BRAIN VISION

Solutions for neurophysiological research

Neuro-Engineering Workshop

UK College of Engineering

2020.10.09

Introduction

Introduction

Who am I?

- Dr. Jeremy Burnison – Scientific Consultant
- Background: Neuroscience/Physics, Engineering
  - – Past research in EEG based BCI for communication replacement.
- Recently focused on research techniques of non-invasive Neuromodulation + EEG

Brain Vision LLC

Judy Cini
CEO

David Kadlec
Support Manager

Edward Lau
Consultant Team Manager

Tamara Spence, PhD
Consultant Team Manager

Brett Bays, PhD

Jeremy Burnison, PhD

INTRODUCTIONS

Brain Vision LLC

Distributor of neurophysiological research solutions in the US and Canada for more than 20 manufacturers including…

BRAIN PRODUCTS
Solutions for neurophysiological research

EASYCAP
EEG Recording Caps and Related Products

BESA

mrcyes
Your Vision Is the Difference

VPixx Technologies
Vision Science Solutions

neuroCare

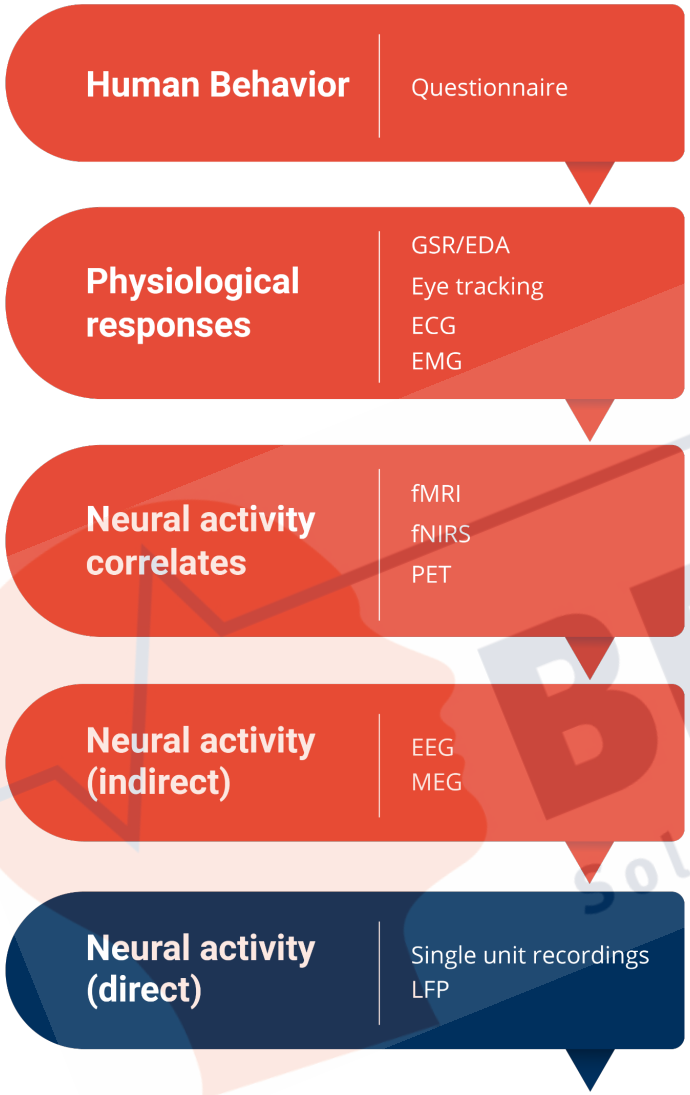
NIRX
OPTICAL NEUROIMAGING

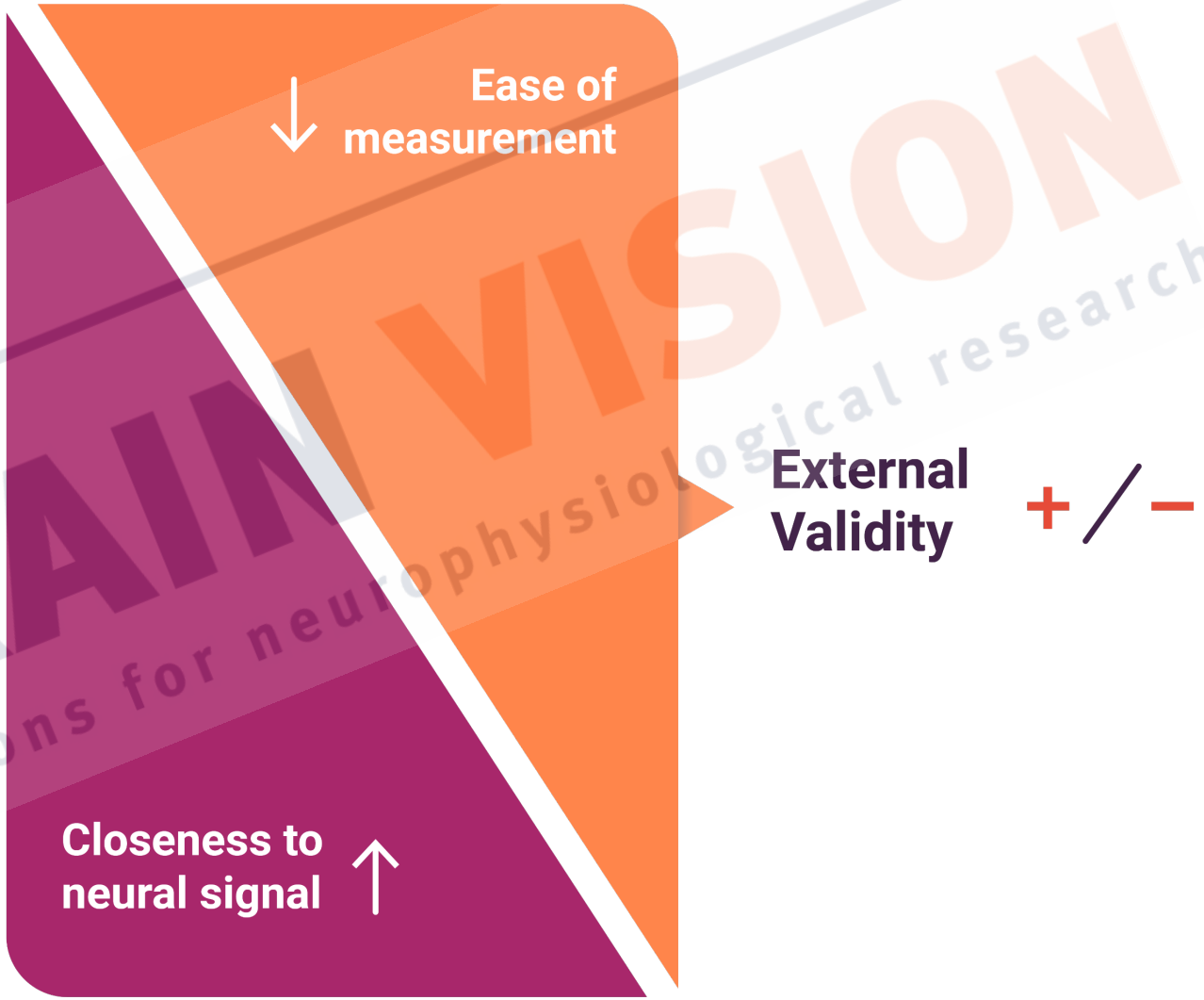
