

Carsickness in real driving conditions induces changes in EEG activity

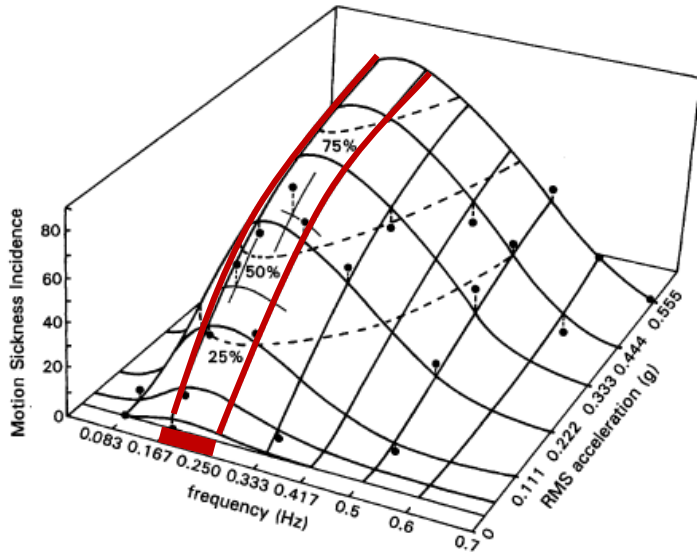
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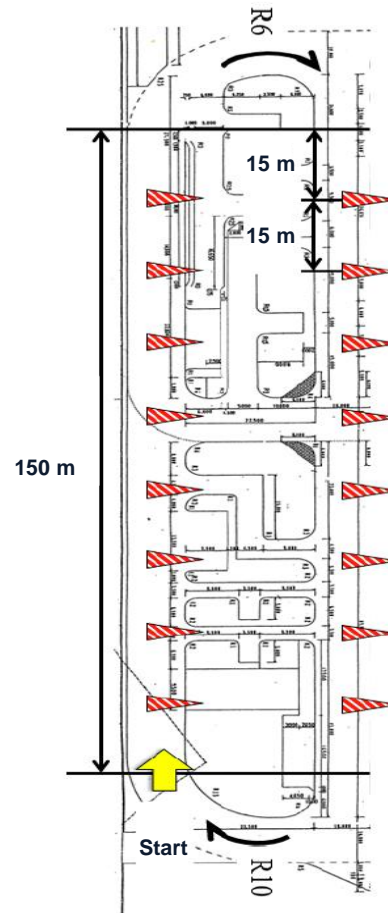


