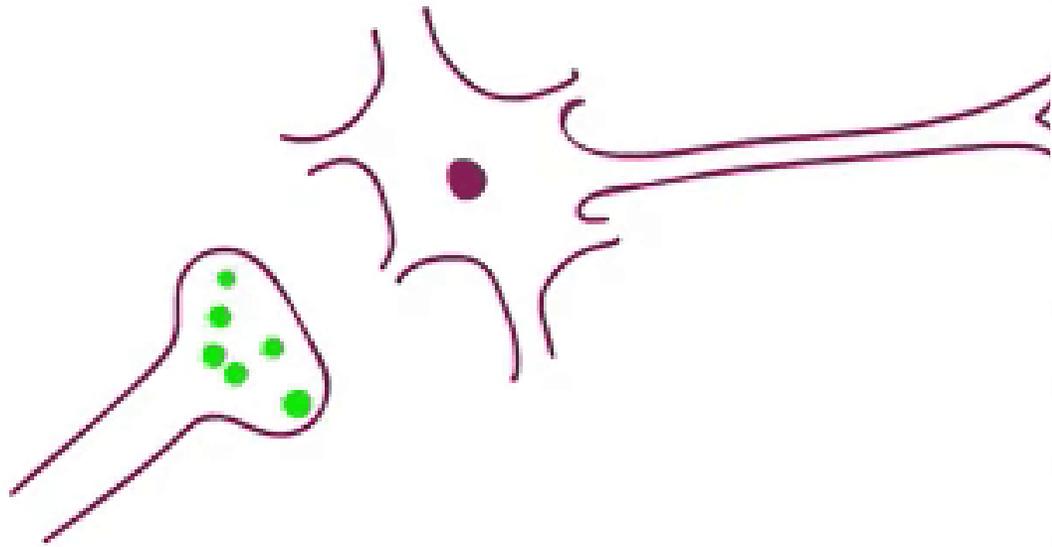
# Cosa registra l'elettroencefalogramma?

*EEG is the summation of **excitatory** and **inhibitory** post-synaptic potentials*

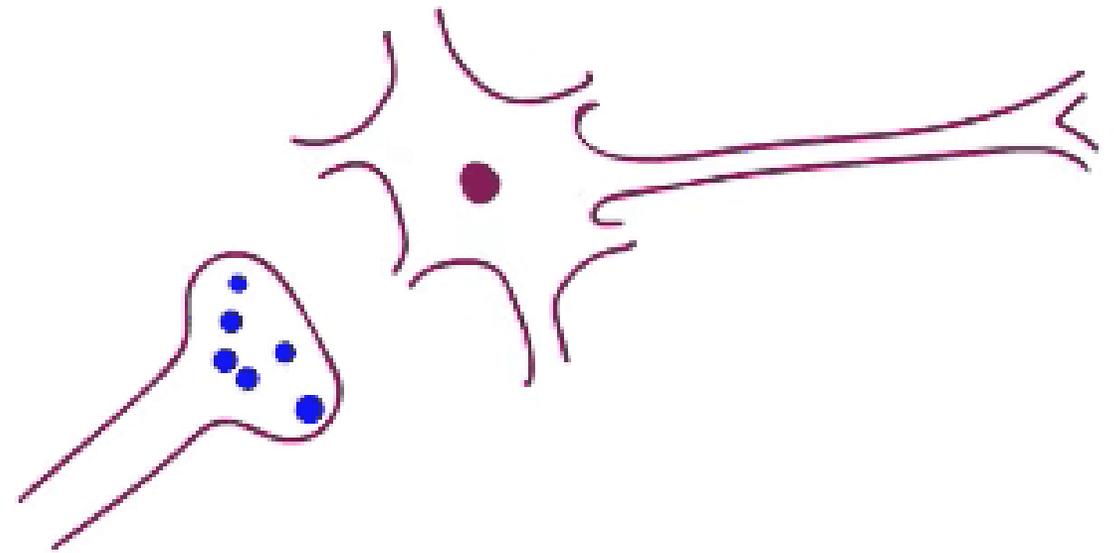


# Cosa registra l'elettroencefalogramma?

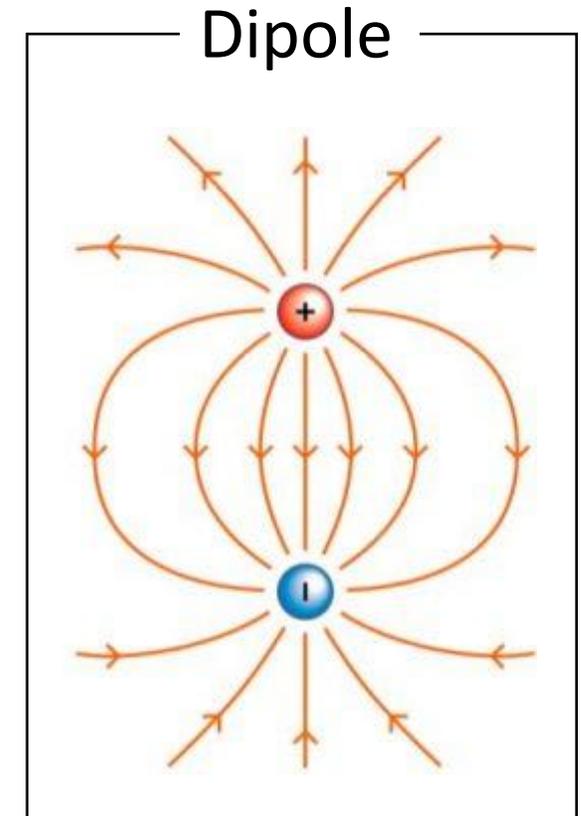
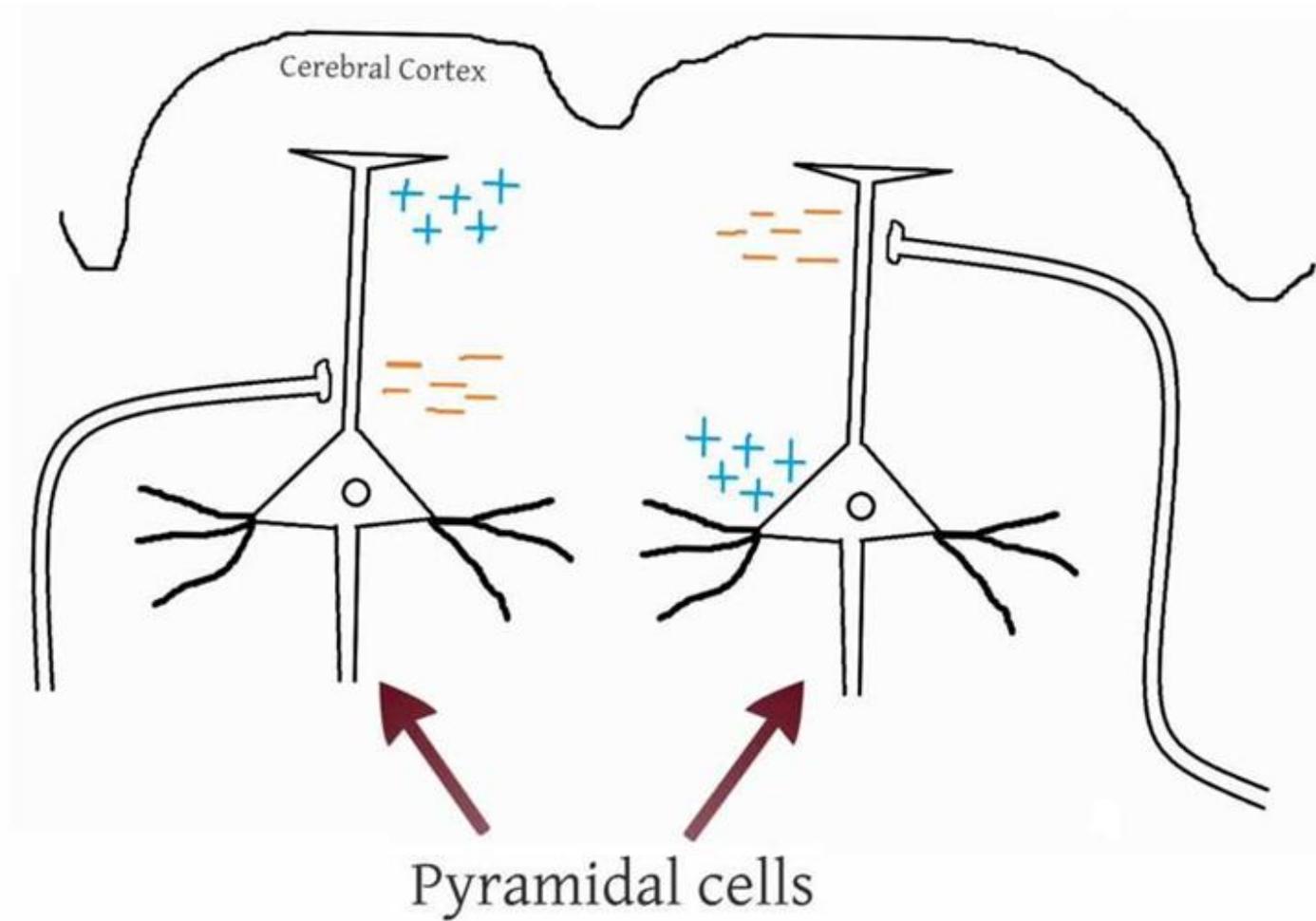
**Excitatory Post-Synaptic Potential (EPSP)**