movisens

Axilum Robotics

EEG Scientific Background

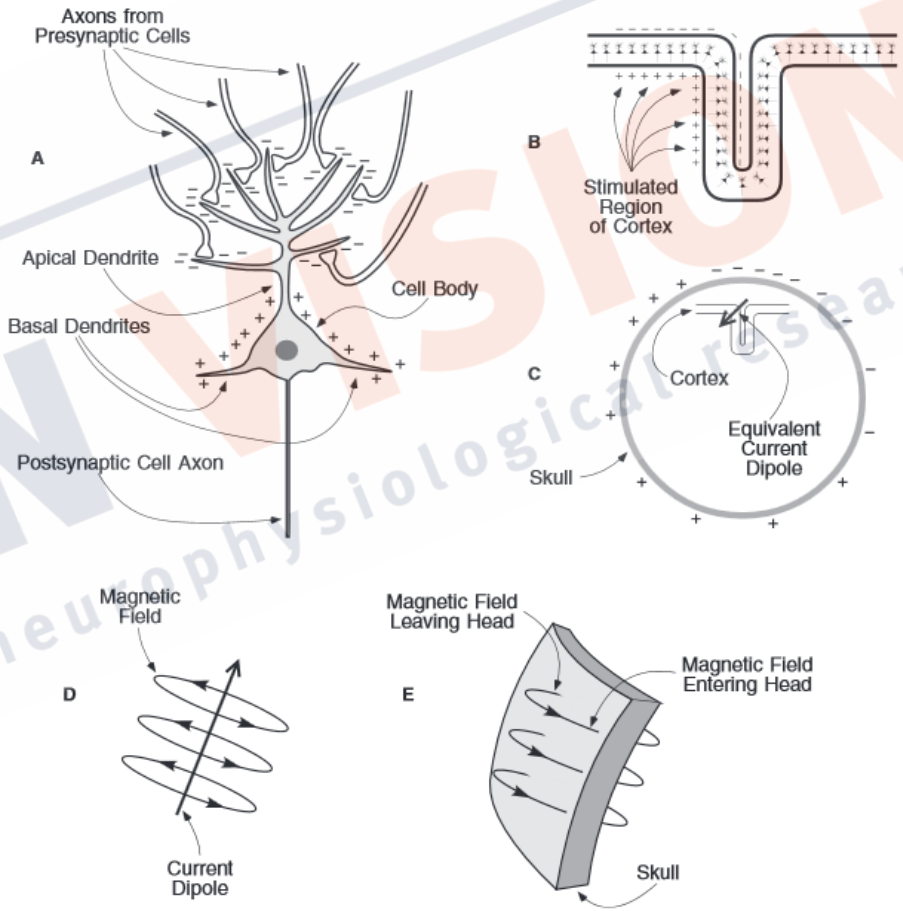
NEUROSCIENCE METHODS





EEG – WORKING NEURAL ACTIVITY MODEL

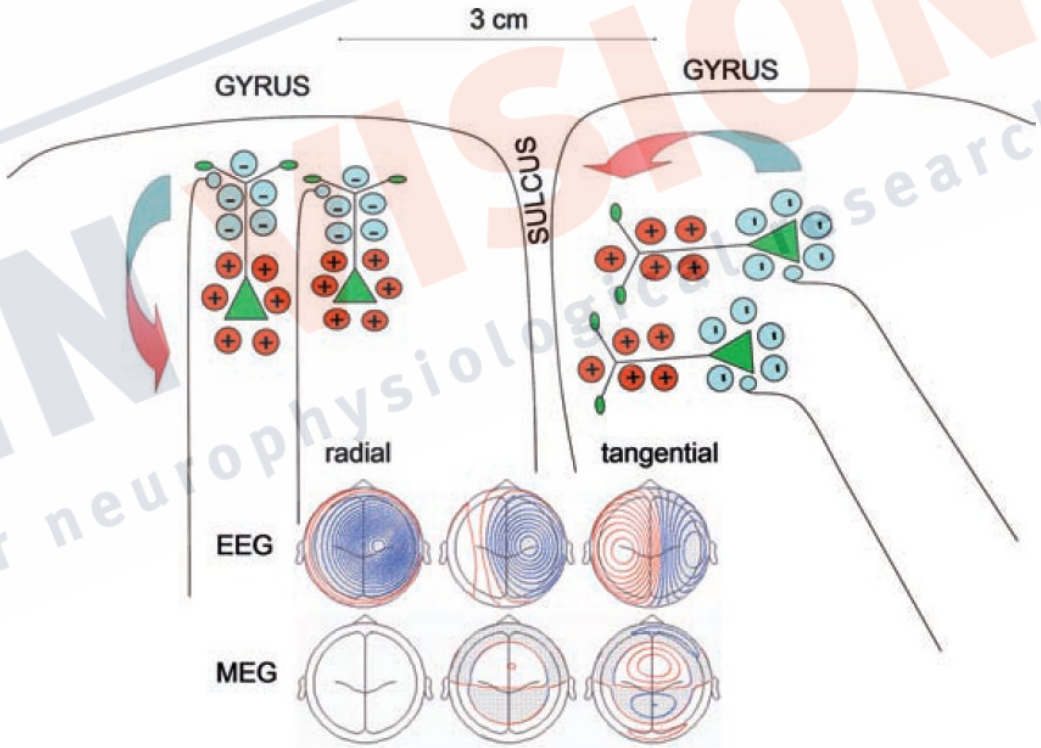
- **Excitatory neurotransmitter** is released from the presynaptic terminal
- **Positive ion flow** into the postsynaptic neuron
  - Results in small dipole
- **Dipole summation** from individual neurons, on the folded cortex regions



Source: Luck (2005). Introduction to the Event-Related Potential Technique. Cambridge: MIT Press

