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Mobile Brain EEG

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Mobile Brain EEG

Terminology

Motivation

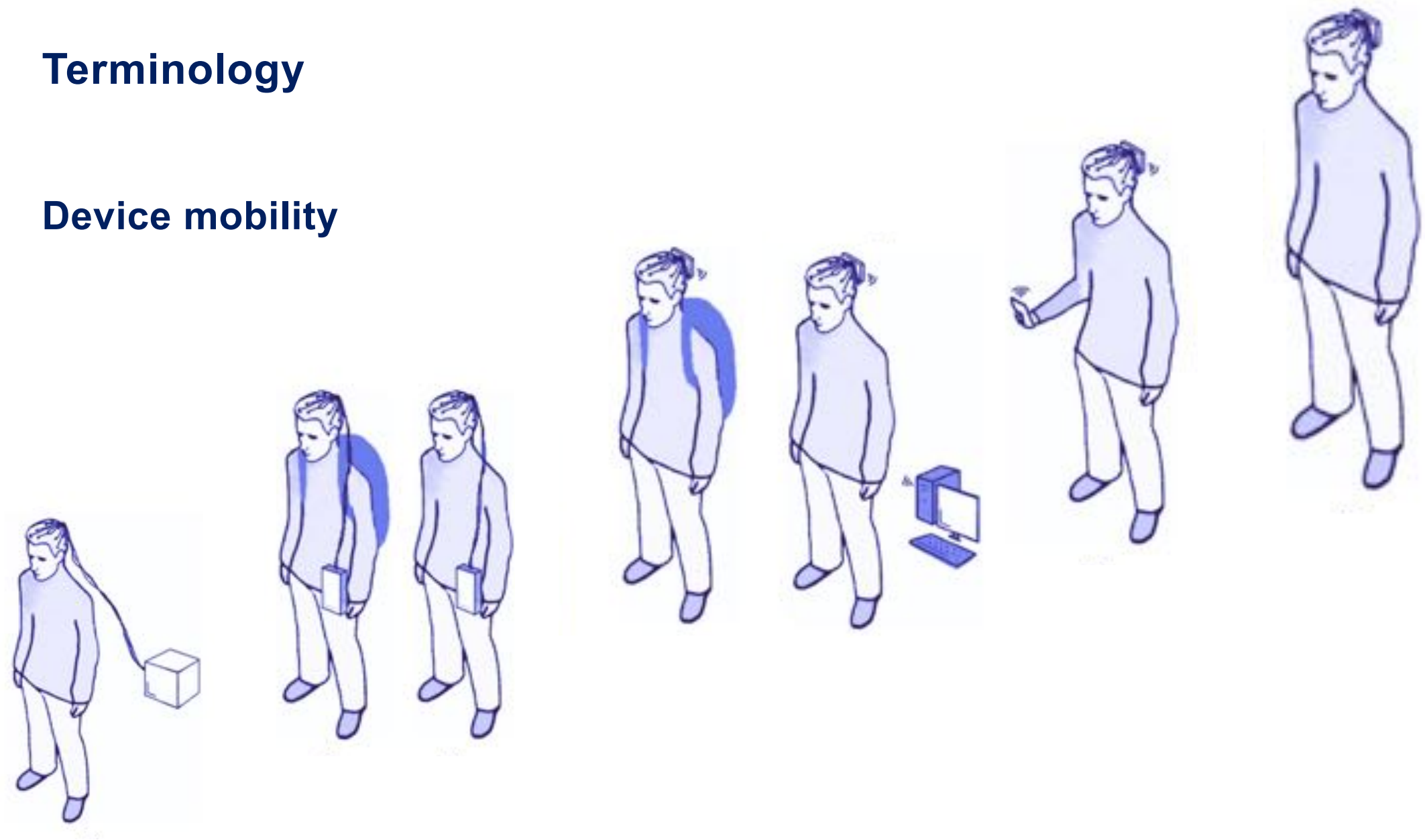
Results & Ideas

Terminology

wearable EEG wireless EEG
smartphone EEG EEG to go
Transparent EEG
Ear EEG
motion-tolerant
Mobile EEG
unobtrusive EEG
Ambulatory EEG
Portable EEG
ecologically valid

Terminology

Device mobility



Bateson et al., (2017). Categorisation of mobile EEG: A researcher's perspective. *BioMed Research International*

Terminology

Device mobility

Participant mobility

Bateson et al., (2017). Categorisation of mobile EEG: A researcher's perspective. *BioMed Research International*

Terminology

Device mobility

Participant mobility

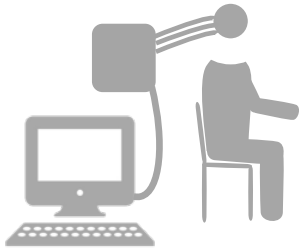
System specification

TABLE 6: System specification scores.

System attribute[1]	1
Bit resolution (bits)	14
Sampling rate (Hz)	125 or 128
Battery life (hours)	Mains, USB or equivalent

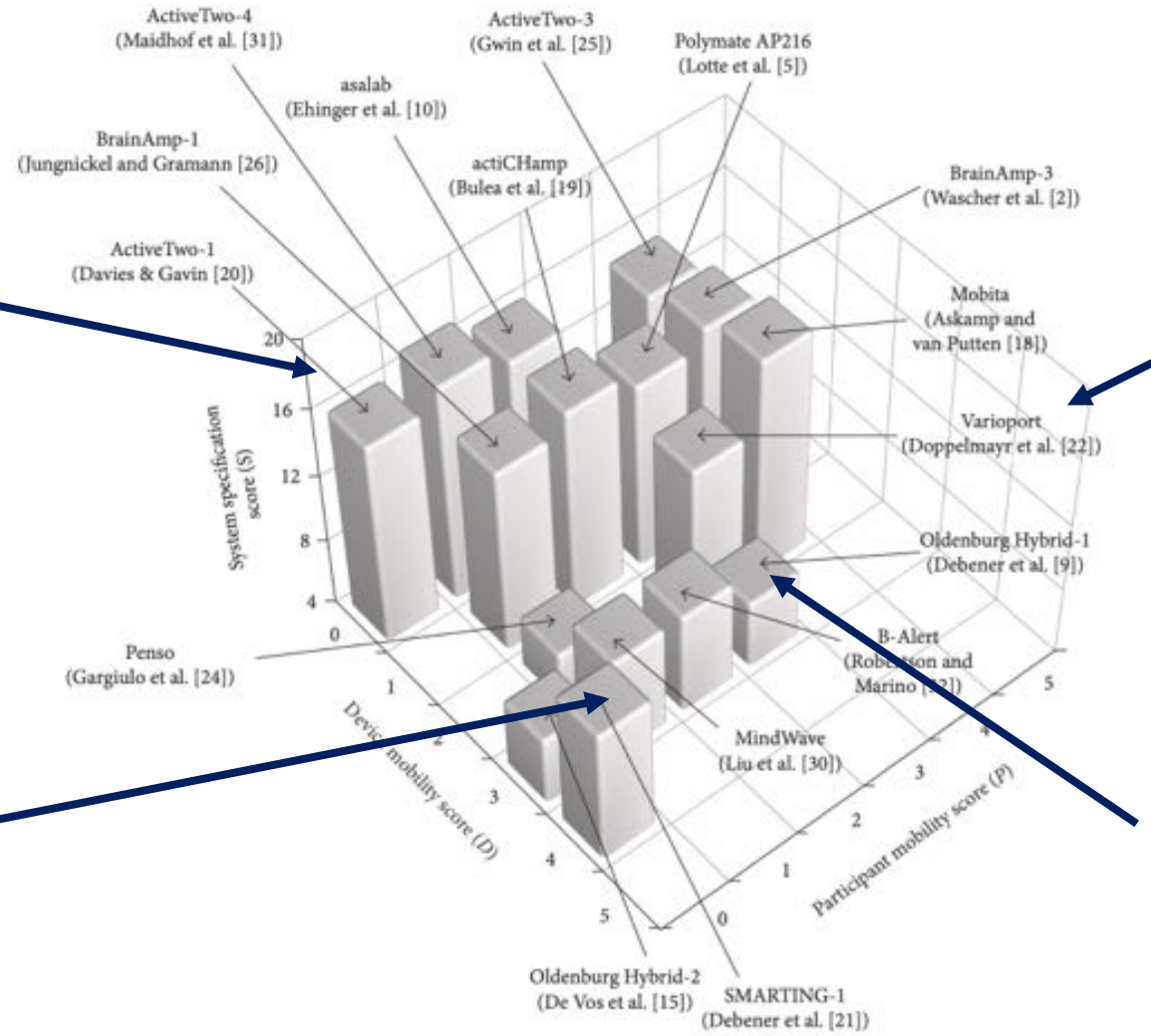
Bateson et al., (2017). Categorisation of mobile EEG: A researcher's perspective. *BioMed Research International*