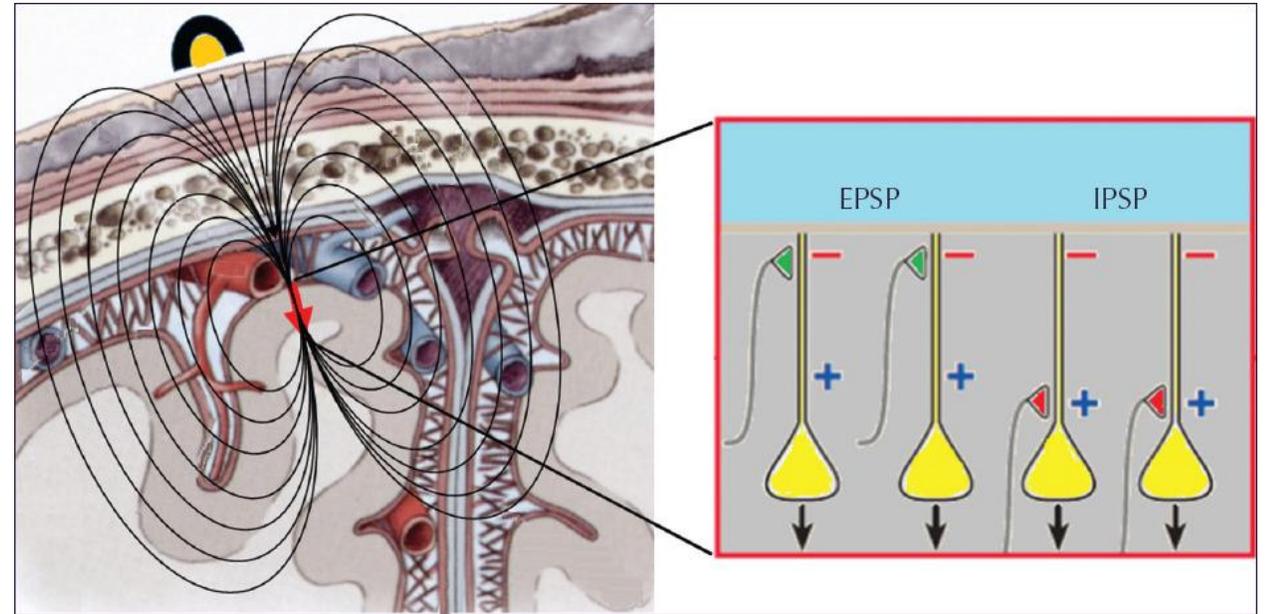
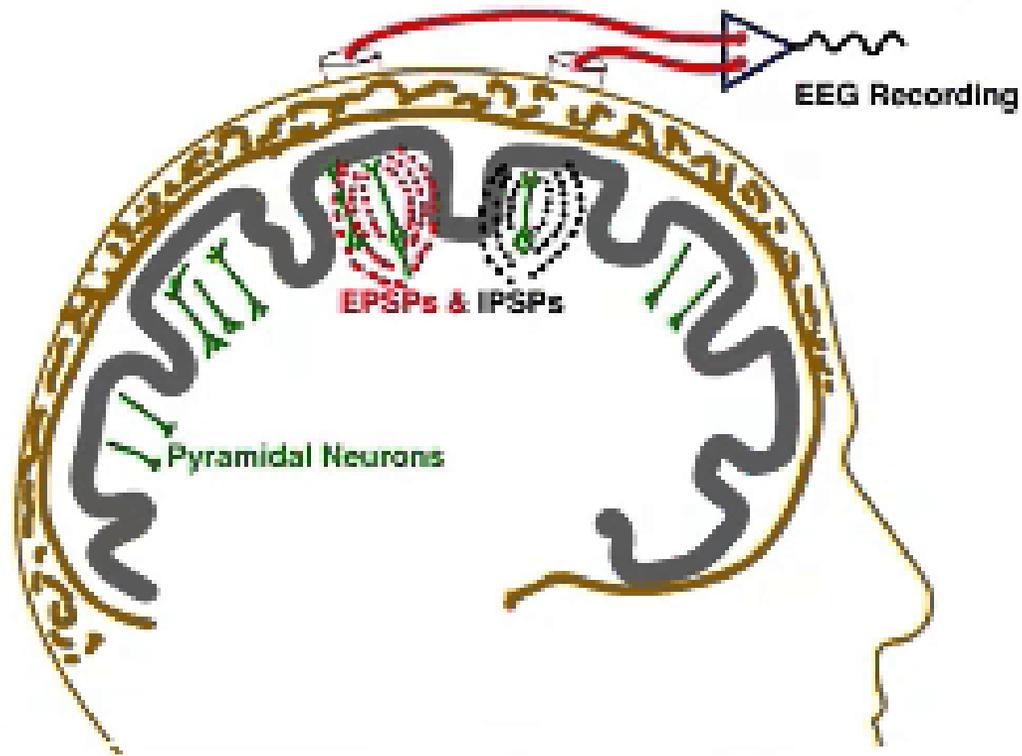
**Inhibitory Post-Synaptic Potential (IPSP)**



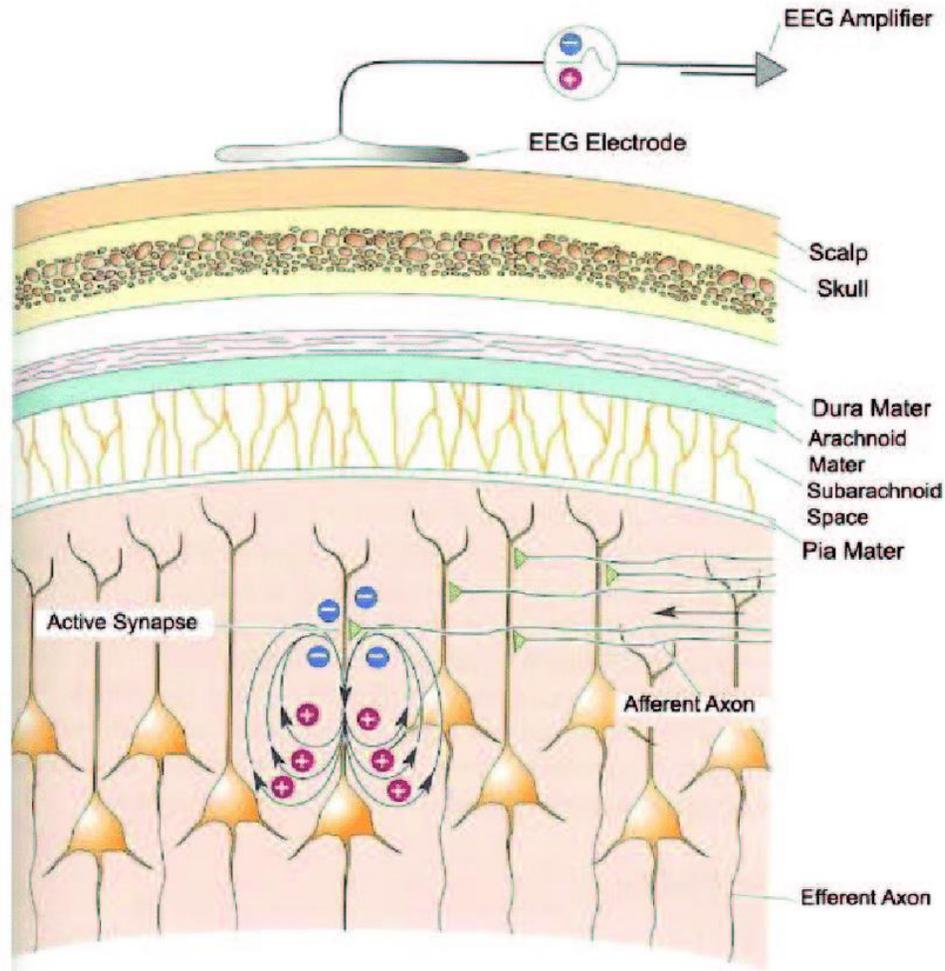
# Cosa registra l'elettroencefalogramma?



# Cosa registra l'elettroencefalogramma?



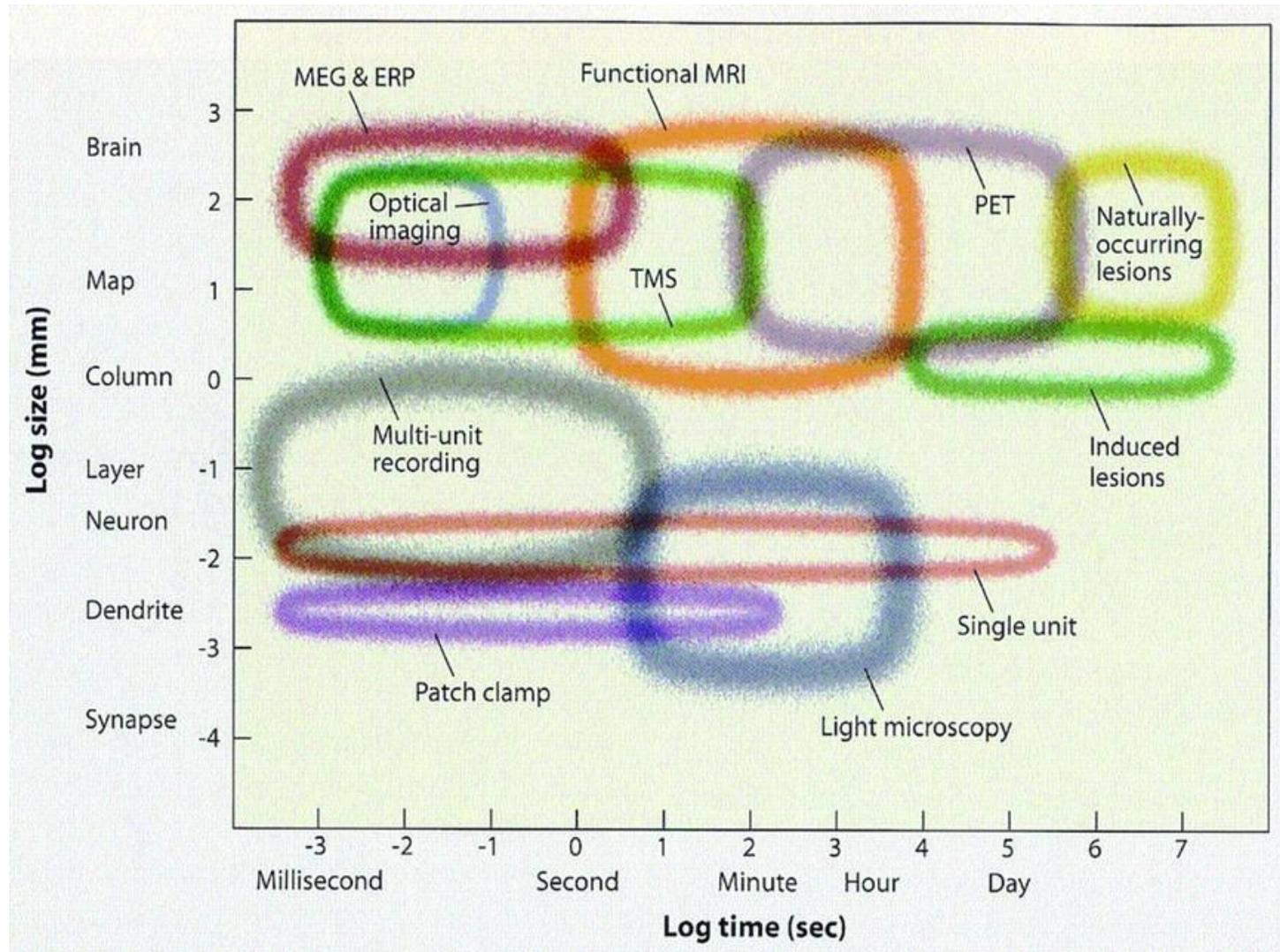
# Cosa registra l'elettroencefalogramma?



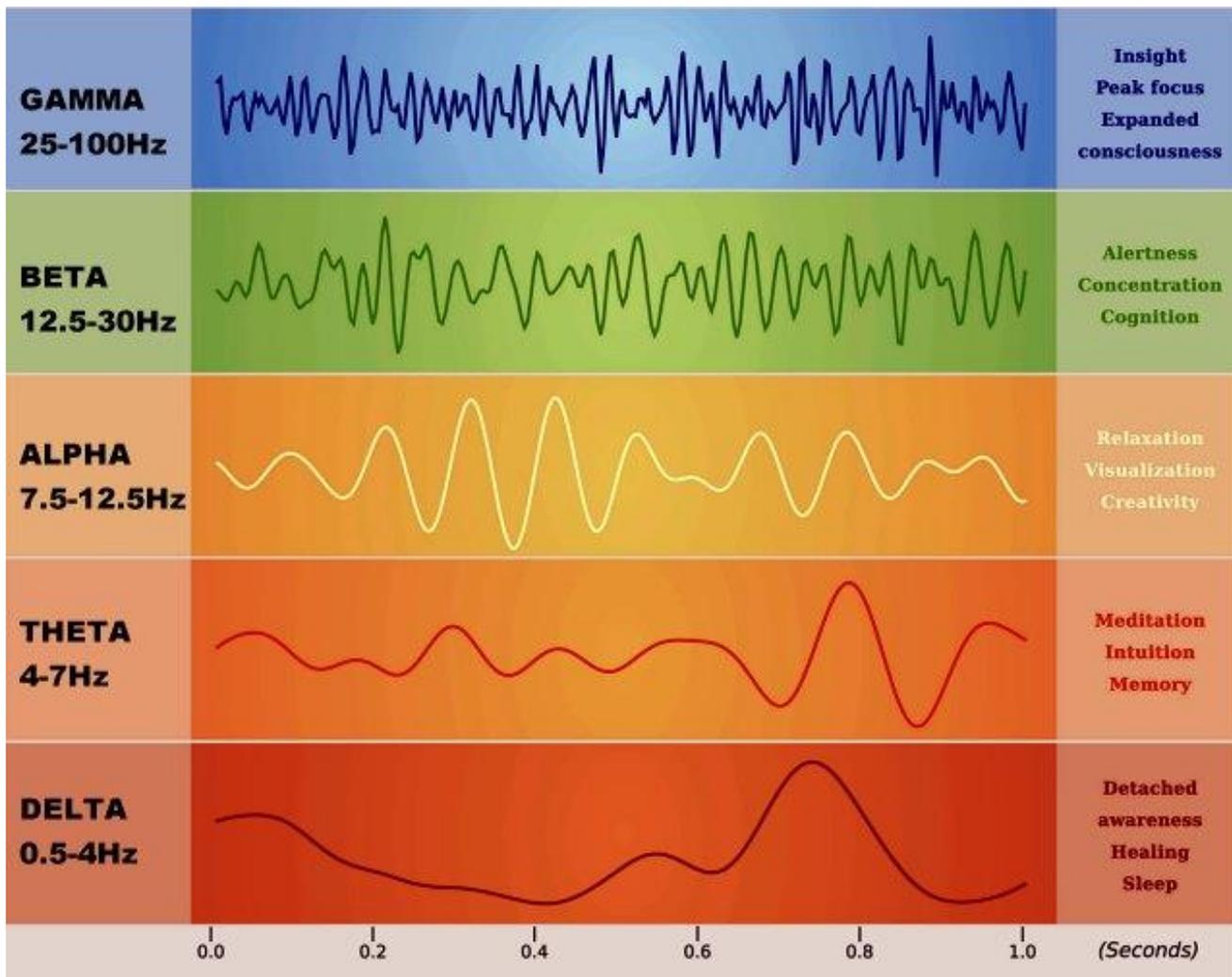
The electrical field produced by the neural activation of the pyramidal neurons travels from the cells to the scalp and decreases in voltage. Necessary conditions to detect the signal:

- **Large numbers** – large populations of pyramidal cells need to be activated
- **Timing or Synchrony** – this activation needs to occur synchronously
- **Orientation** – the orientation of the active neural population needs to be the same or the electrical fields would cancel each other out.