EEG – WORKING NEURAL ACTIVITY MODEL

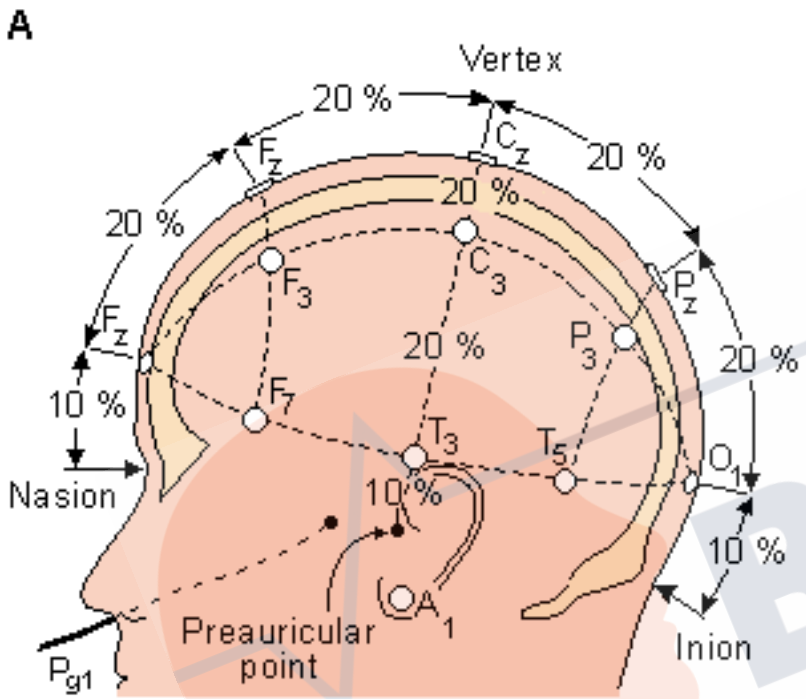
- The summated dipoles can be approximated by a **single equivalent current dipole**
- **The position and orientation** (positive or negative) can be recorded