Vehicle Dynamic



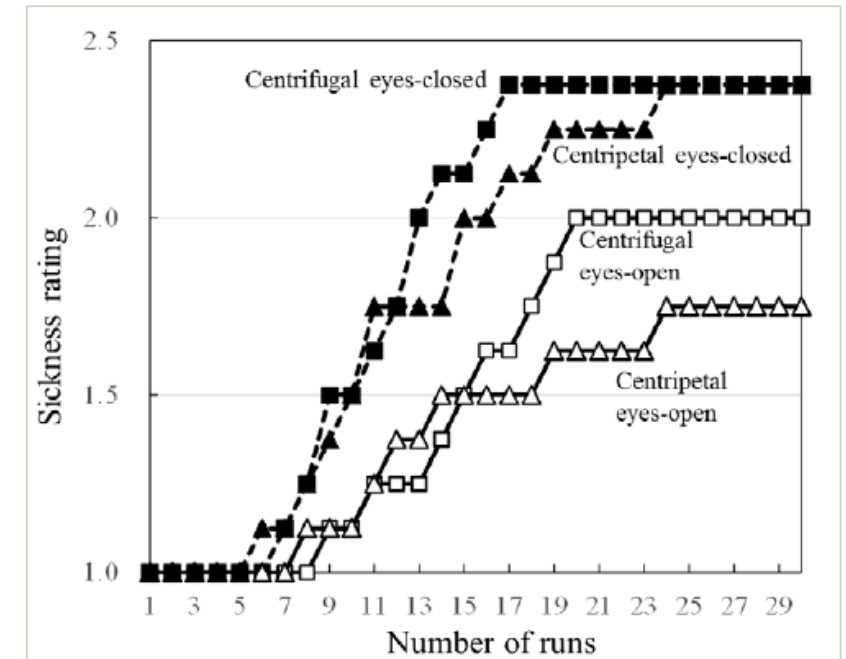
Bles & Bos, 1998

- Low frequency **vertical** movements induce **motion sickness** symptoms



Slaloms – Curved Road with 0,2 Hz movements

Wada & Yoshida, 2015



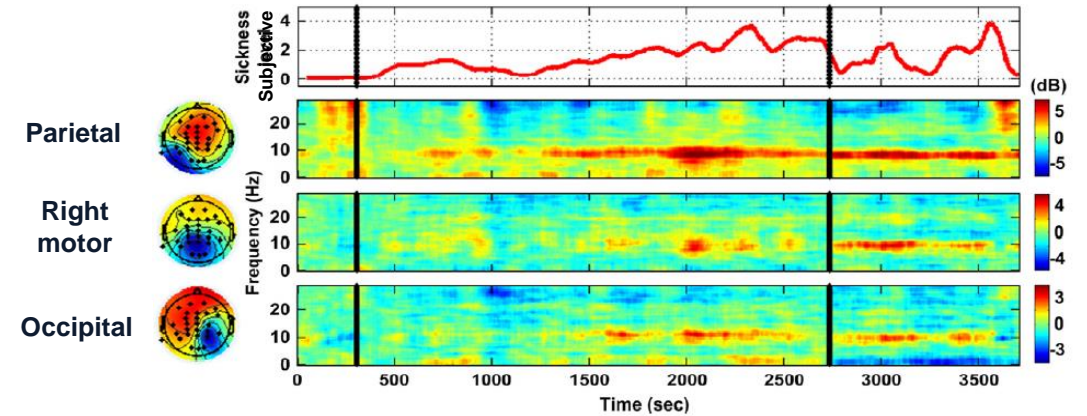
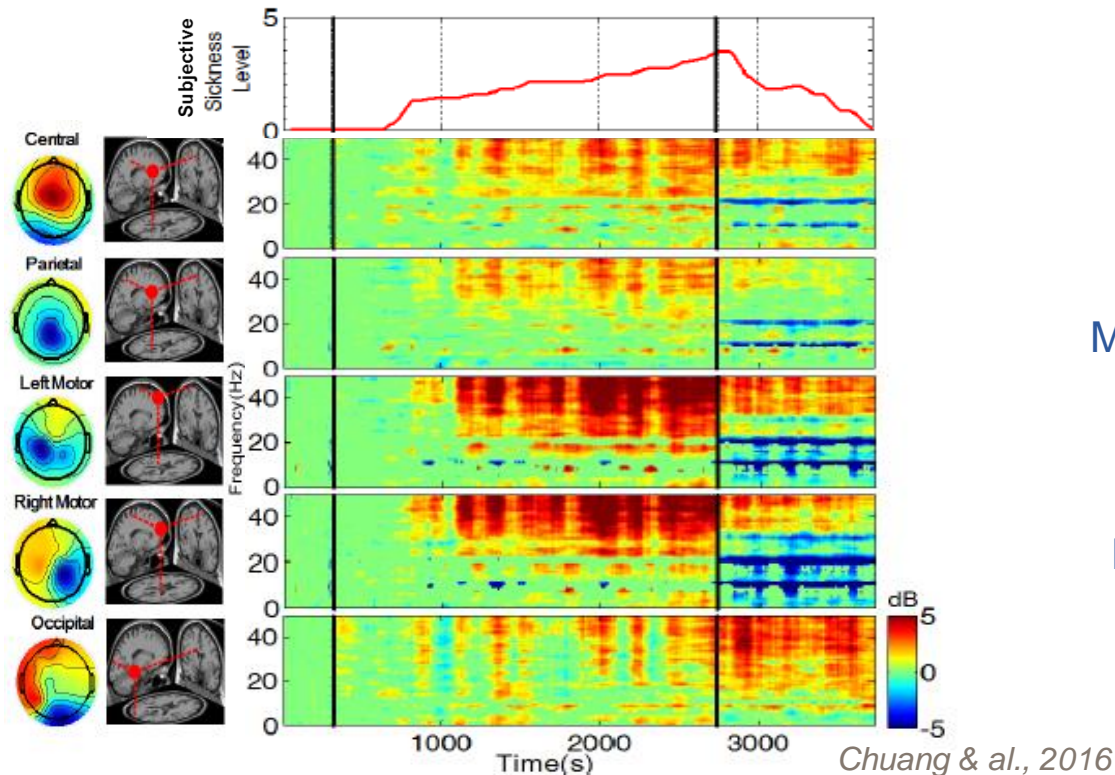
Wada & Yoshida, 2015