# Caratteristiche spaziali e temporali



# Onde cerebrali

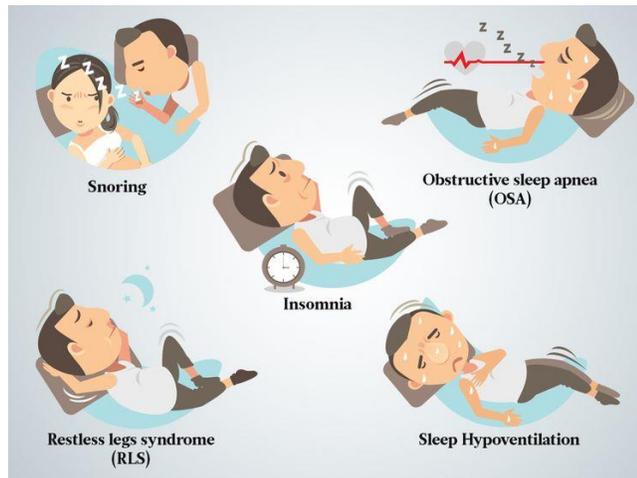




# EEG e pratica clinica

An EEG can highlight changes in brain activity that might be useful in the analysis of sleep disorders

## SLEEP DISORDERS



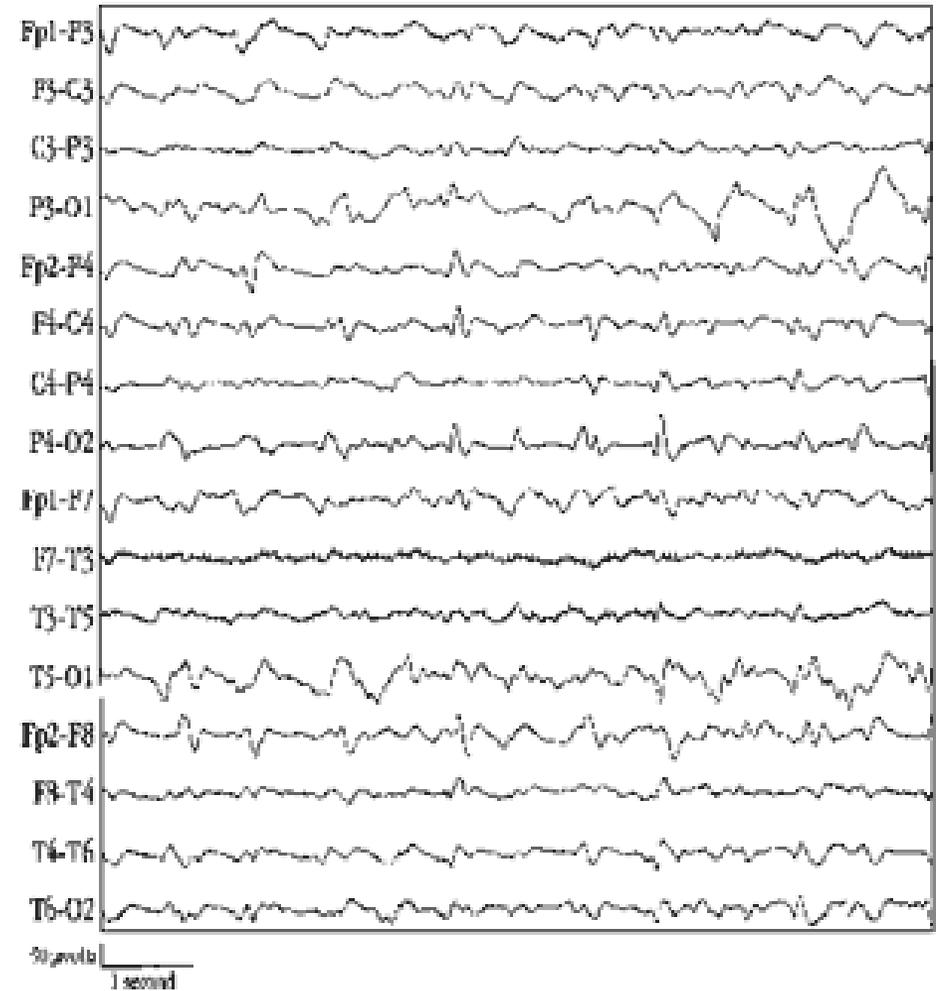
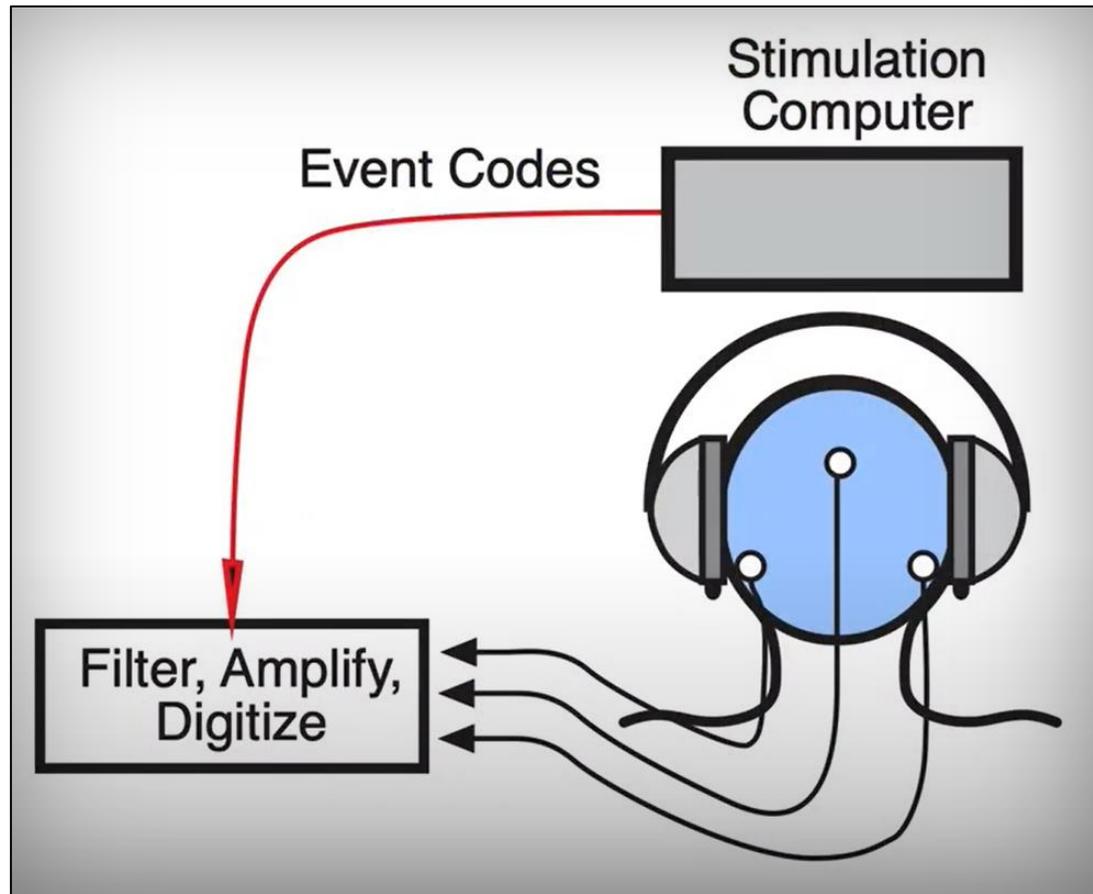
# EEG e pratica clinica

Altri utilizzi dell'EEG per scopi clinici:

- Distinguere disturbi che potrebbero erroneamente essere interpretati come crisi epilettiche come ad es. disturbi psicologici e psichiatrici, disturbi di tipo visivo che precedono la comparsa di mal di testa (aura emicranica) e movimenti involontari della muscolatura e degli arti.
- Nel caso di una sindrome demenziale l'EEG, insieme ad altri esami di laboratorio e strumentali, fornisce informazioni necessarie per escludere alcune condizioni che possono essere simili a una demenza (come, per esempio, una intossicazione da farmaci o un danno al cervello).
- L'EEG è obbligatorio in caso di espianto di organi per accertare lo stato di morte cerebrale del donatore.