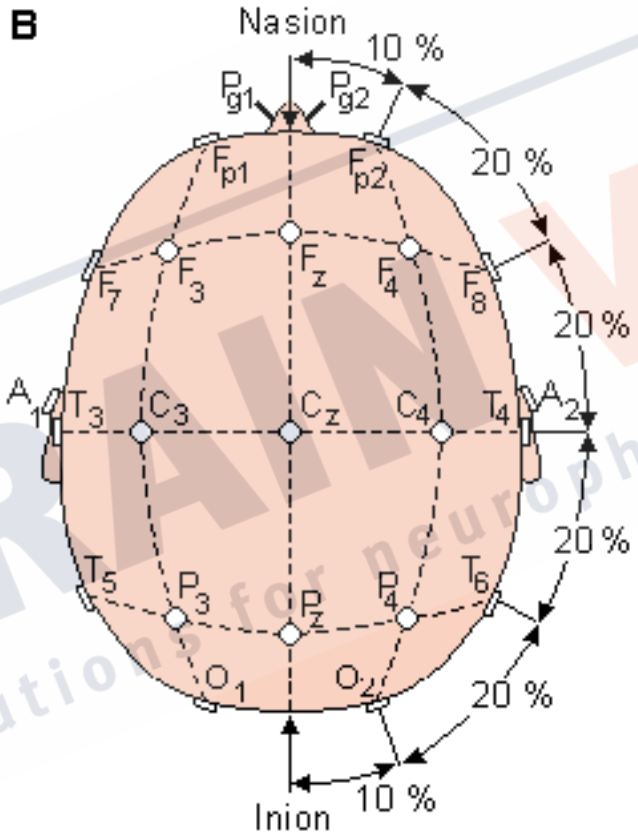


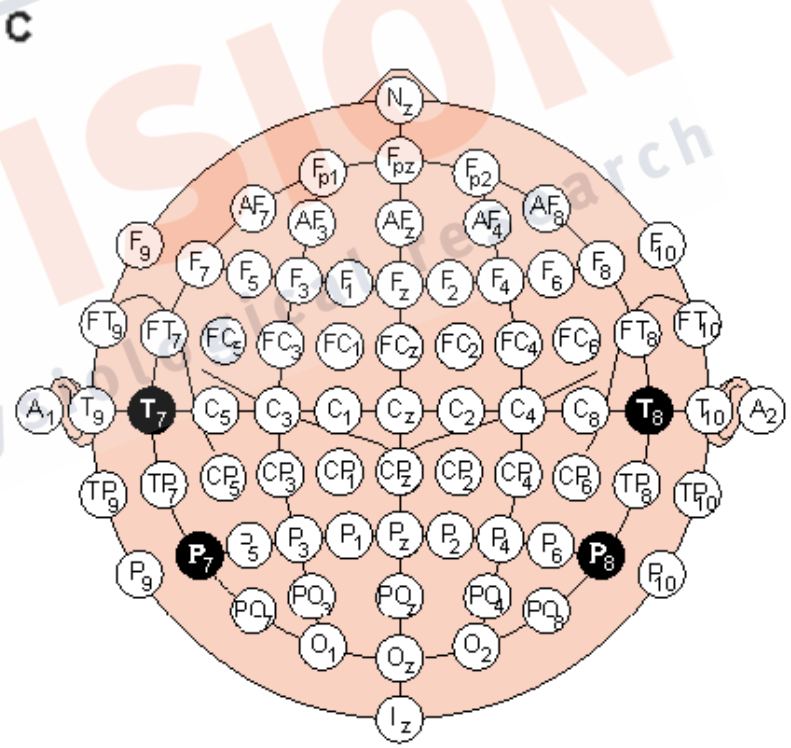
Source: Michel et. Al (2009). Electrical Neuroimaging. Cambridge University Press.

Topography / Montage

10/20 system ... 10/10 system ... 10/5 system ...

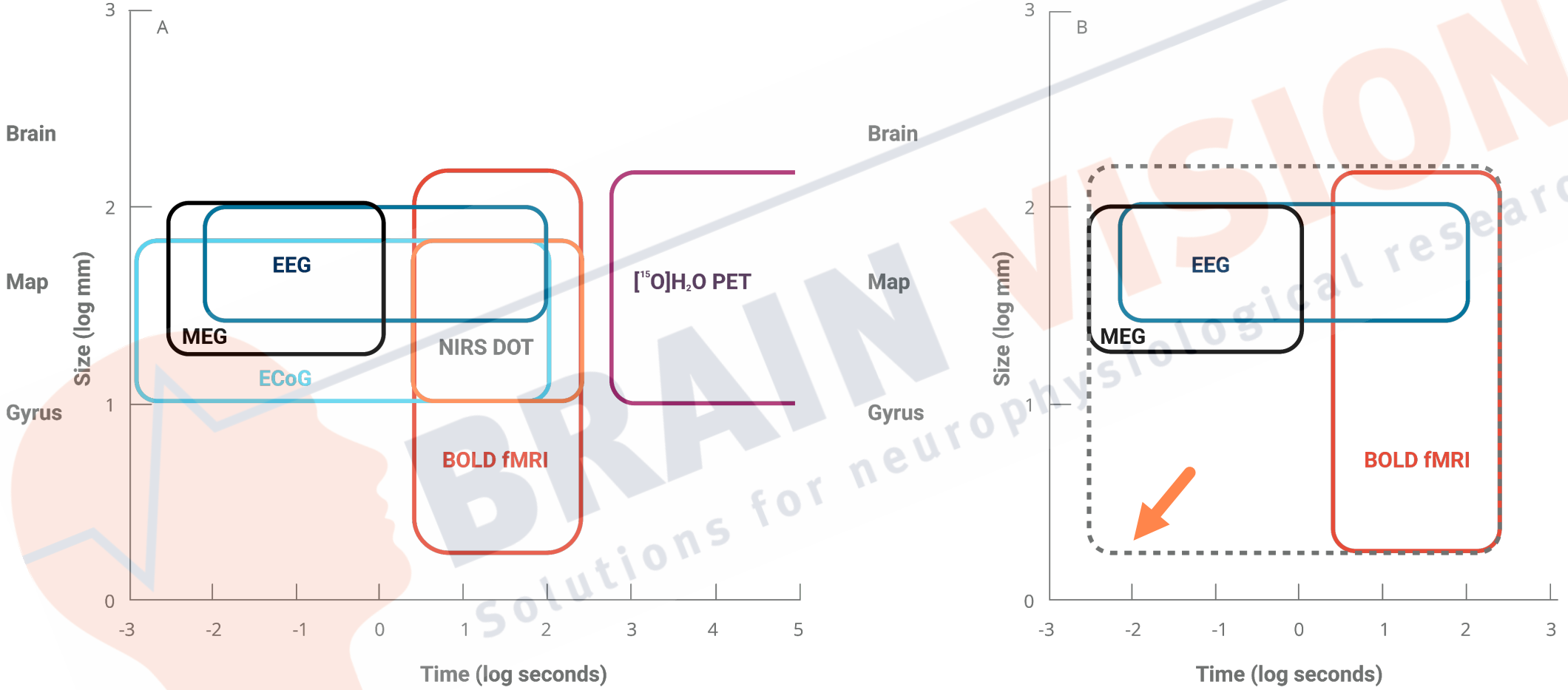






- Left = odd numbers
- Right = even numbers
- Smaller numbers closer to midline
- Relative – vs – absolute distances...