Terminology



0D, 0P, 17S, 96C

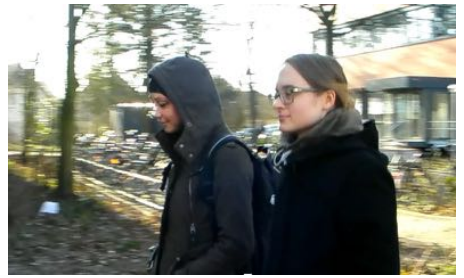
Transparent EEG
Bleichner & Debener, 2017



Debener et al., 2015

4D, 0P, 12S, 16C

Debener et al., 2012



3D, 3P, 8S, 14C

Bateson et al., (2017). Categorisation of mobile EEG: A researcher's perspective. *BioMed Research International*

Terminology

Table 5: Electrode type scoring.

Passive (0) Active (1)	Unshielded (0) Shielded (1)	Dry (1) Wet (2) Gel (3)

Do active electrodes outperform passive electrodes at modest participant mobility?

Bateson et al., (2017). Categorisation of mobile EEG: A researcher's perspective. *BioMed Research International* doi.org/10.1155/2017/5496196

Terminology

64ch active electrodes:

Device mobility score 1

www.brainproducts.com

64ch passive electrodes:

Device mobility score 3

Scanlon et al., (2020). Does electrode amplification style matter? A comparison of active and passive EEG system configurations during standing and walking *European Journal of Neuroscience*

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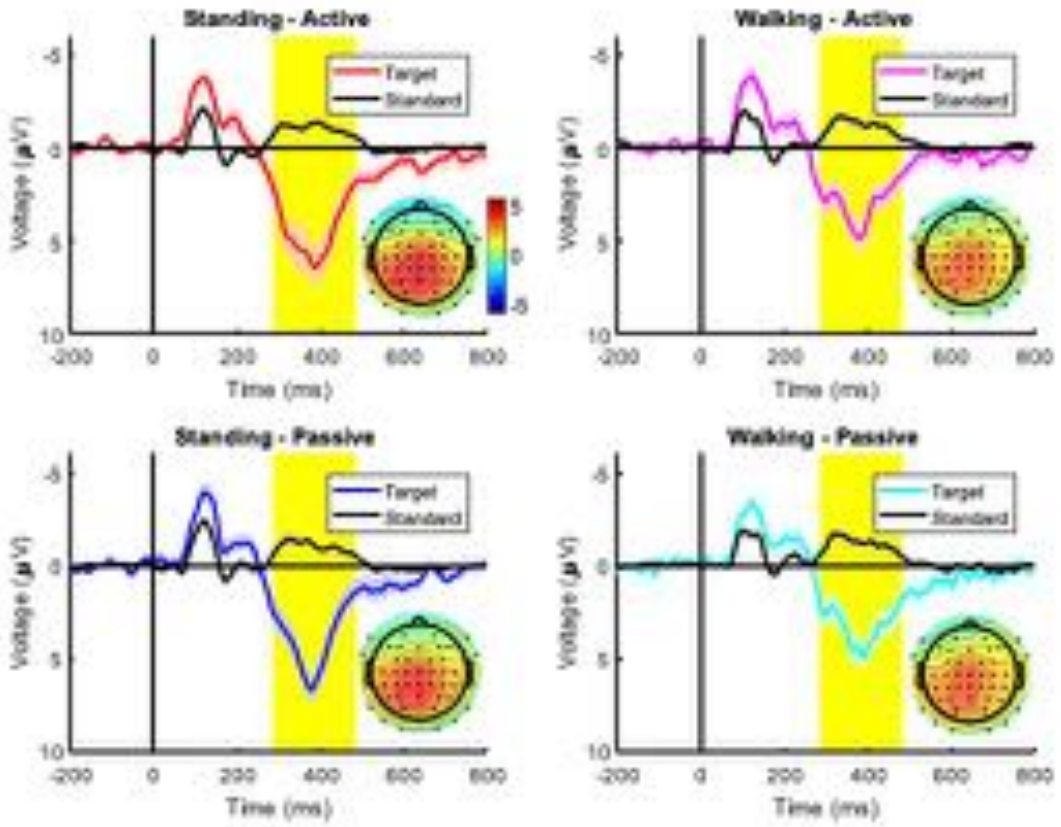

No evidence in favour of active electrodes

Scanlon et al., (2020). Does electrode amplification style matter? A comparison of active and passive EEG system configurations during standing and walking *European Journal of Neuroscience*

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Terminology

Take home

Mobile EEG claims should be substantiated with evidence based on at least modest participant AND modest device mobility levels.

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Mobile Brain EEG

Terminology

Motivation

Results & Ideas

Motivation

Real-world neuroscience
Brain-behavior relationship
Ecological Validity
Natural study conditions
Next generation tool
Real-life
Daily-life
Home monitoring
Brain-Body Imaging
Motor cognition

Holleman et al., (2020).
Frontiers Psychology

Why is physical activity beneficial for brain & cognition?