- Low frequency **lateral** movements induce **car sickness** symptoms

Simulator sickness and Cerebral activity



Lin & al., 2007



Main EEG dynamic changes related to motion sickness **occipital, parietal and somatosensory** brain areas



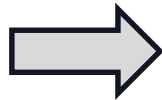
Increase of power in **alpha and theta** bands which had positive correlation with the subjective motion sickness level

Objectives

Simulator conditions \neq real driving conditions



Necessary to focus on carsickness in real driving conditions



Identifying cerebral activity changes induced by carsickness symptoms in real driving conditions

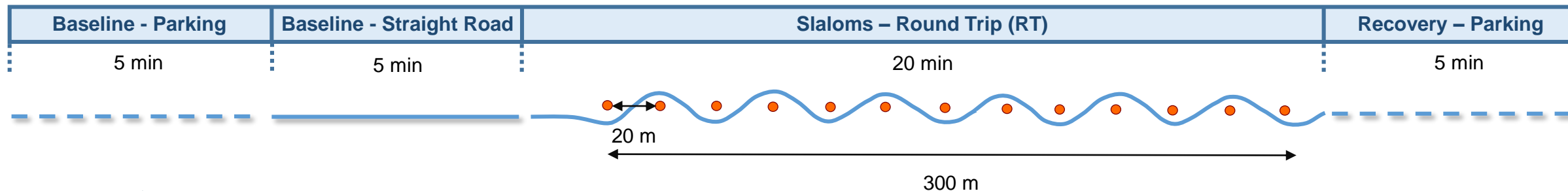
Experimental protocol

n = 9 participants
(41.8 ± 9.1 yo)



Vehicle : **C4 Picasso Citroën**
Movement frequency : **0.2 Hz**
Regulated speed : **35 km/h**

Protocol



Measurements

Bas.

RT_{start}

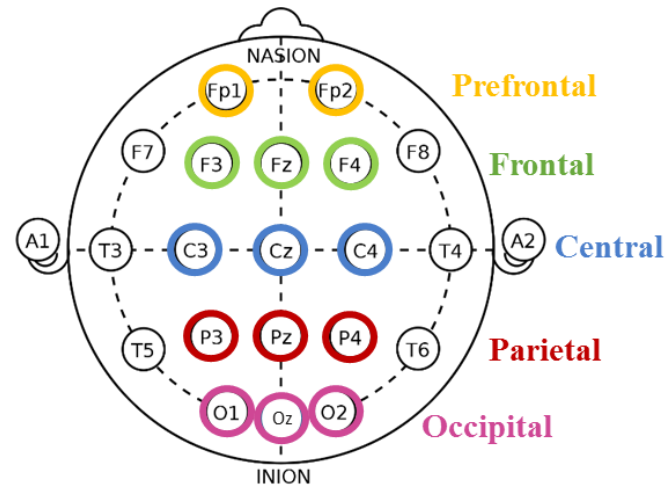
RT₊₊

RT_{stop}

Recov.