COMBINING MODALITIES



Source: Scott A. Huettel, Allen W. Song, Gregory McCarthy.
Functional Magnetic Resonance Imaging

EEG Technology

EEG Caps/Nets/Electrodes

BRAIN VISION
Solutions for neurophysiological research

Active

Sponges

Passive

Customized

Dry Electrodes

Drypad Sensor

Drypad sensors make direct skin contact for ECG and EEG recordings.

Flex Sensor

Flex sensors slide through hair for high-quality scalp contact.

HydroFlex Sensor

HydroFlex sensors are extra comfortable for direct skin contact and through-hair applications.

A1 Earclip

A1 earclip has two sensor locations: Reference and Ground.

A2 Earclip

A2 earclip is used in linked-ears configurations.

Drypad Ear Sensor

Dedicated Drypad sensors for use with Earclips.

EEG EQUIPMENT

EEG – Equipment

EEG Practical Applications

EEG – Applications

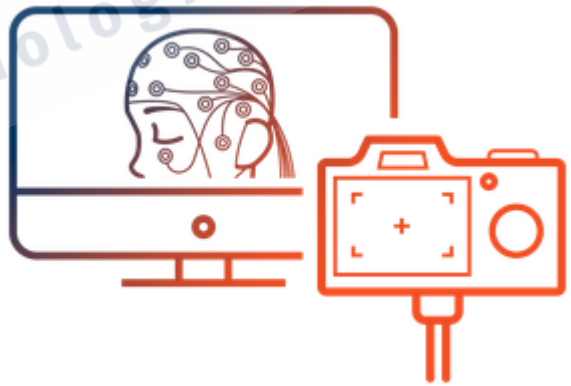
- **Psychiatric**
- **Psychology**
- **Clinical Applications**
  - **Sleep**
  - **Epilepsy**
  - **Stroke/TBI detection**
  - **More…**
- **Neuromarketing**
- **BCI / BMI**
- **Neurofeedback**
- **Sports Science**
- **MoBI**

Research Fields

- Sleep
- Higher cognitive functions
- Emotion / motivation
- Language
- Perception / attention
- Social cognition / interaction
- Disorders of the nervous system
- Modeling and analysis methods
- Learning / memory
- Motor behavior
- Physiology / metabolism /pharmacology
- Aging / development

EEG – And other modalities

- TMS
- tES
- fNIRS
- fMRI
- MEG
- Eye-Tracking
- Peripheral stimulation
- ECoG / LFP
- Video Recording



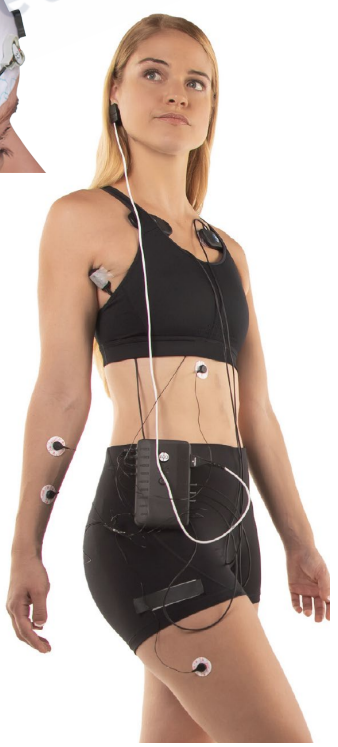
PREPARE THE SUBJECT

Right fit of the Cap

- Measure the head circumference with the measurement tape (Starter Kit) in centimeters
- Choose the appropriate cap size (last two digits on label)
- Wipe forehead with alcohol wipes
- Measure from Nasion to Inion, and mark the first 10% from the Nasion
- Apply Cap on the participants head, frontal electrodes first
- Close the chinstrap. Fix electrodes with addition double-side adhesive rings (i.e. Fp1-2, Mastoids)