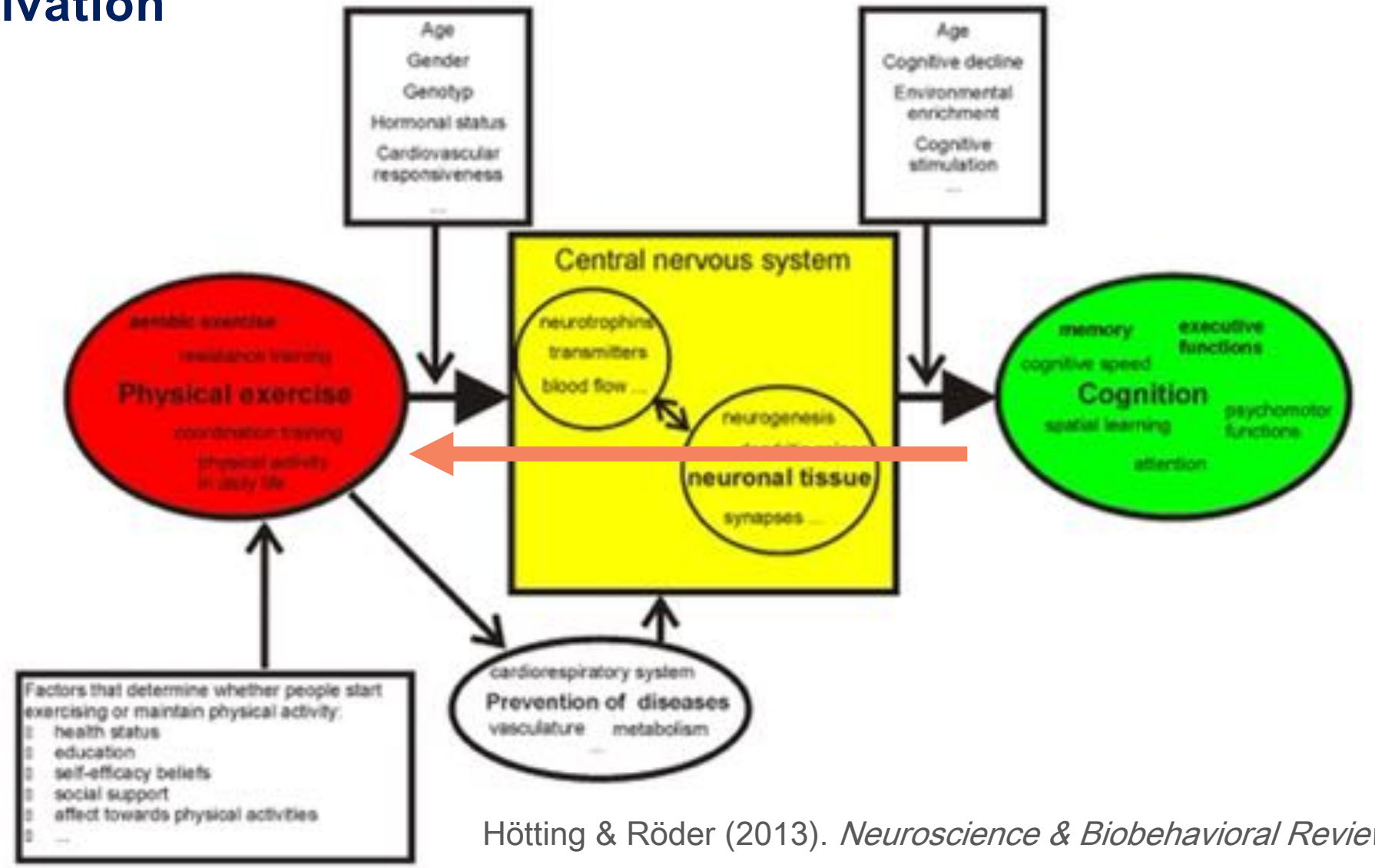
Motivation

Physical activity keeps brain & cognition in shape

- Age-related hippocampus decline can be slowed down
- Benefits in particular for episodic memory
- Physical activity has beneficial effects for depresssion
- Slowing of gait predicts MCI
- ...

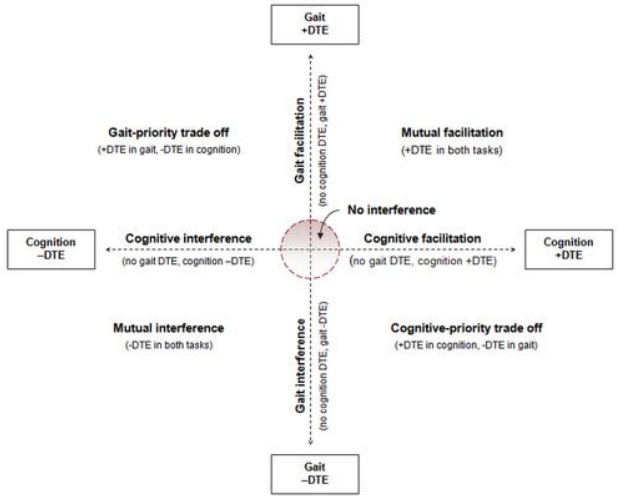
-> Physical activity is a cornerstone for healthy aging

Motivation



Hötting & Röder (2013). *Neuroscience & Biobehavioral Reviews*

Motivation



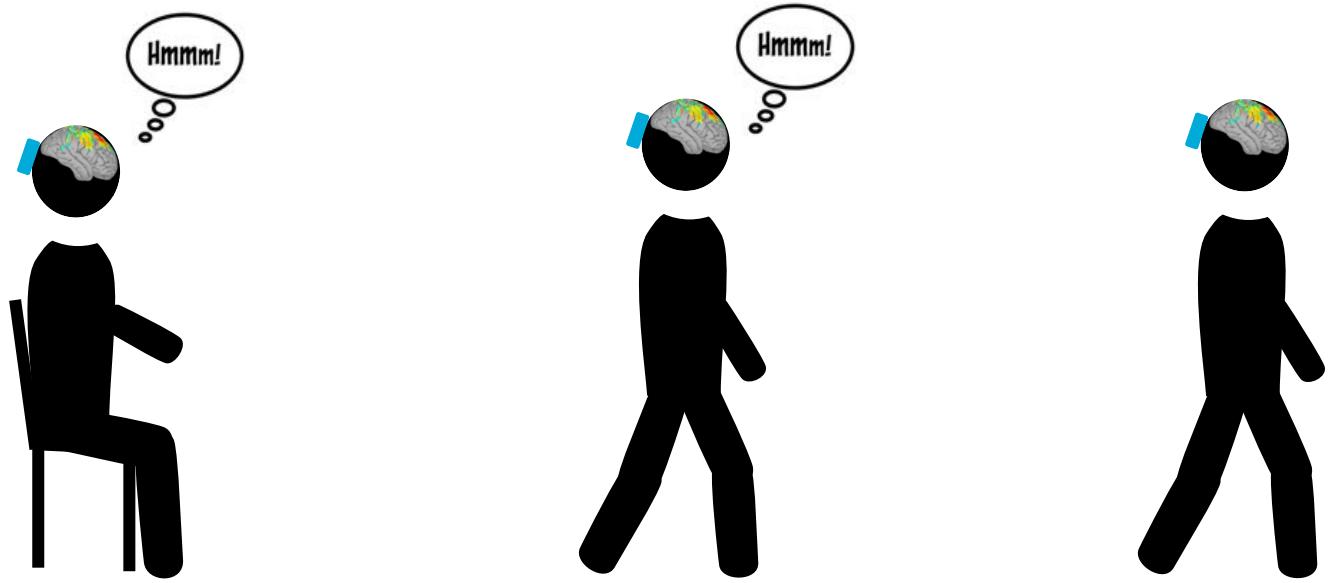
Plummer & Eskes (2015). *Frontiers in Human Neuroscience*

How cognitively demanding is physical activity?