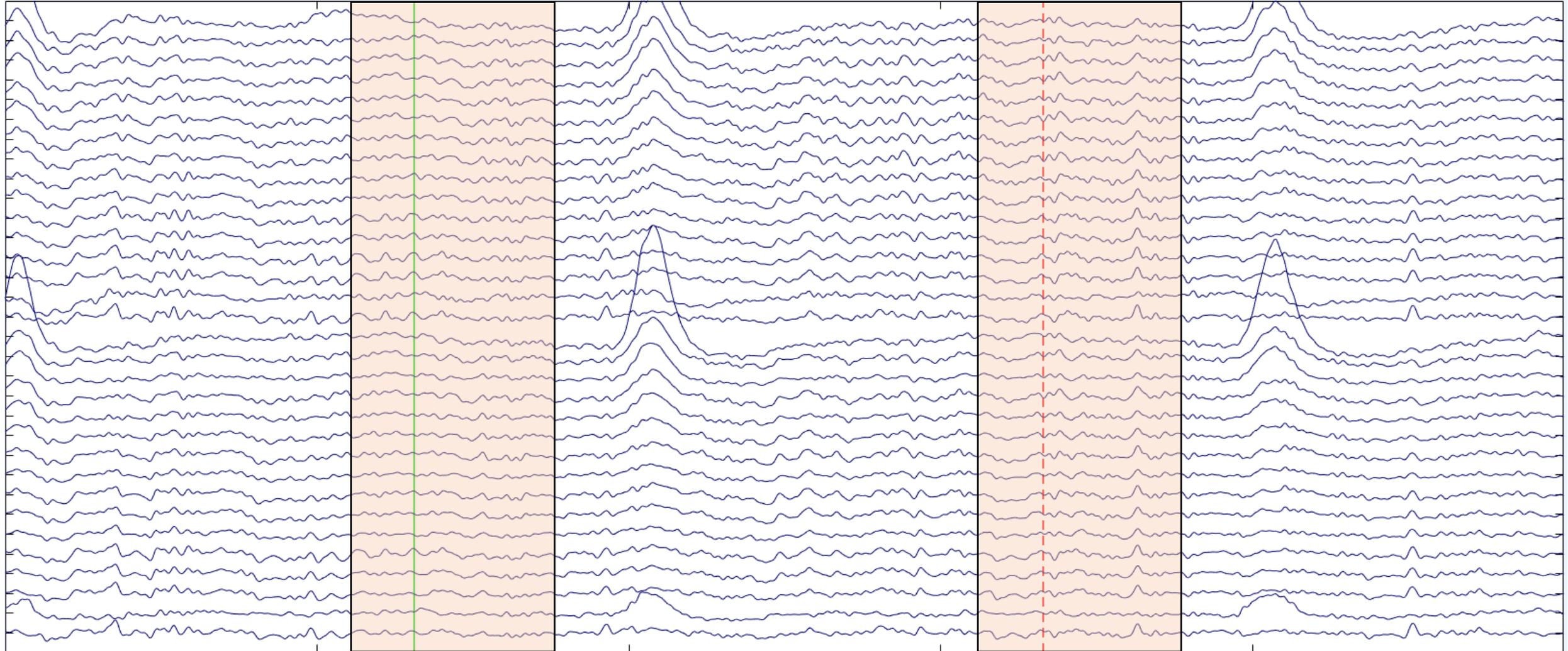
# EEG e ricerca



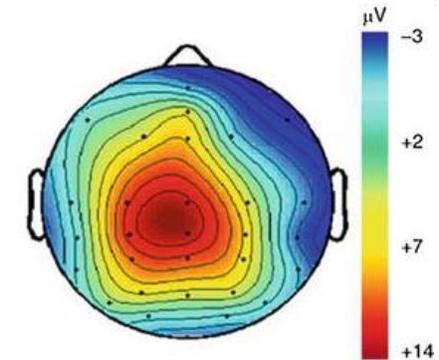
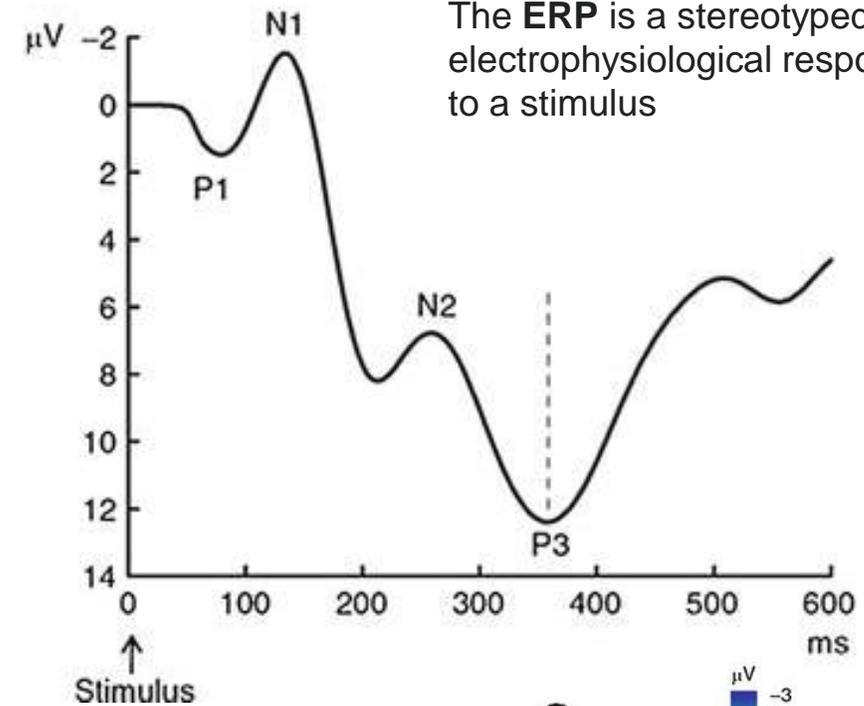
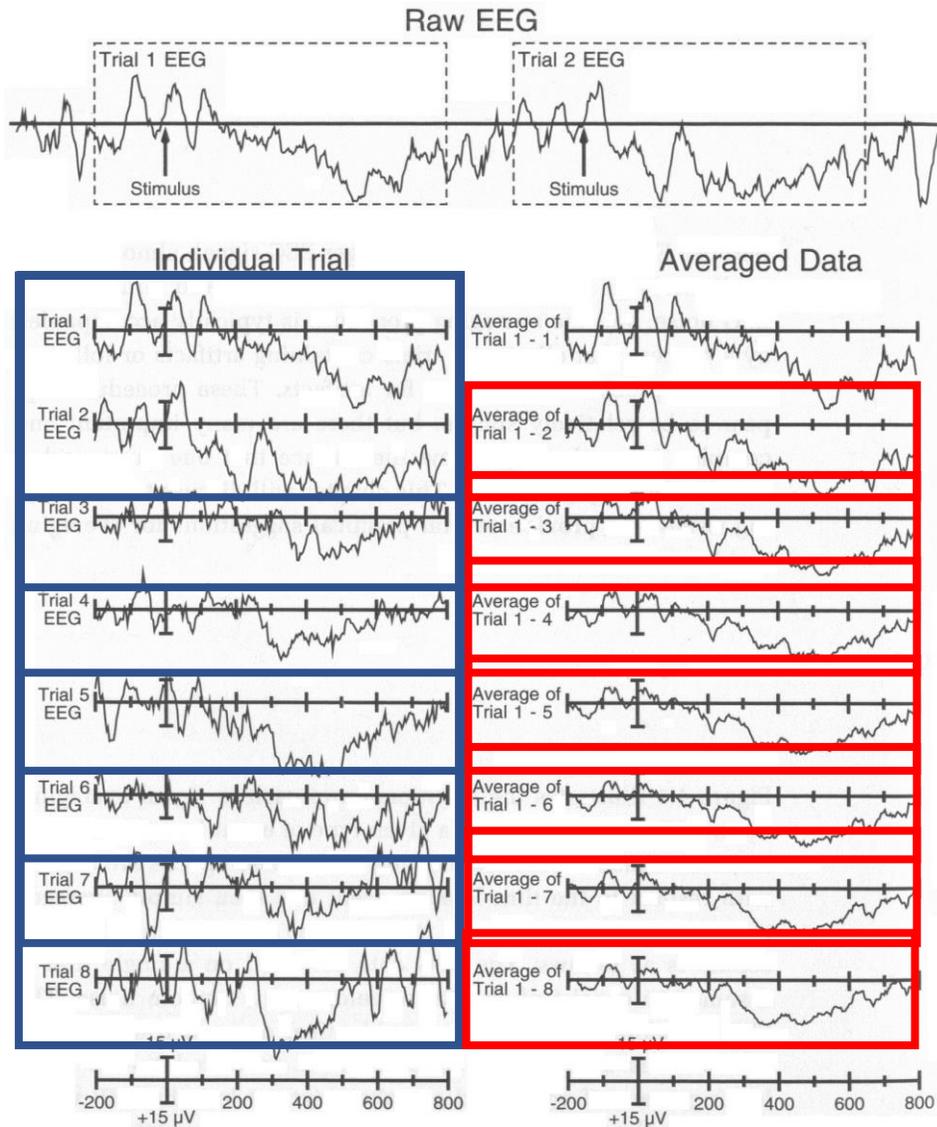
# EEG e ricerca