Measurements

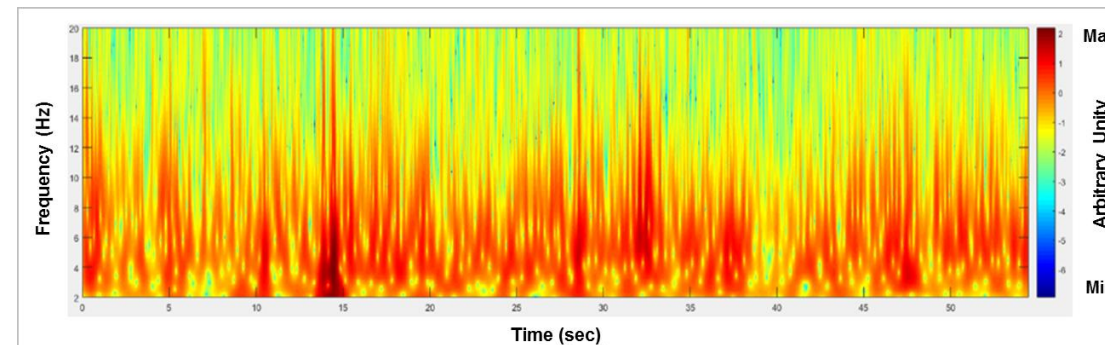
 Carsickness ratings

 EEG recordings


System EEG
14 electrodes

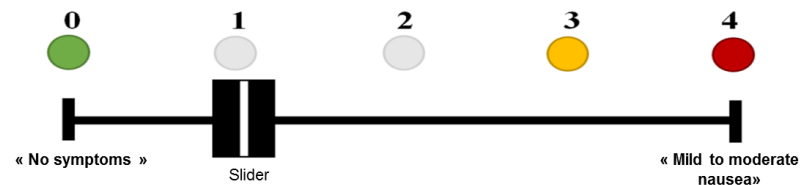
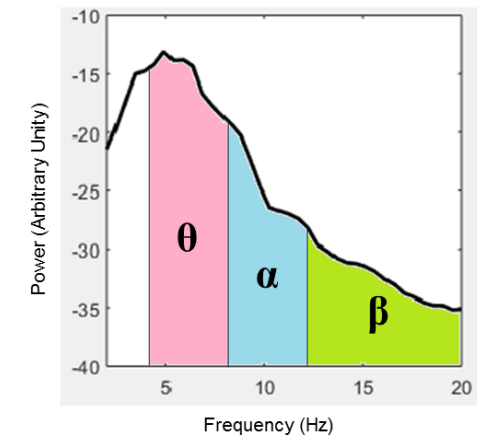


Time-frequency analysis



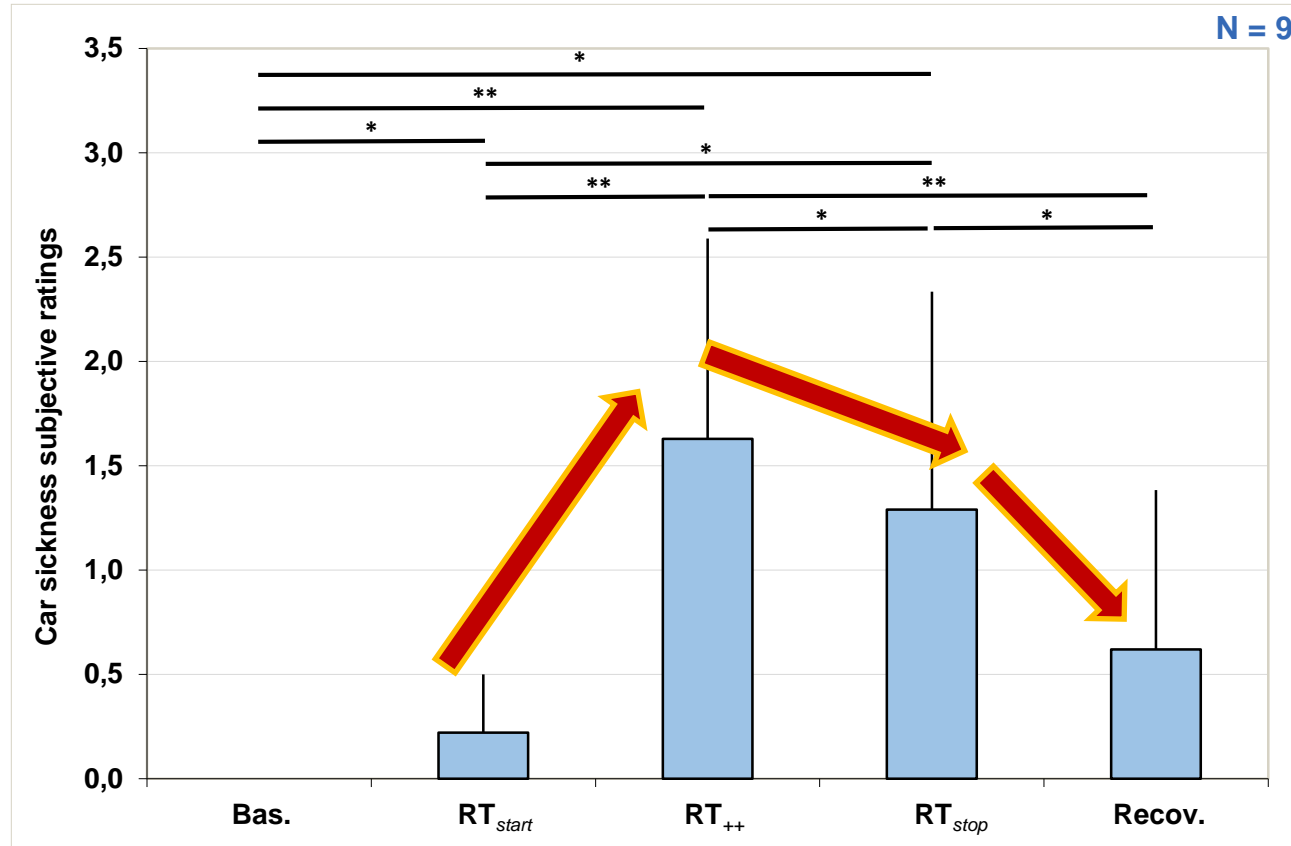
RT (60 sec)