Dual task approach:

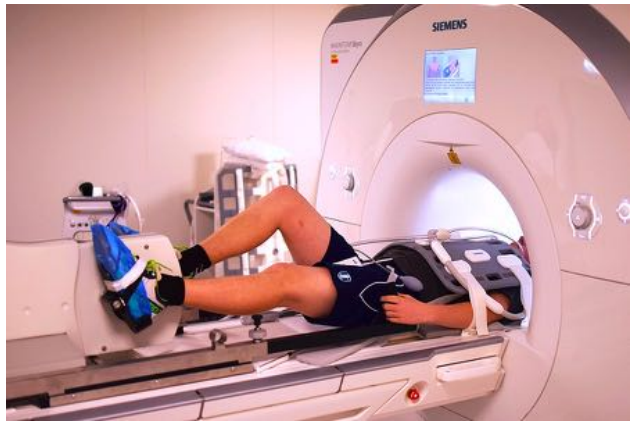
Neural correlates of cognitive task at rest vs. during physical activity

Neural correlates of physical activity alone vs during cognitive task



Motivation

Mobile EEG can capture the neural correlates of cognitive and motor processes



Matthias Seehase, UMG

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Mobile Brain EEG

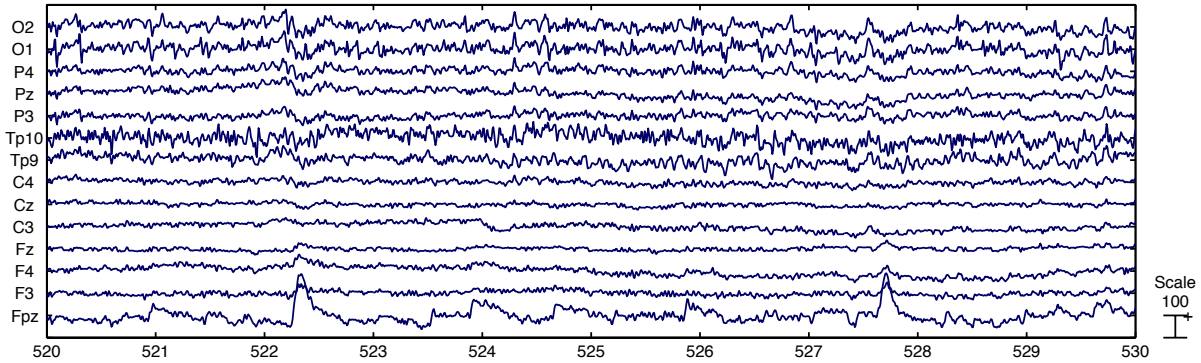
Terminology

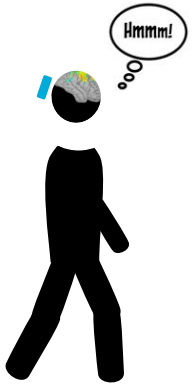
Motivation

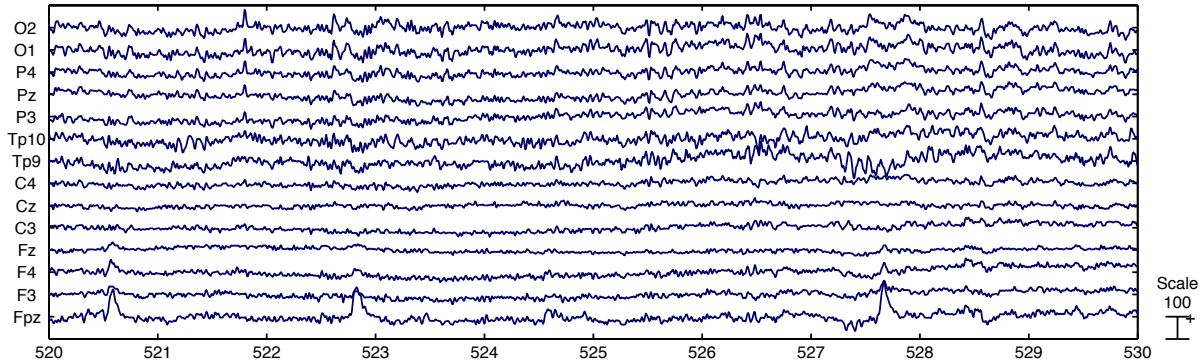
Results & Ideas

Results & Ideas: Gait

Auditory oddball task sitting vs walking outdoors



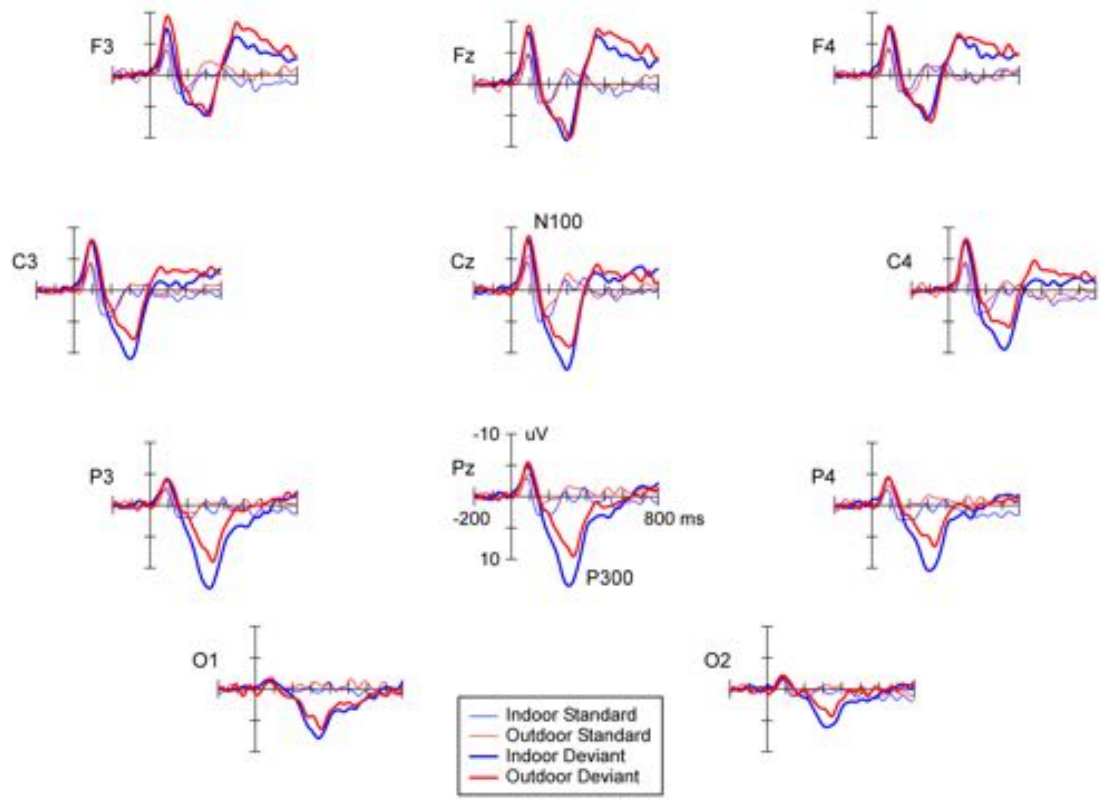




Debener et al., (2012). How about taking a low-cost, small and wireless EEG for a walk? *Psychophysiology*

Results & Ideas: Gait

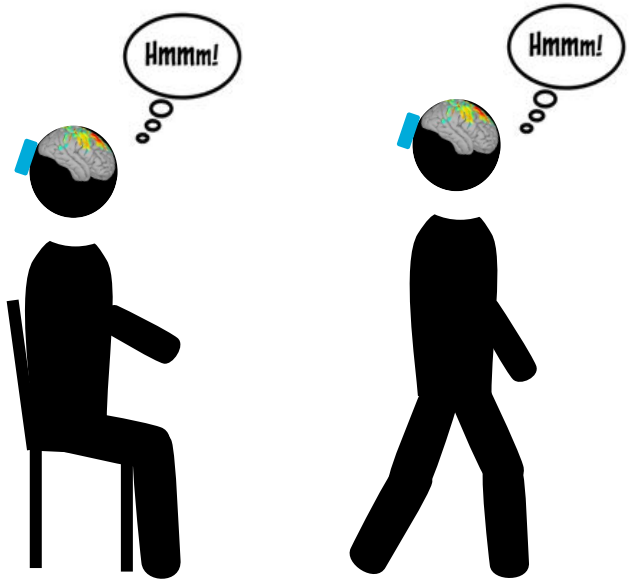
Auditory oddball task sitting vs walking outdoors