Epoca 1

Epoca 2



# Dal segnale continuo alla risposta ERP

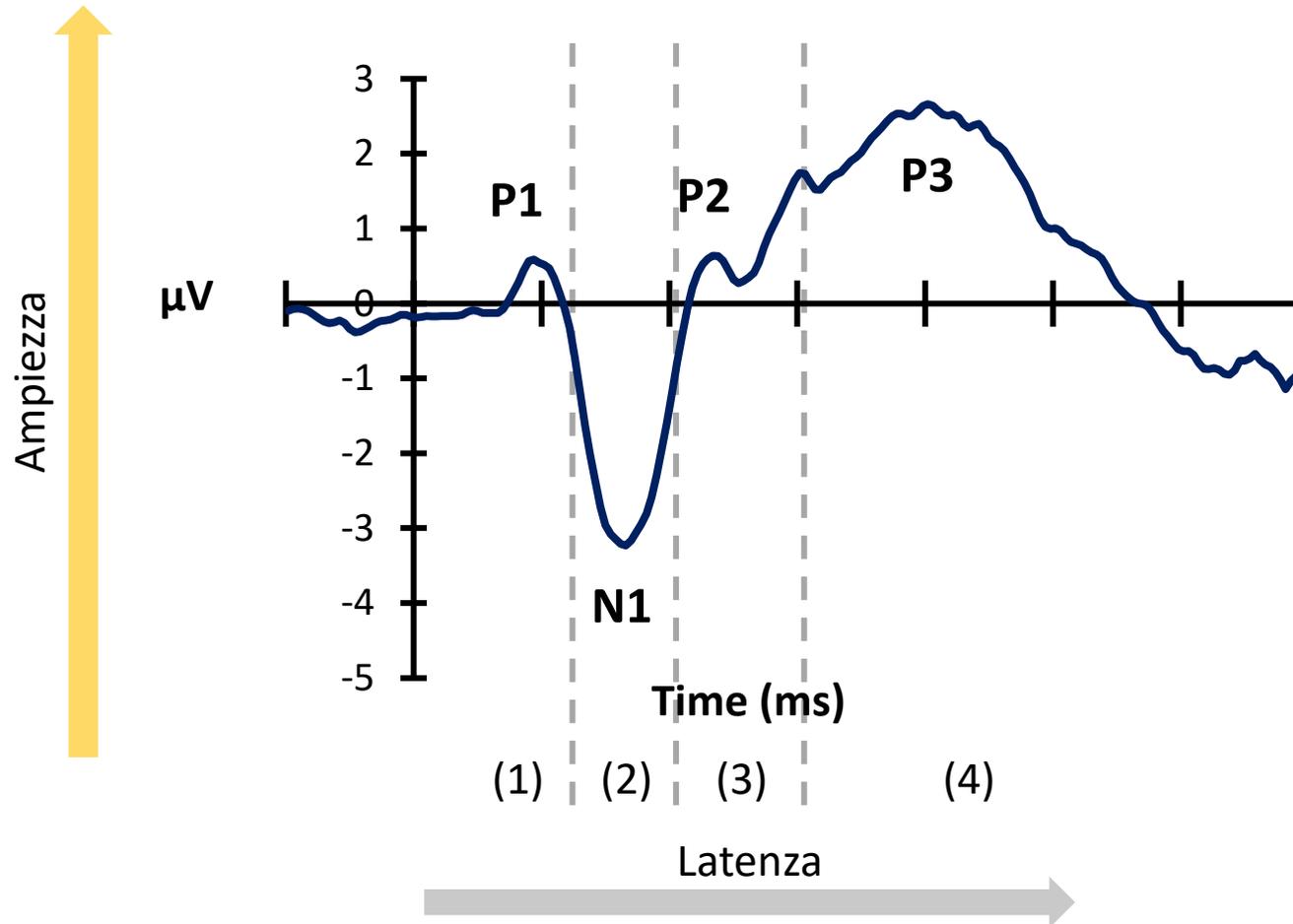


# Event-Related-Potentials

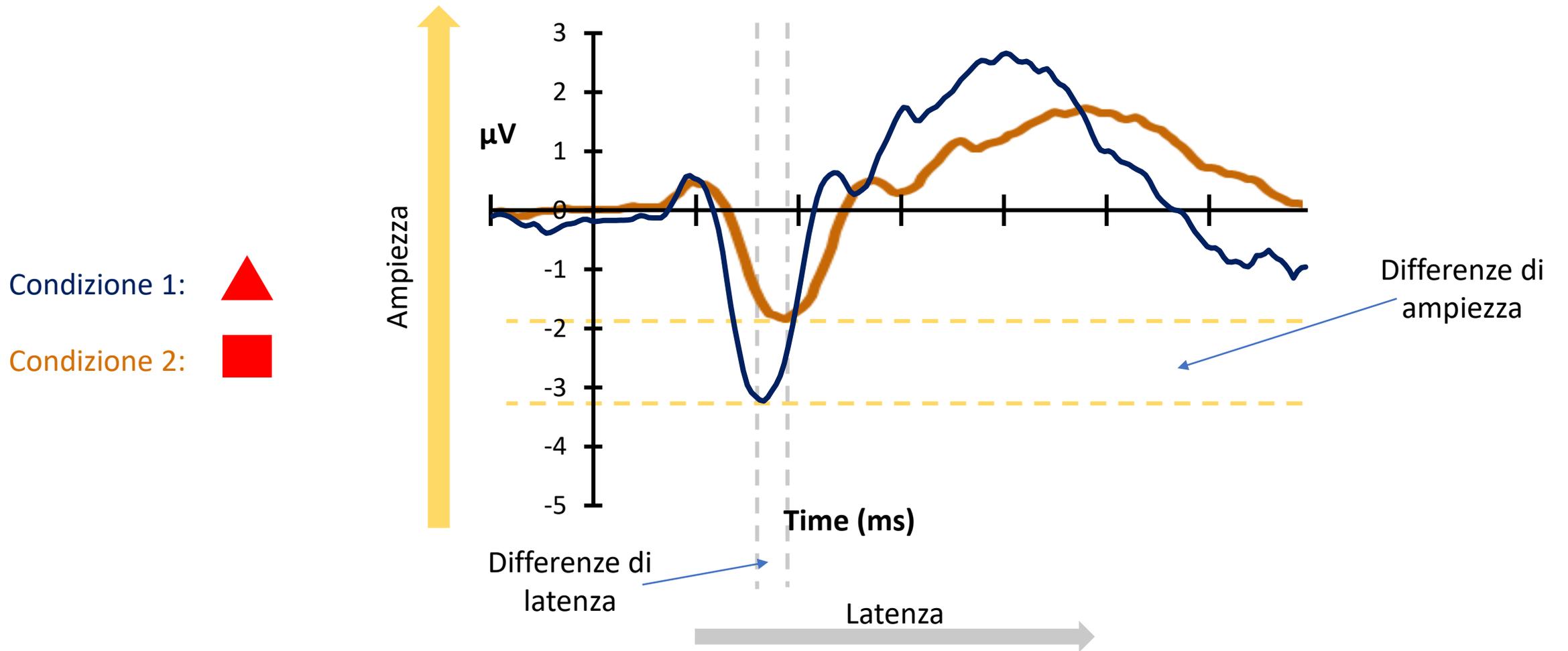
Gli ERP possono essere divisi in **componenti** (e.g. P1, N1, P2, P3 etc. etc.) legate a specifiche funzioni cognitive.

Precoci (1-2): processi di elaborazione sensoriale

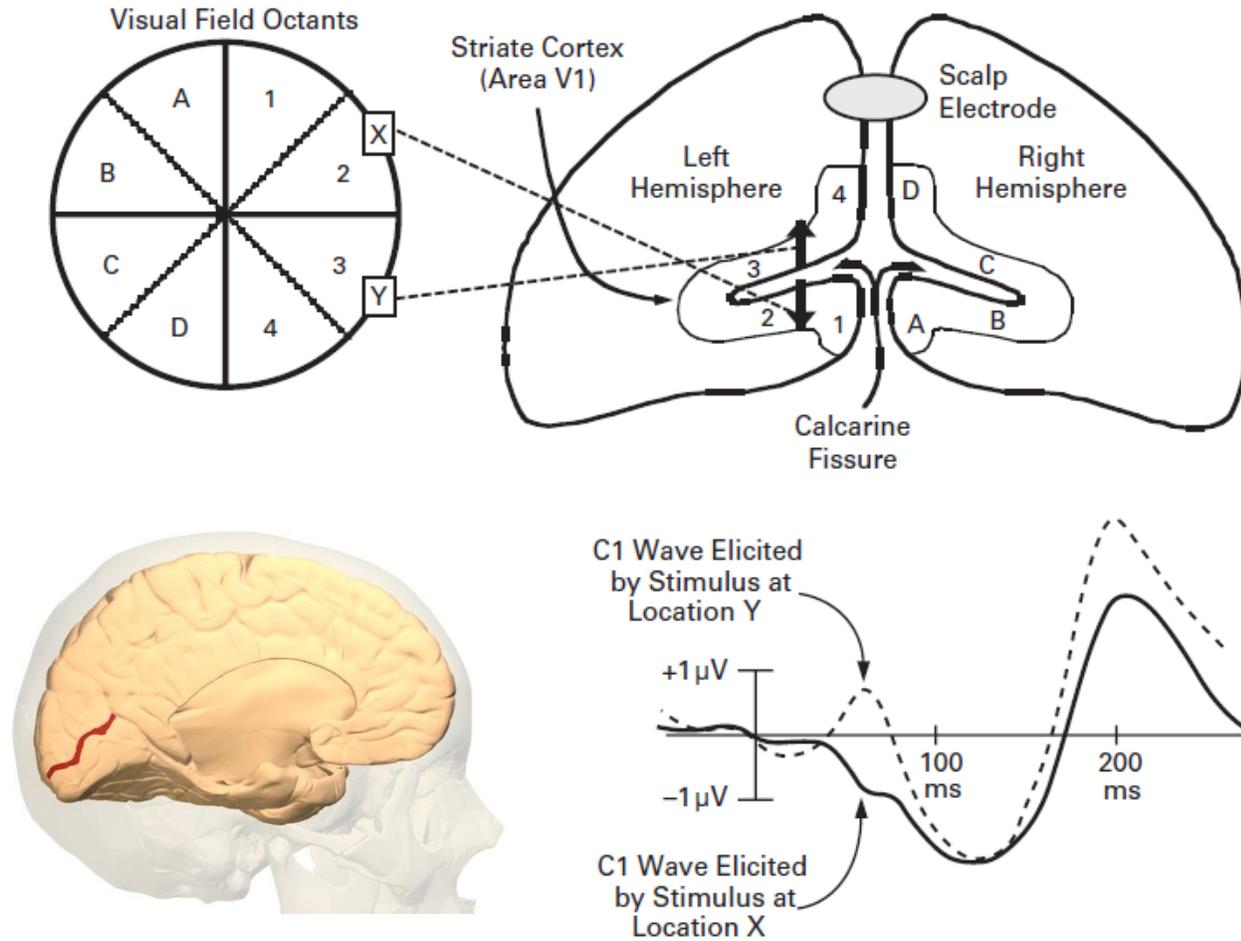
Tardive (3-4): processi di ordine superiore (e.g. memoria, categorizzazione etc. etc.)



# Event-Related-Potentials

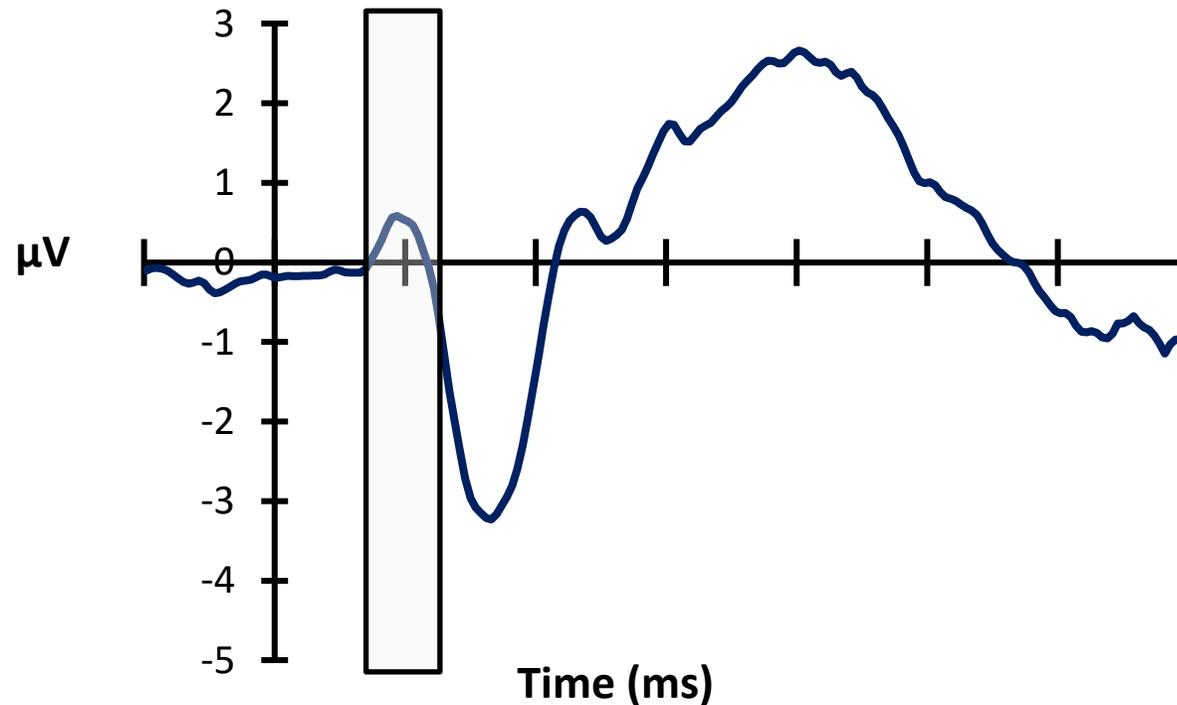


# C1 component



- C1 is largest at posterior midline electrode sites
- Its polarity can vary
- C1 wave appears to be generated in area V1 (primary visual cortex), which in humans is folded into the calcarine fissure
- The voltage recorded from an electrode above the calcarine fissure is positive for stimuli in the lower visual field and negative for stimuli in the upper visual field

# P1 component



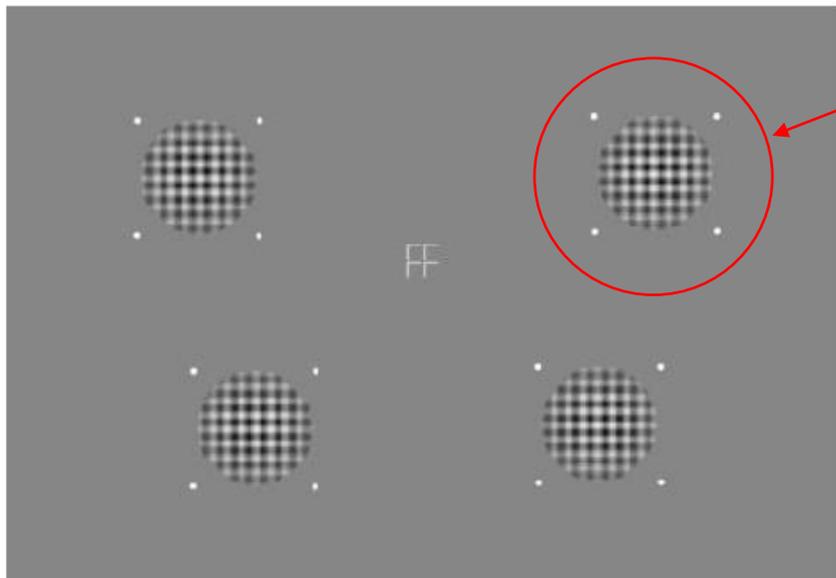
- P1 is largest at lateral occipital electrode sites and typically onsets 60 – 90 ms poststimulus with a peak between 100 and 130 ms
- Like the C1 wave, the P1 wave is sensitive to variations in stimulus parameters, as would be expected given its likely origins in extrastriate visual cortex
- The P1 wave is also modulated by **selective attention** and by the subject's **state of arousal**.