Power in frequency bands



Griffin et Newman, 2004

Car sickness ratings



Low frequency lateral movements

- emergence of carsickness symptoms
- stopping these movements allows for recovery

Bos & Bles, 1998 ; Wada & Yoshida, 2015

➡ Cumulative effect

*Bos & Bles, 1998 ; Chen & al., 2010 ;
Wada & Yoshida, 2015*

➡ Habituation phenomena

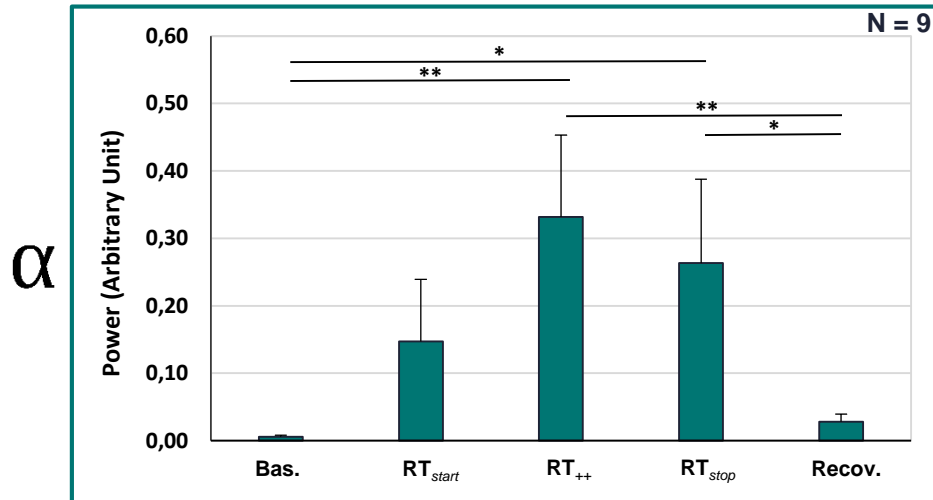
Golding, 2006 ; Wada & Yoshida, 2015

* p<0.05 ; ** p<0.01

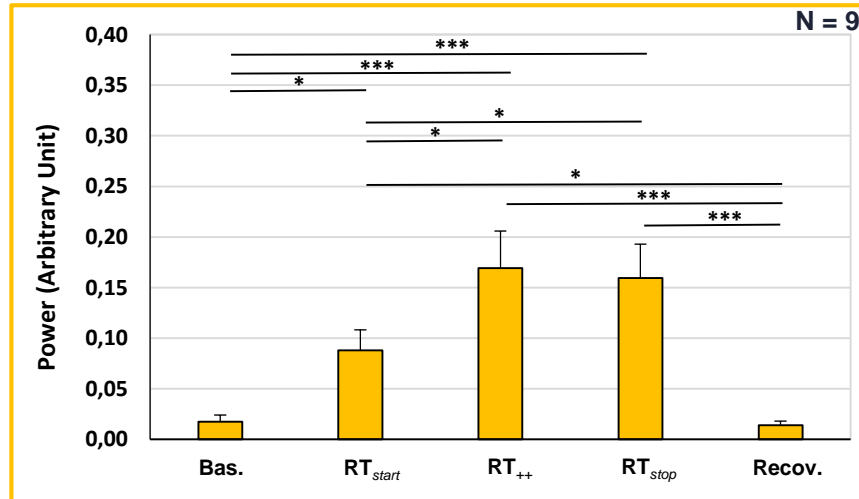
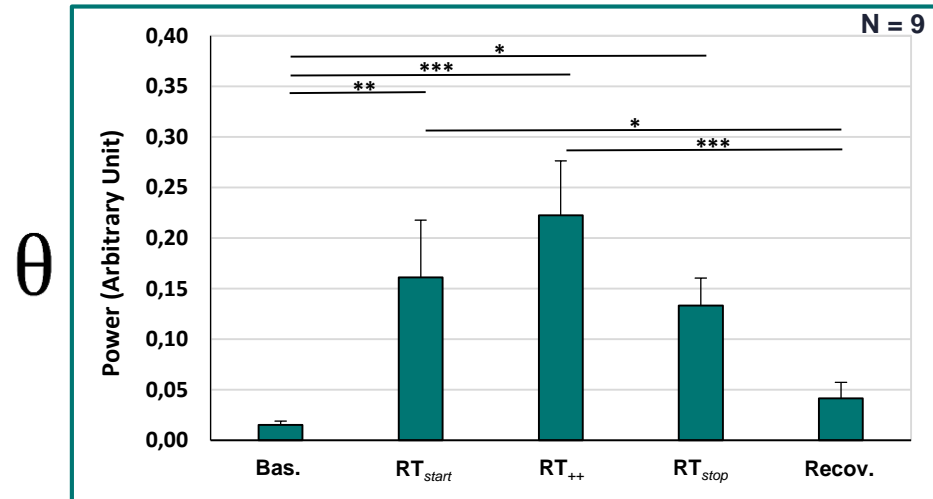