Debener et al., (2012). How about taking a low-cost, small and wireless EEG for a walk? *Psychophysiology*

Results & Ideas: Gait

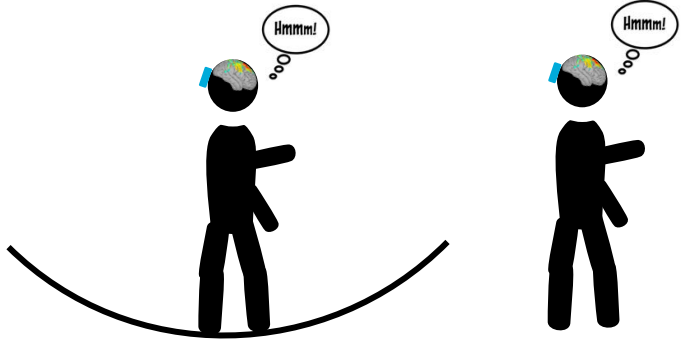
P300 reduction captures the cognitive demands of physical activity



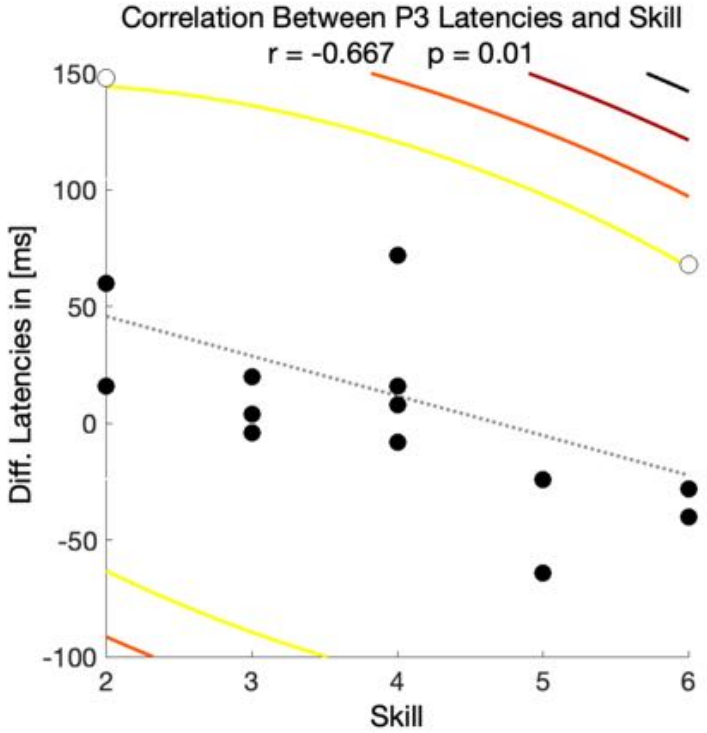
See
Debener et al., 2012
De Vos et al., 2014
Ladouce et al., 2019
Scanlon et al., 2020
…

Could this be confounded by residual movement artifacts?

Results & Ideas: Beyond gait



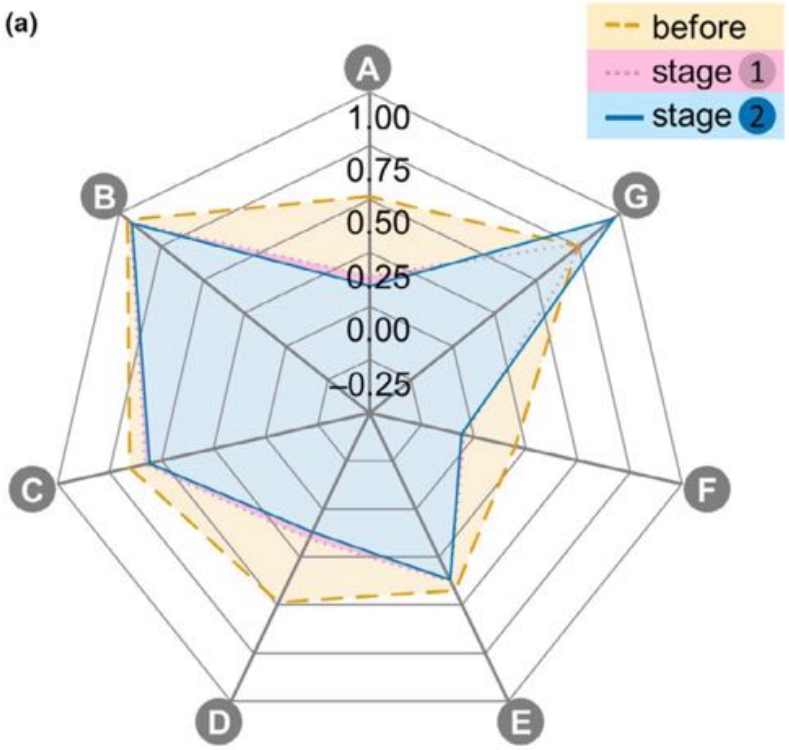
P300 amplitude and latency during slacklining vs standing