# P1 e attenzione visuo-spaziale

## Source Analysis of Event-related Cortical Activity during Visuo-spatial Attention

Francesco Di Russo<sup>1,2,3</sup>, Antígona Martínez<sup>1,4</sup> and Steven A. Hillyard<sup>1</sup>

<sup>1</sup>Department of Neurosciences, University of California San Diego, La Jolla, CA, USA, <sup>2</sup>Fondazione Santa Lucia, IRCCS, Rome, <sup>3</sup>Istituto Universitario di Scienze Motorie, IUSM, Rome, Italy and <sup>4</sup>Nathan S. Kline Institute for Psychiatric Research, Program in Cognitive Neuroscience and Schizophrenia, New York, USA

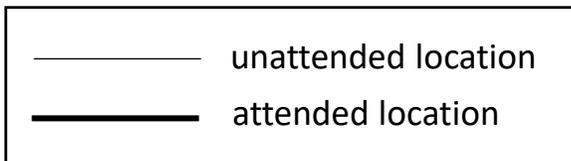
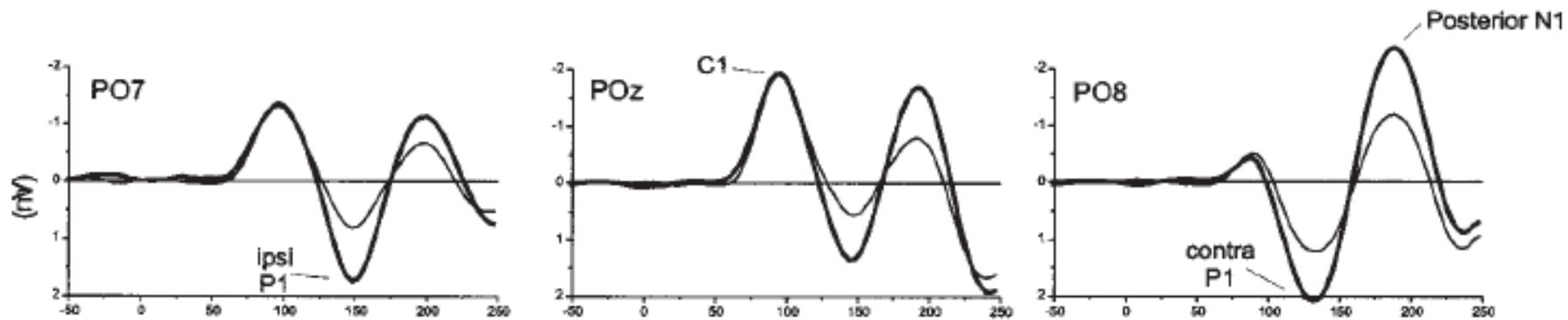


Attentional spot

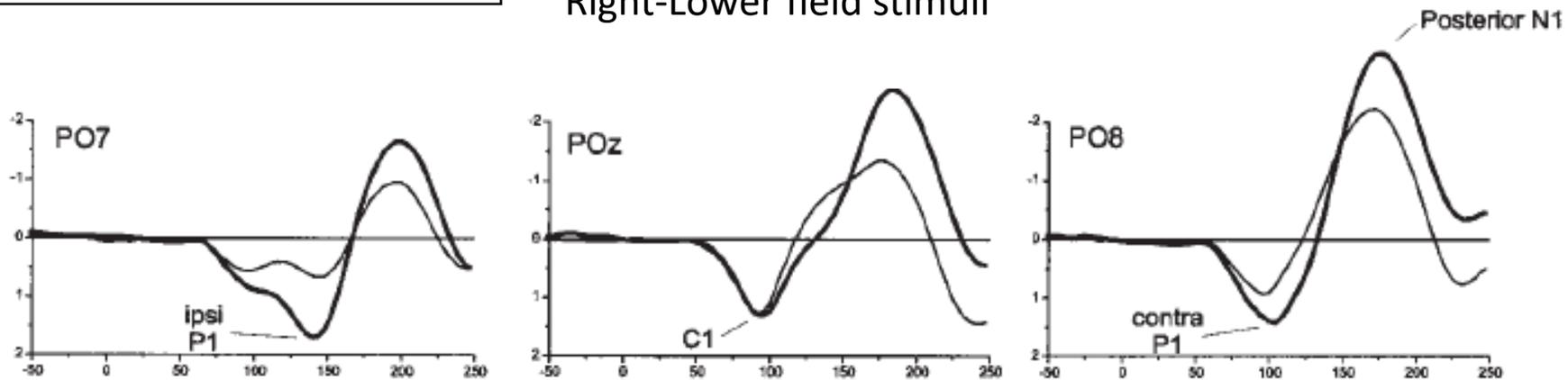
**Task:** Small checkerboard stimuli were flashed in random order to the four quadrants of the visual field at a rapid rate while subjects attended to stimuli in one quadrant at a time

# P1 e attenzione visuo-spaziale

Left-Upper field stimuli



Right-Lower field stimuli



# N170 and Face Processing

## Electrophysiological Studies of Face Perception in Humans

**Shlomo Bentin**

Hebrew University, Israel

**Truett Allison and Aina Puce**

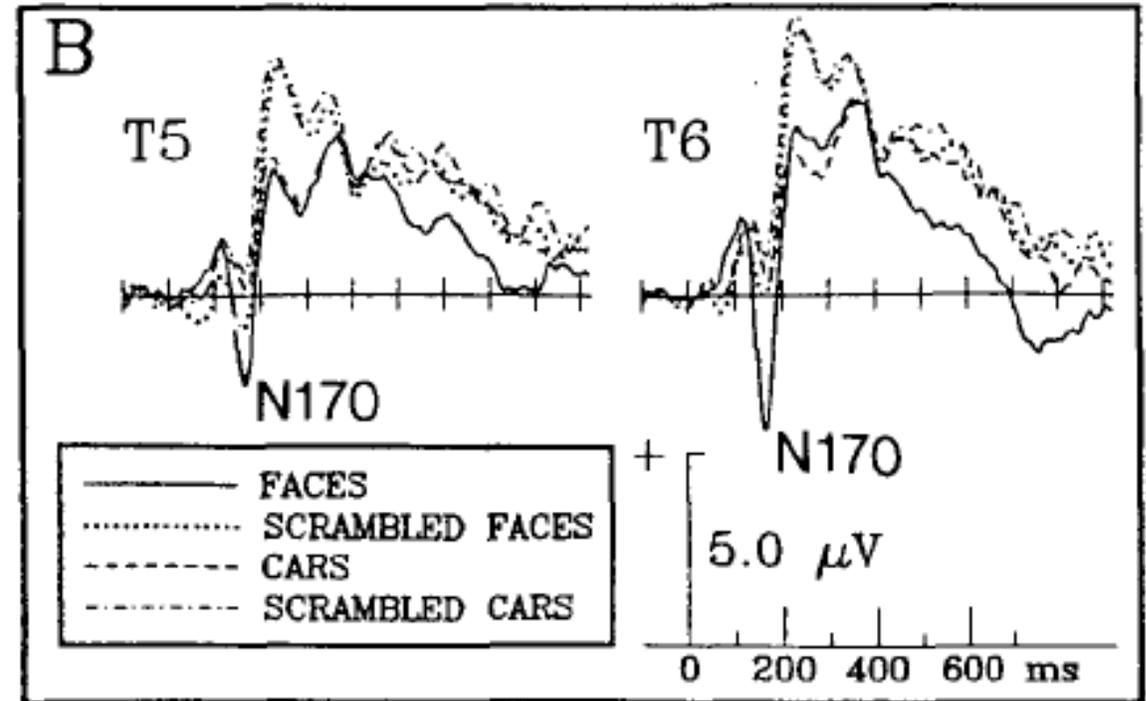
West Haven VA Medical Center and Yale University School of Medicine

**Erik Perez**

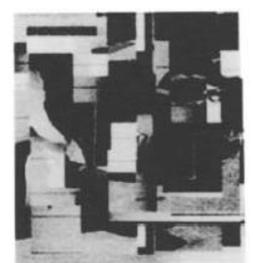
Hebrew University, Israel

**Gregory McCarthy**

West Haven VA Medical Center and Yale University School of Medicine



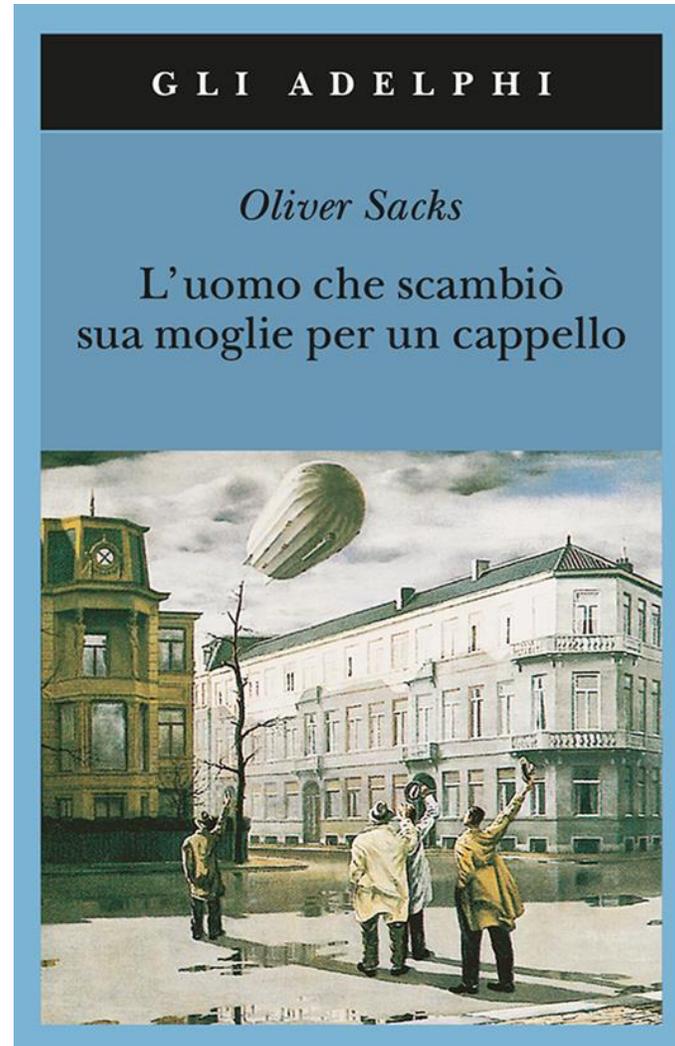
**Task:** visual target detection task in which they mentally counted the number of occurrences of pictorial stimuli from a designated category such as butterflies. Target stimuli were embedded within a series of other stimuli including unfamiliar human faces and other nonface stimuli.