Additional measures

- Passive BiPolar recordings for EMG, ECG/EKG, EOG, GSR, respiration, accelerometers can be applied.
- Electrode can be applied with double-side adhesive ring, and tape

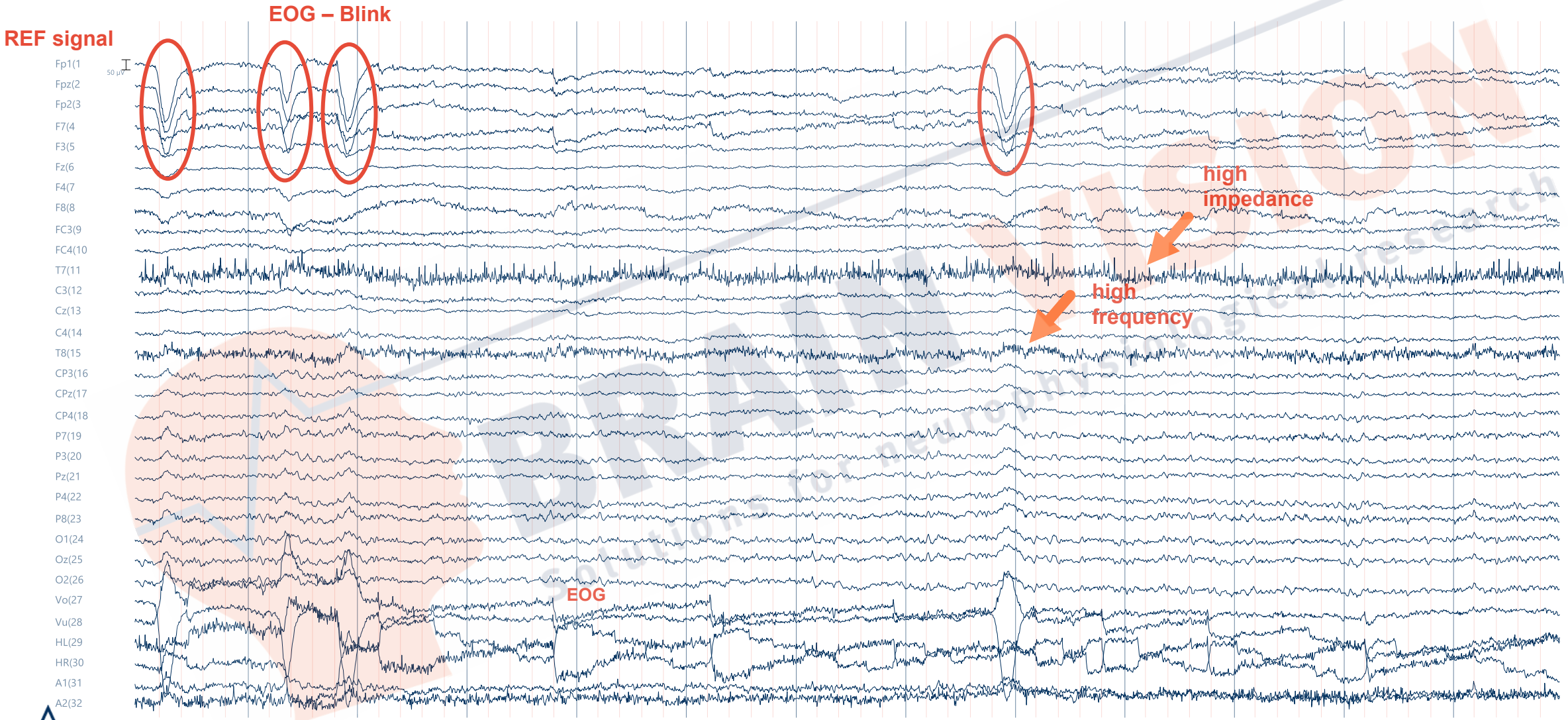


PREPARE THE SUBJECT

All impedances below 50kOhm or lower (signal quality)

- Rubbing alcohol to cut through natural skin oils
- Part the hair at each site
- Fill all electrodes will gel
- Go thru and abrade each position, refilling with gel
- Once the 50kOhm mark is reached, go for the <20kOhm range for good quality
- Each application and environment requires a different impedance for optimal signal quality