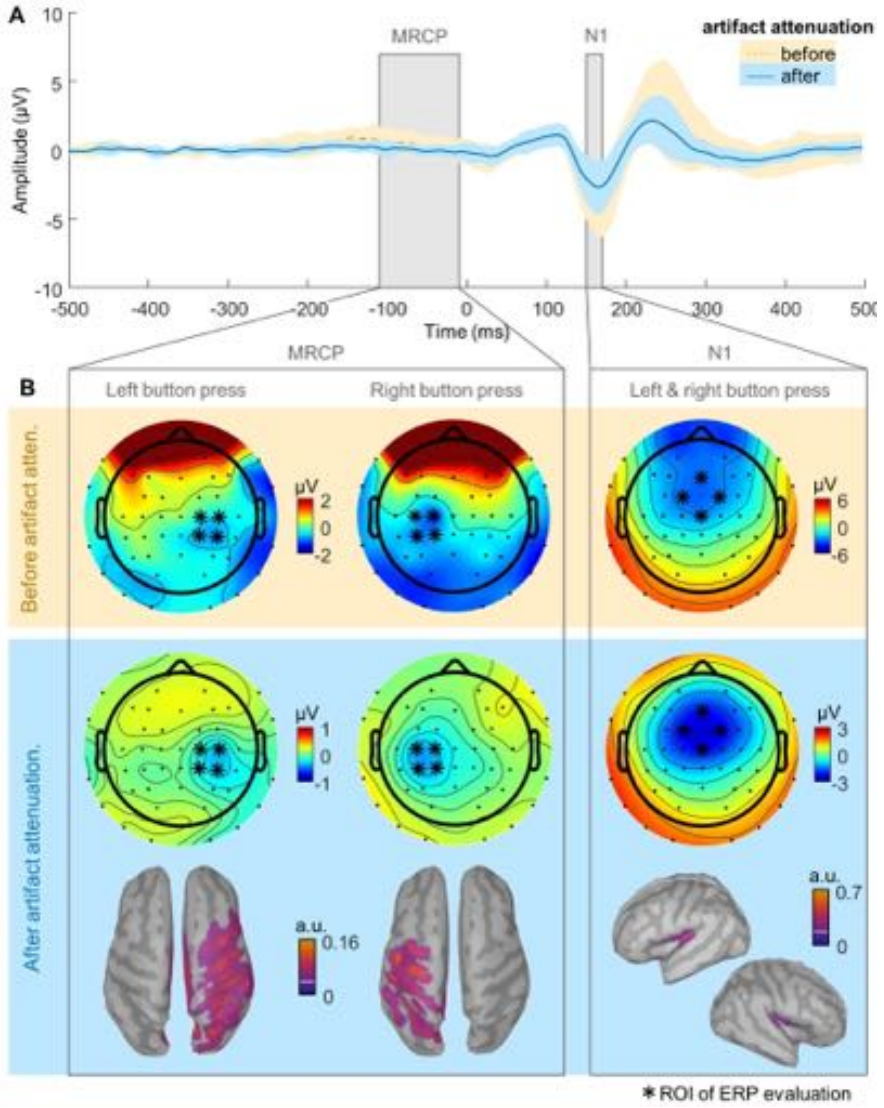


Lara Papin (2022). *Master thesis, University of Oldenburg.*

Results & Ideas: Artifacts

Arifact reduction strategy should include measures of sensitivity and specificity





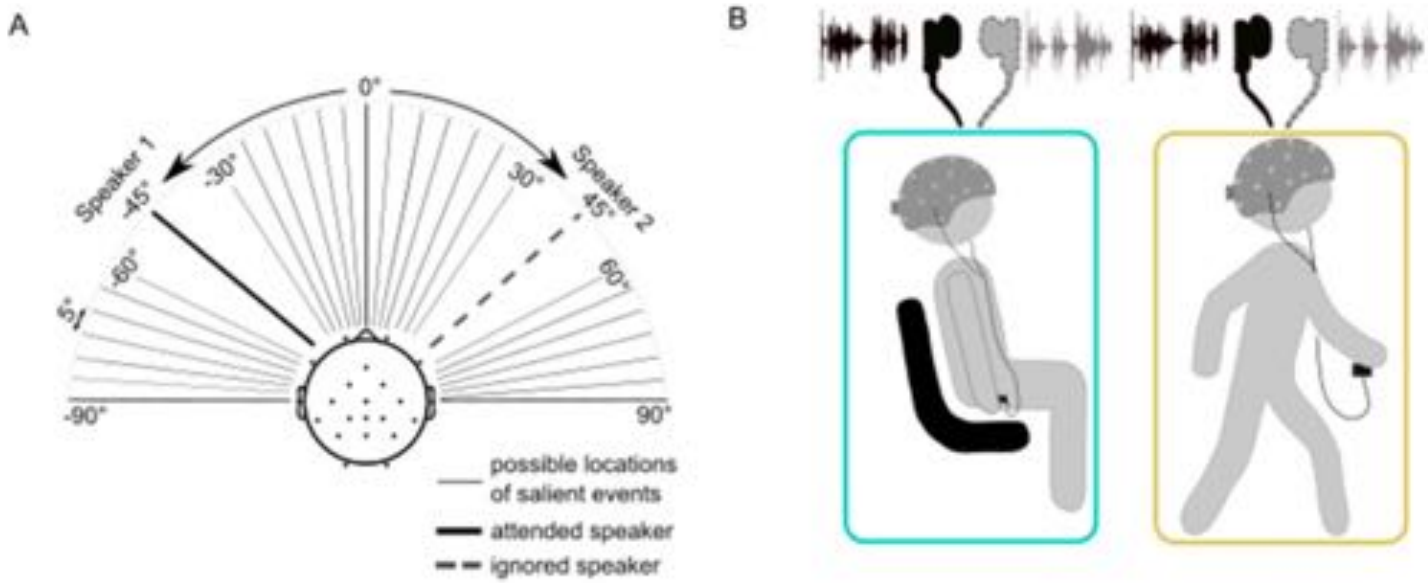
Jacobsen et al., (2020). A walk in the park? Characterizing gait-related artifacts in mobile EEG recordings. *European Journal of Neuroscience*

Results & Ideas: Attention tracking to go

Capturing bottom-up and top-down processes of attention

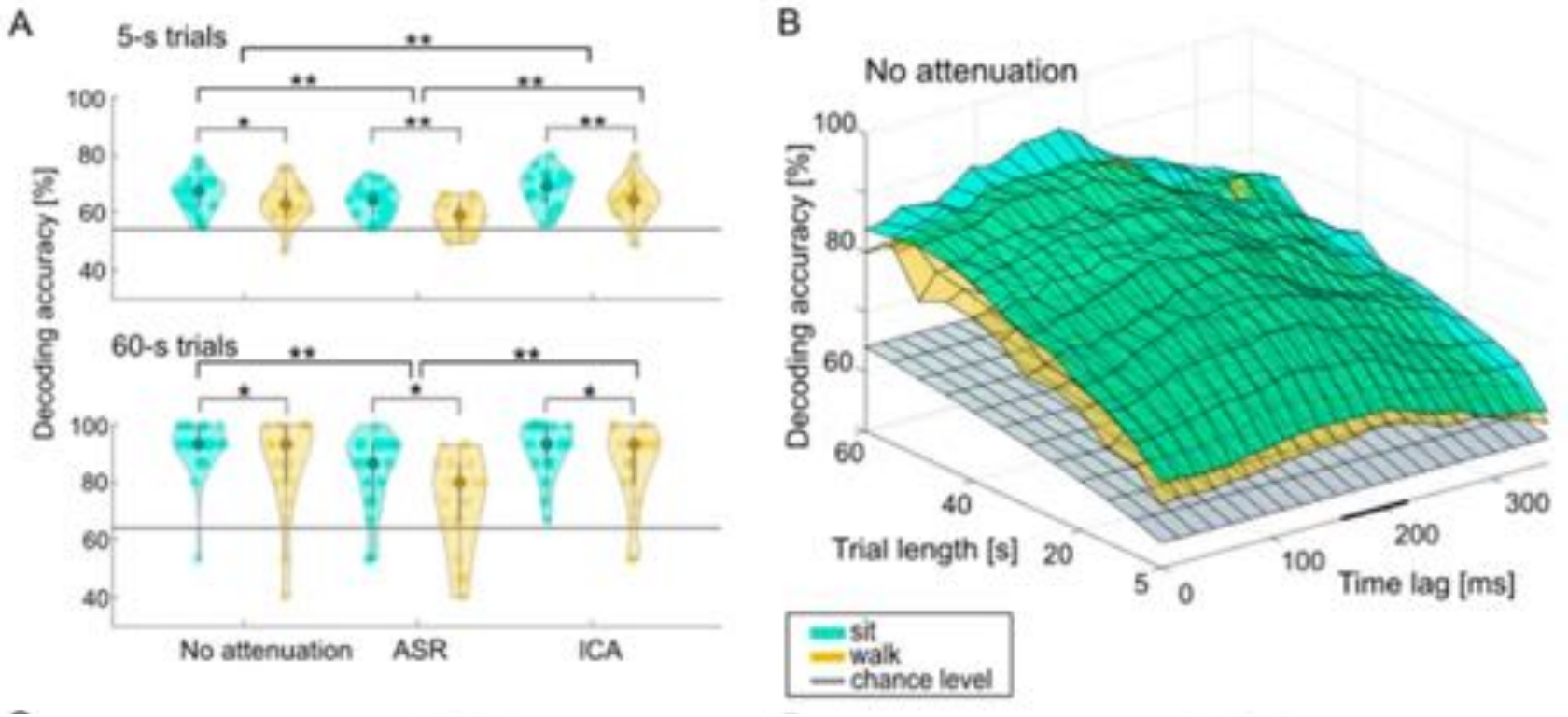
Task: Listen to one of two concurrently played audiobooks