# N170 and Face Processing

Sensation Without  
Perception:  
Visual Prosopagnosia

# N170 and Face Processing

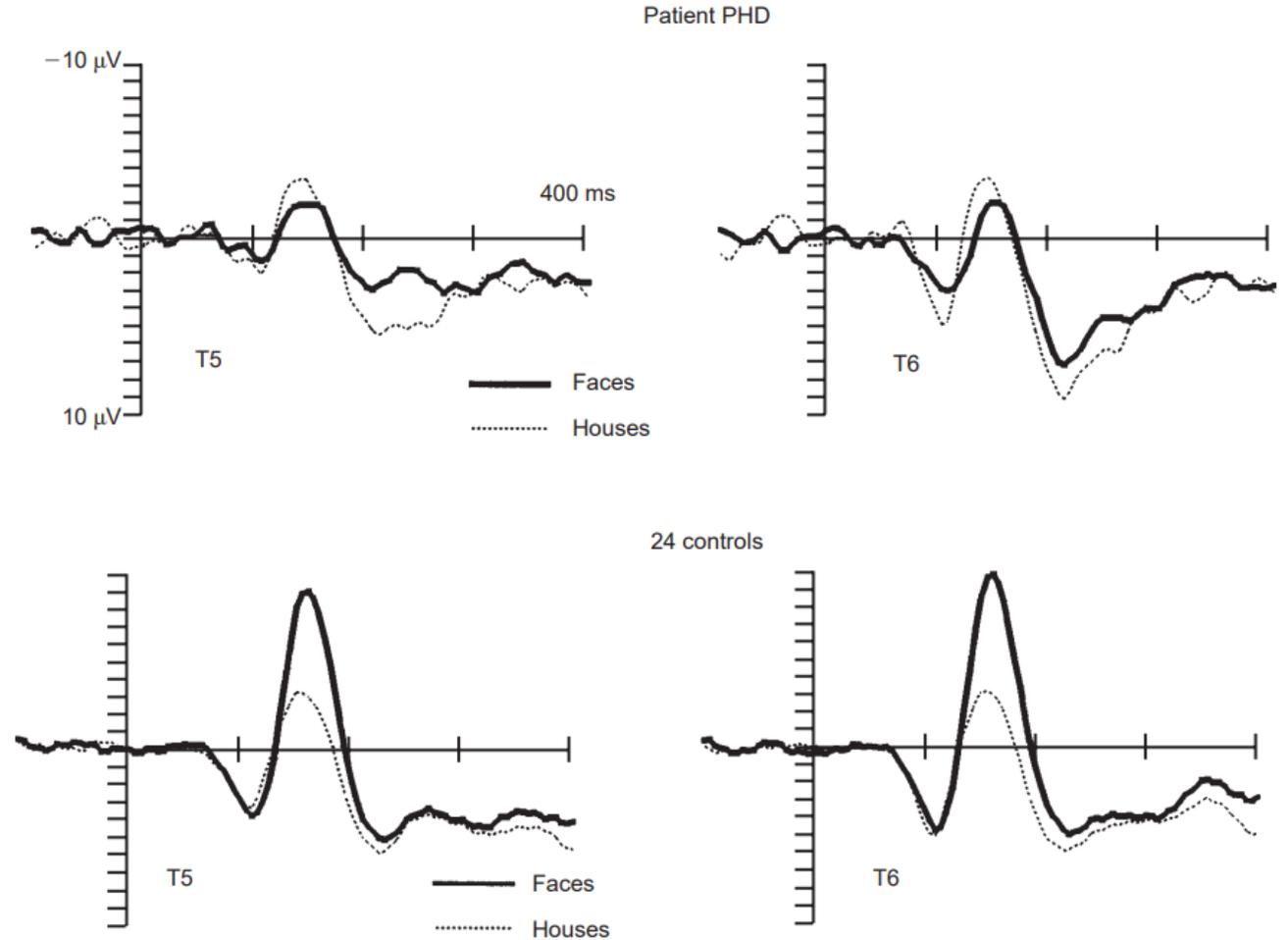


# N170 and Face Processing

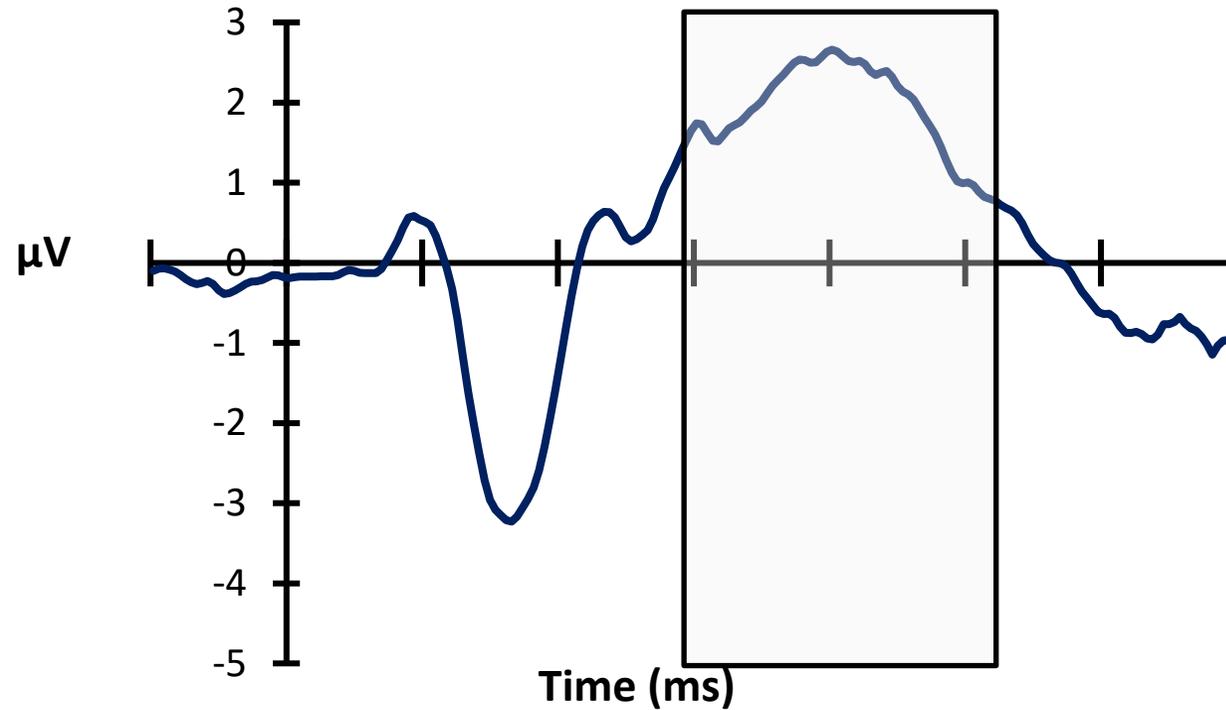
NeuroReport 10, 255–259 (1999)

## Prosopagnosia and structural encoding of faces: Evidence from event-related potentials

Martin Eimer<sup>CA</sup> and Rosaleen A. McCarthy

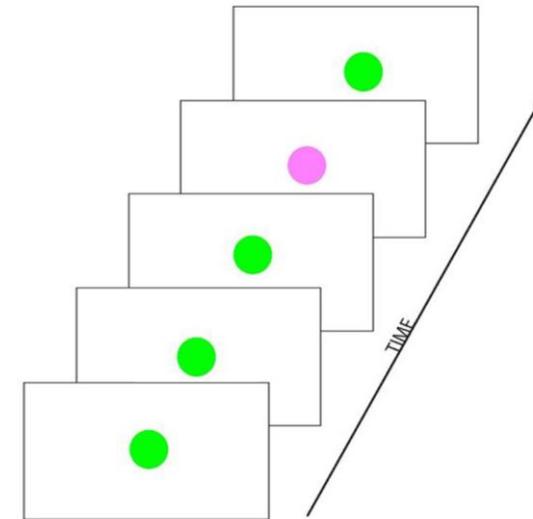


# P3 component



P3 amplitude gets larger as target probability gets smaller

## Oddball task



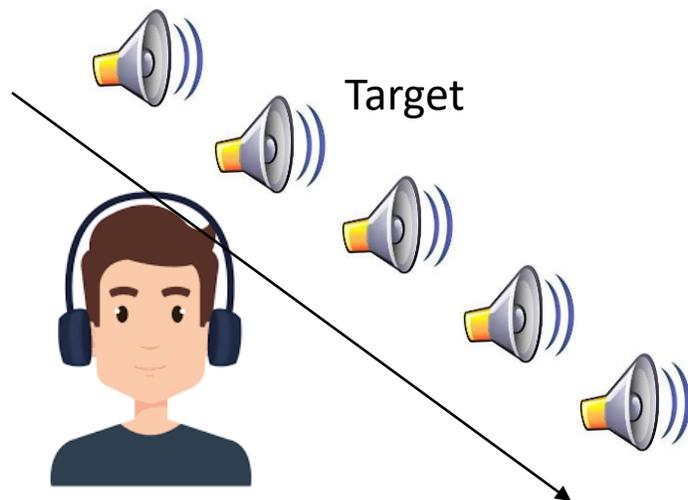
«press space bar when you see the target (pink dot)»

# P3 component

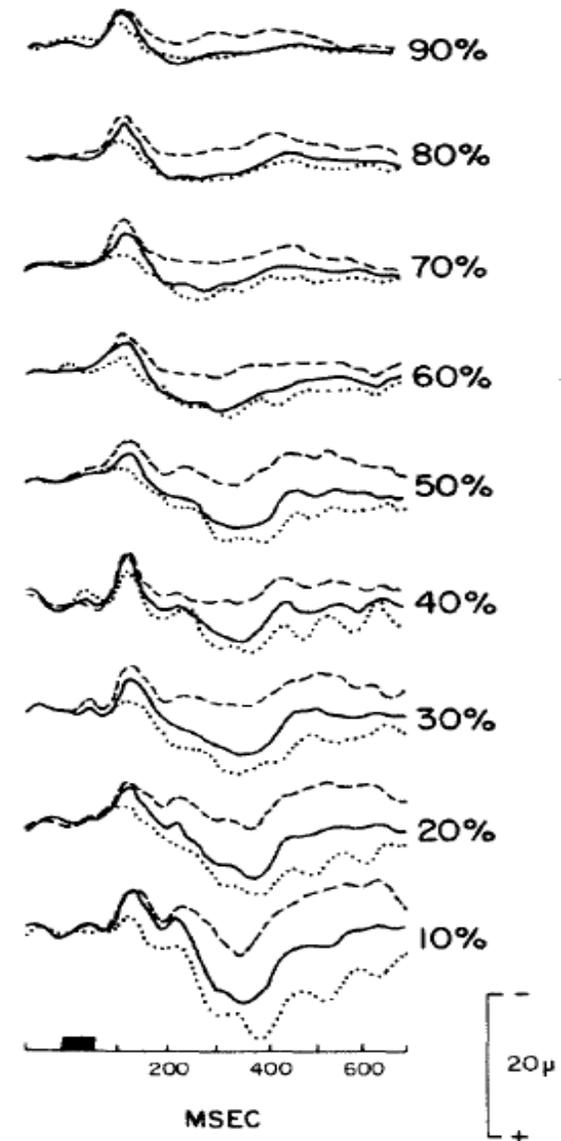
## On Quantifying Surprise: The Variation of Event-Related Potentials With Subjective Probability

CONNIE C. DUNCAN-JOHNSON AND EMANUEL DONCHIN

*Cognitive Psychophysiology Laboratory, Department of Psychology, University of Illinois*