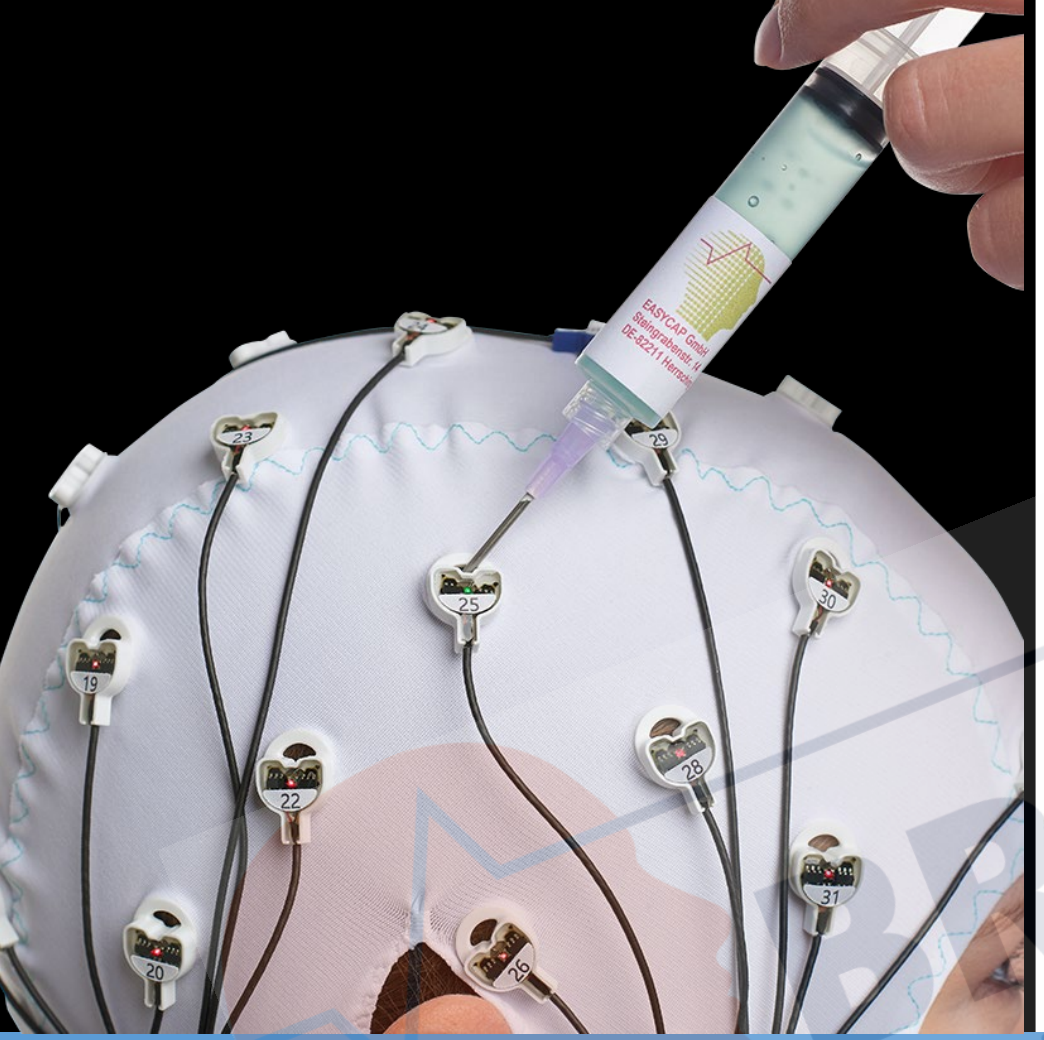
EEG –SIGNAL


EOG – Blink
REF signal
Fp1(1
Fpz(2
Fp2(3
F7(4
F3(5
Fz(6
F4(7
F8(8
FC3(9
FC4(10
T7(11
C3(12
Cz(13
C4(14
T8(15
CP3(16
CPz(17
CP4(18
P7(19
P3(20
Pz(21
P4(22
P8(23
O1(24
Oz(25
O2(26
Vo(27
Vu(28
HL(29
HR(30
A1(31
A2(32
high impedance
high frequency
EOG

Practical Demo

- Eyes Open / Eyes closed
- Muscle artifacts
- Markers/Triggers considerations

- Questions?


EASYCAP GmbH
Steingrabenstr. 14
DE-82211 Herrsching
23
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-800k
µV 0
800k
No TMS Artifact
TMS Artifact
Muscle Artifact
No TMS Artifact
0
1
2
milliseconds
NIRX

Thank You!