Analysis: attention decoding by envelope tracking (mTRF, Crosse et al., 2016)



Straetmans et al., (2021). Neural tracking to go: auditory attention decoding and saliency detection with mobile EEG *Journal of Neural Engineering*

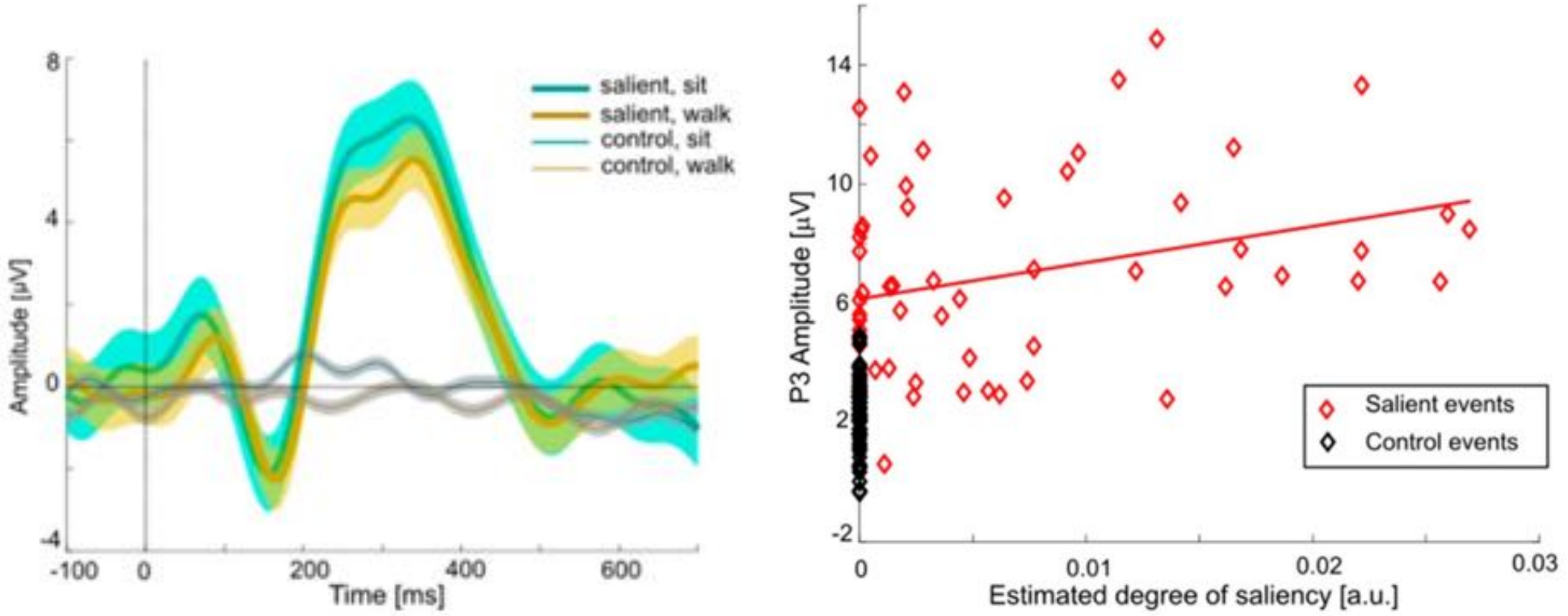
Results & Ideas: Attention tracking to go



Straetmans et al., (2021). Neural tracking to go: auditory attention decoding and saliency detection with mobile EEG *Journal of Neural Engineering*

Results & Ideas: Attention tracking to go

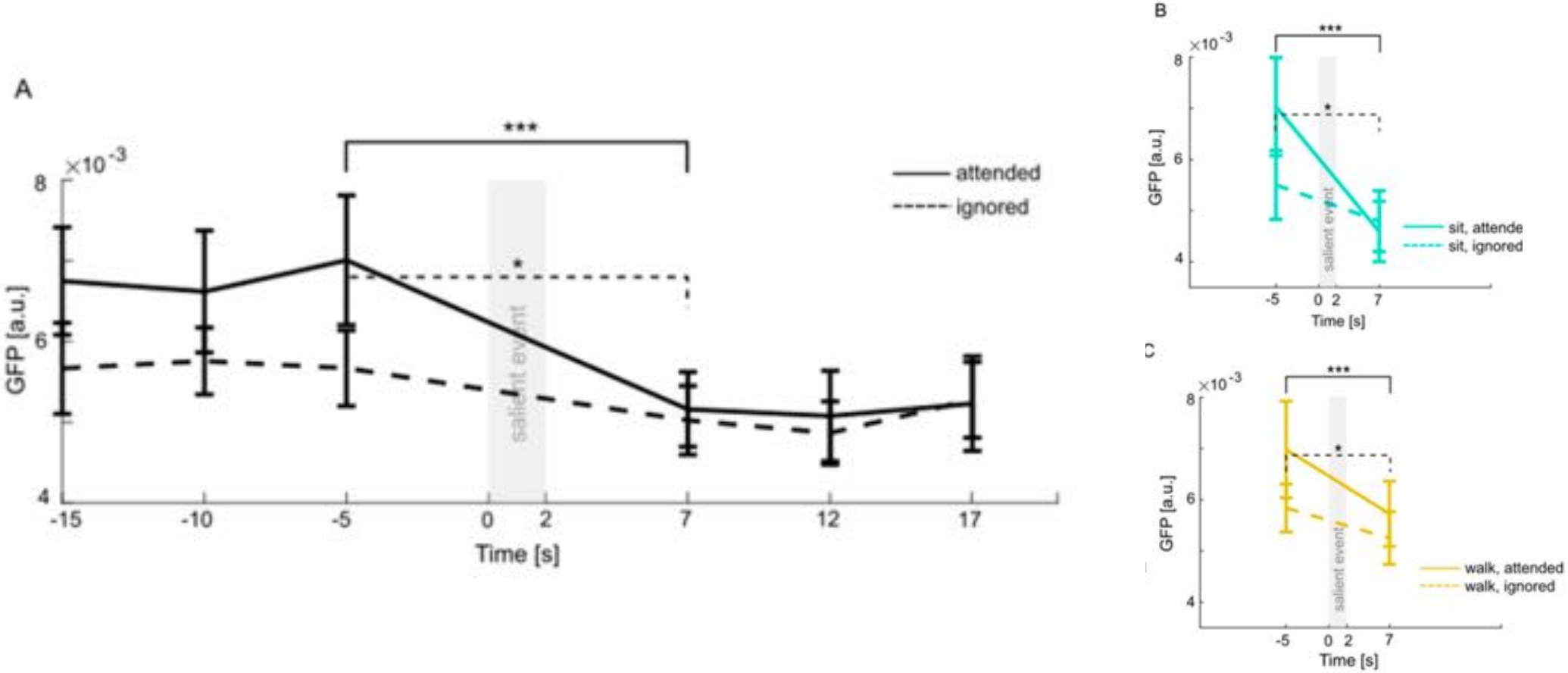
Novelty-P3 amplitude correlates with computational model of auditory saliency (cf. Kaya & Elhiali, 2014)