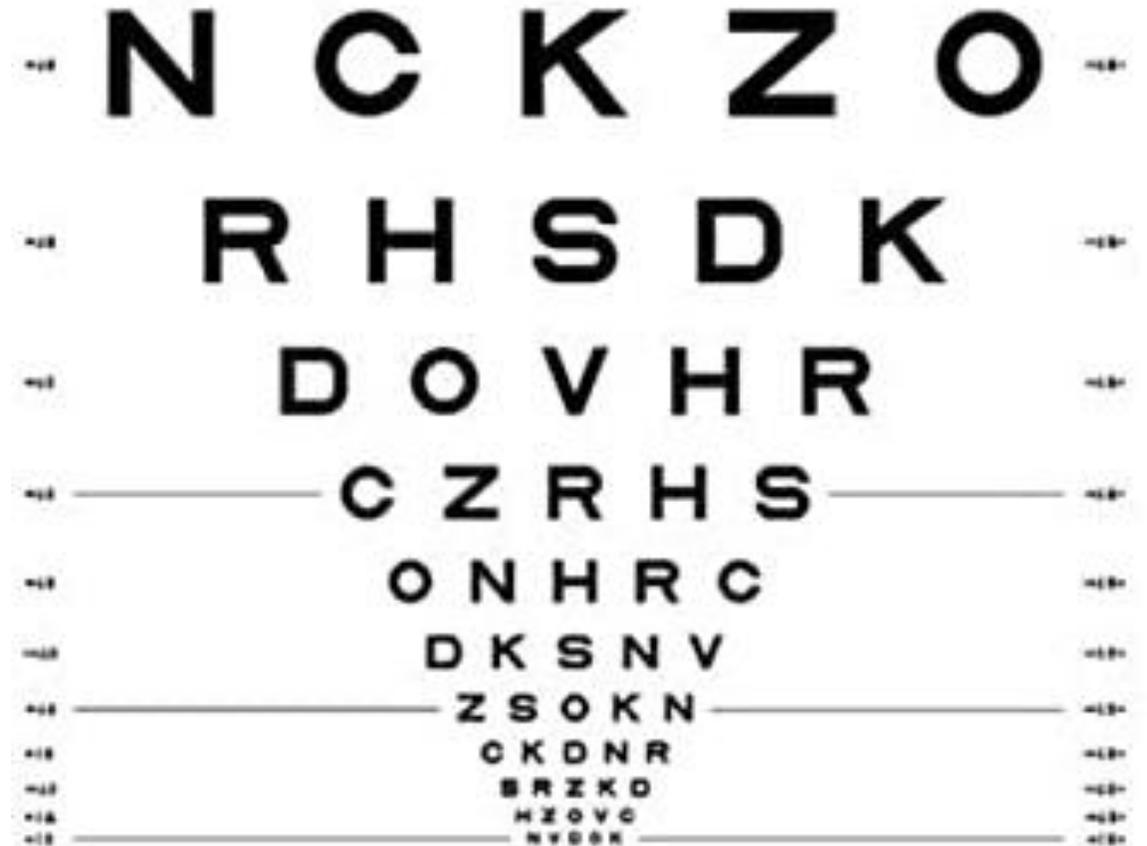
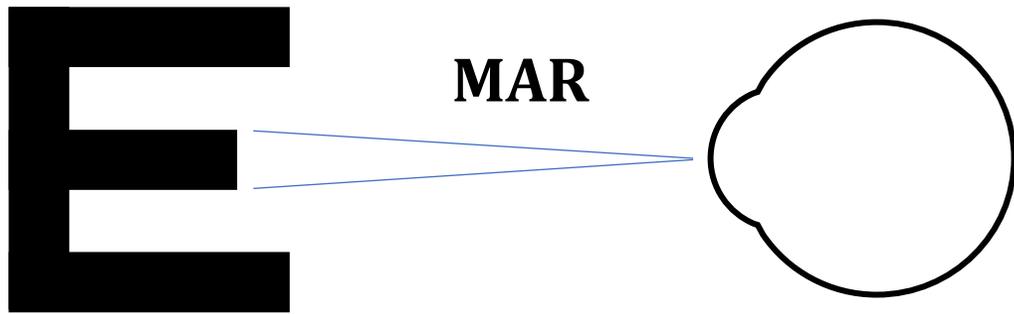


**Task:** count how many target tones are present in the sequence





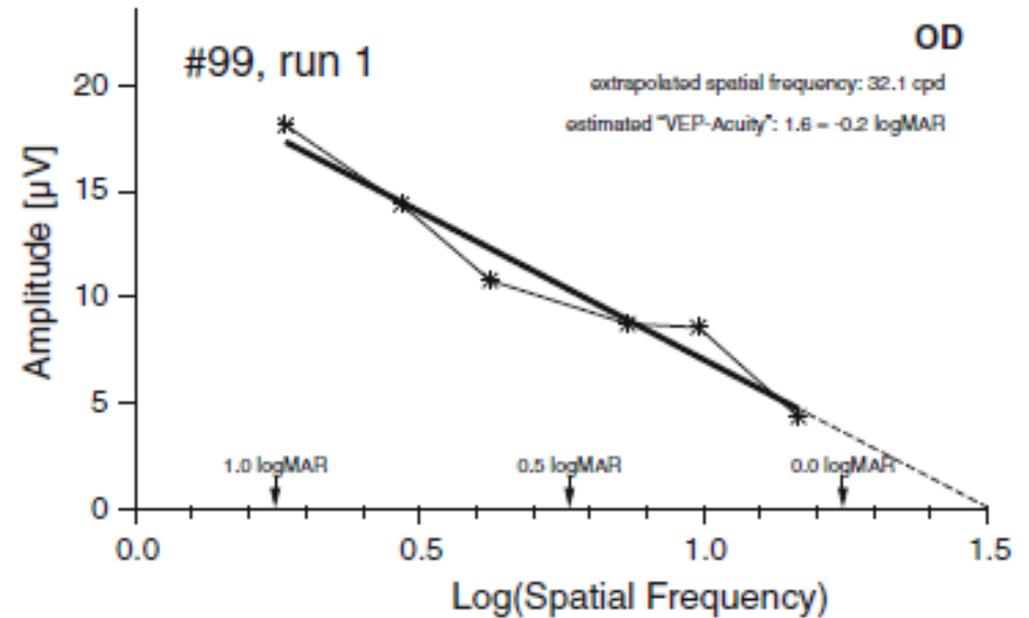
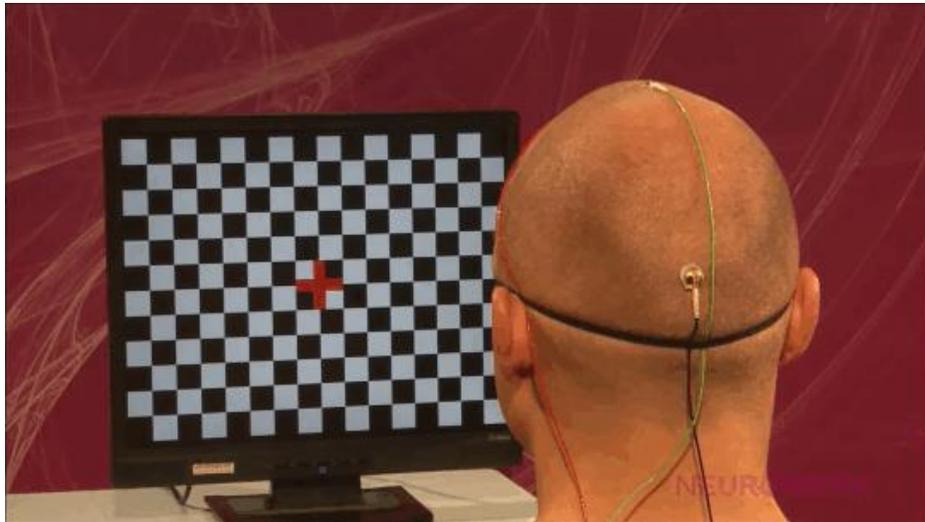
# Calcolo Acuità Visiva nella Pratica Optometrica



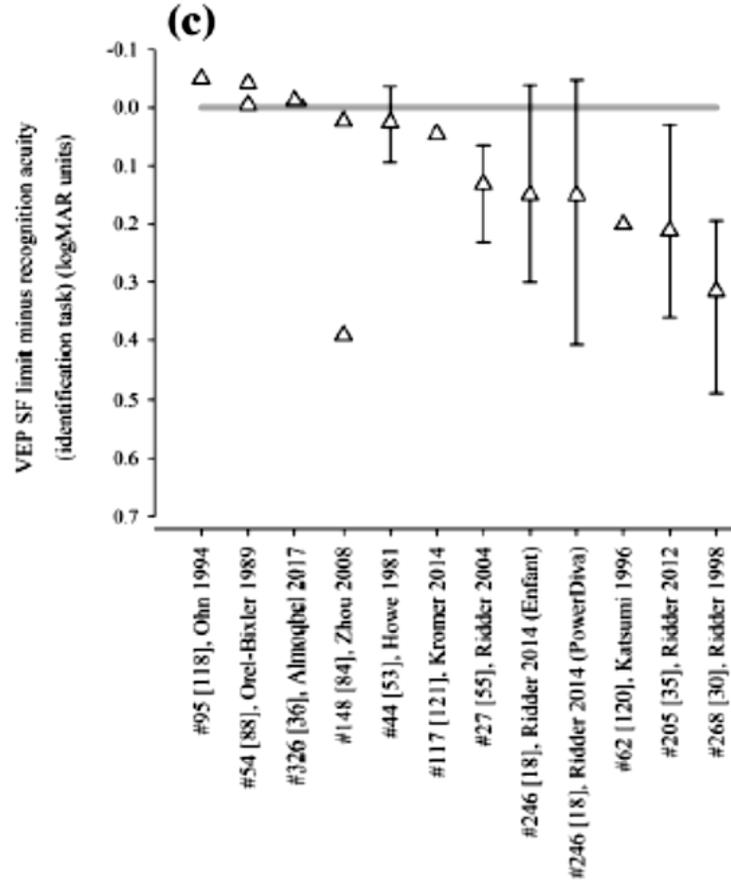
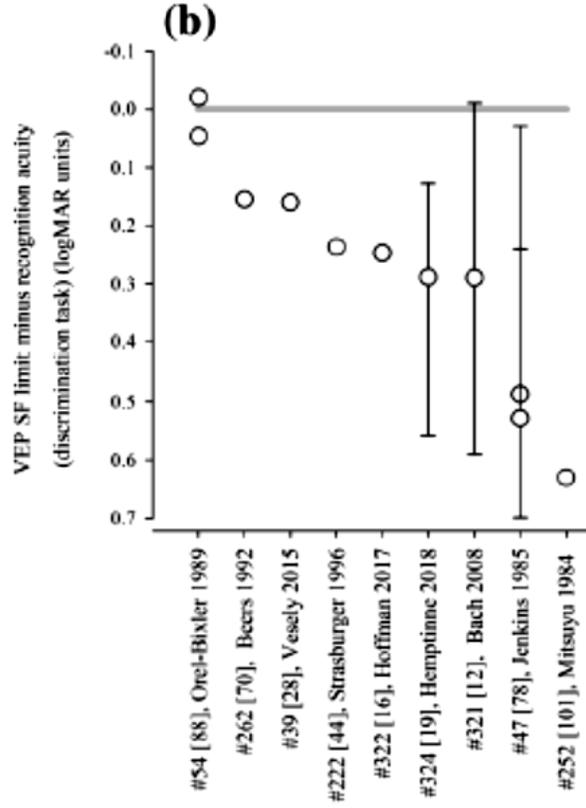
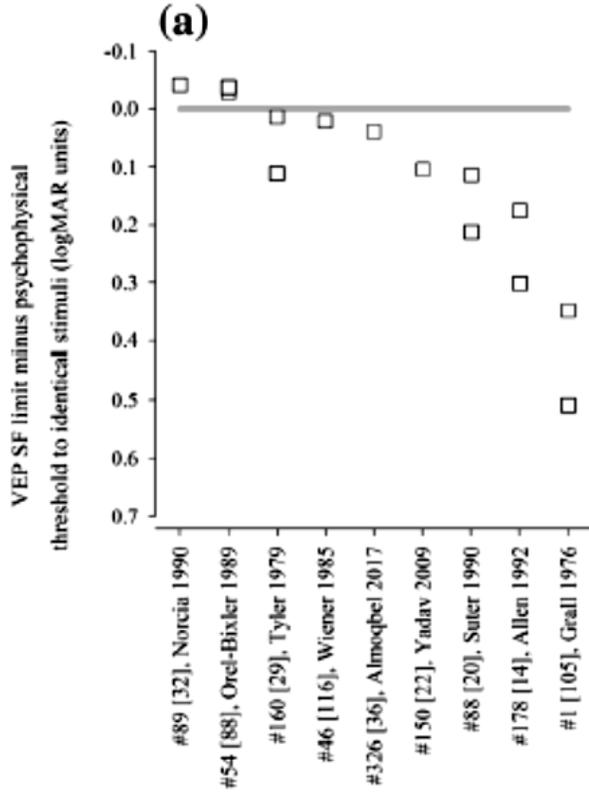
# Using ssVEP to measure visual acuity

## Why using ssVEP instead of ETDRS charts?

Visual evoked potentials (VEPs) are used in patients who cannot or will not reliably complete subjective or behavioural tests and in those with difficulties in perception and recognition to aid in localising defects.



# How reliable are ssVEP for visual acuity measurements?



**ATTENTION**  
**THANK YOU FOR**  
**YOUR ATTENTION**

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