Straetmans et al., (2021). Neural tracking to go: auditory attention decoding and saliency detection with mobile EEG *Journal of Neural Engineering*

Results & Ideas: Attention tracking to go

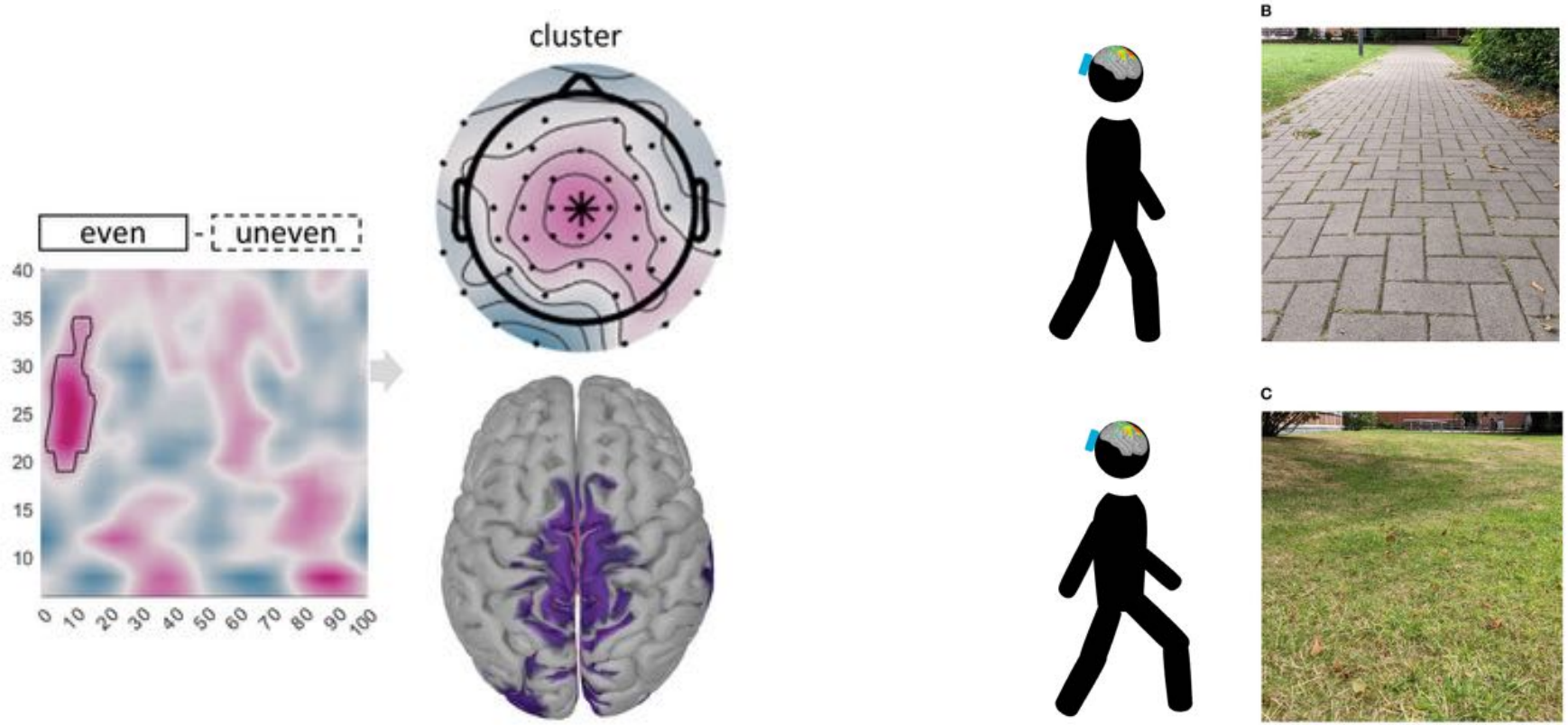
Dynamics of distraction can be captured, even during walking



Straetmans et al., (2021). Neural tracking to go: auditory attention decoding and saliency detection with mobile EEG *Journal of Neural Engineering*

Results & Ideas: What‘s next?

Gait-phase related power modulations in the beta band reflect terrain-dependent gait control demands



Jacobsen et al., (2022). Mobile EEG captures differences of walking over even and uneven terrain *Frontiers in Sports and Active Living*

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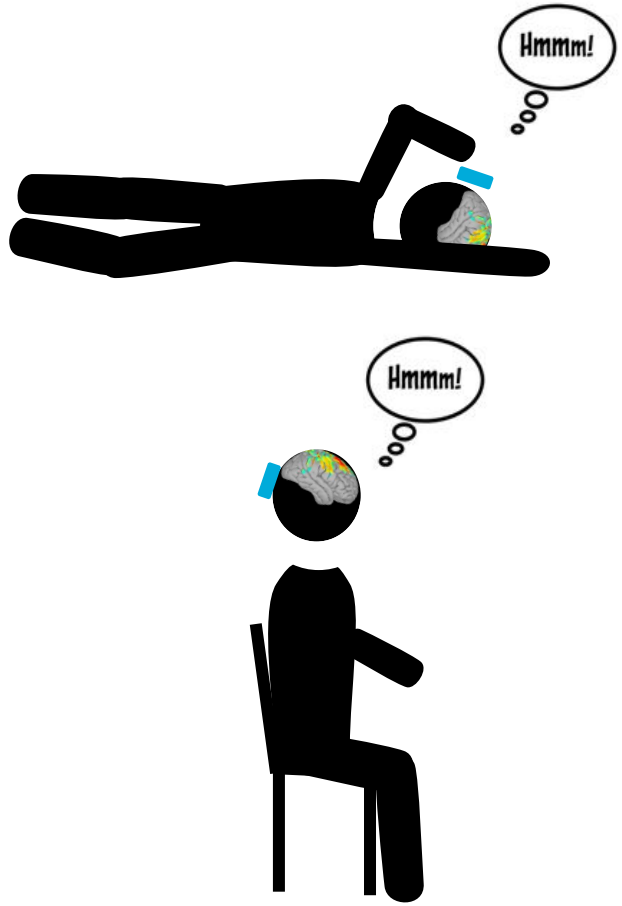
Results & Ideas: What‘s next?

Integrate the dynamics of physical activity, using IMUs

Results & Ideas: What‘s next?

Integrate the dynamics of physical activity, using IMUs

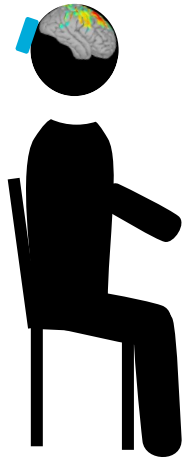


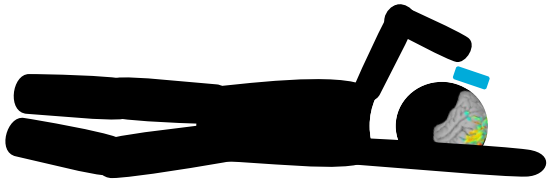
Outlook

Mobile EEG with high device mobility and system specification is needed

Mobile EEG offers insights into the cognitve demands of physical activity

This may help to develop individualized programs facilitating healthy aging





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Hearing 4all

neli neurophysiology of everyday life

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DFG Deutsche Forschungsgemeinschaft