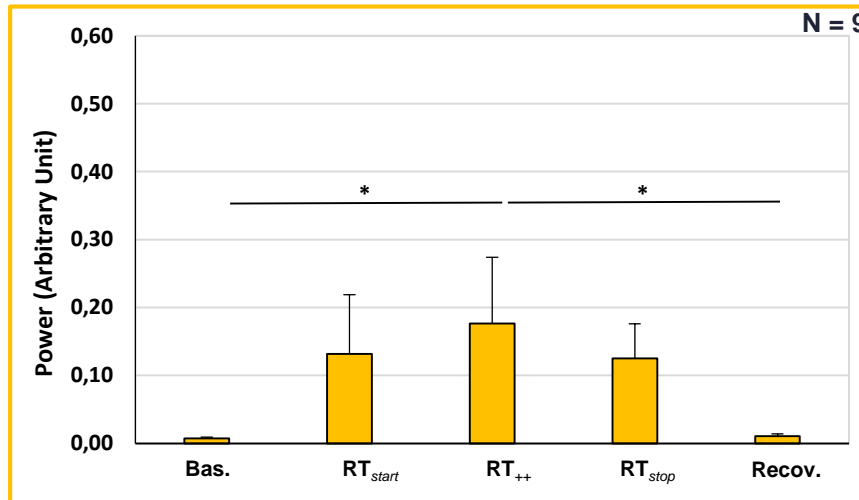


EEG recordings

Parietal area



Occipital area



Changes in cerebral activity

➔ Reduced integration of sensory inputs

Chen & al., 2010 ; Chuang & al., 2016

➔ Sleepiness symptoms

Sauvet et al., 2014

* p<0.05 ; ** p<0.01 ; *** p<0.001

Conclusion and perspectives

- ✓ **Validated methodology to induce carsickness symptoms**
 - ➔ Increase of carsickness ratings
- ✓ **Carsickness in real driving conditions induces changes in EEG activity**
 - ➔ Increase in alpha and theta bands in occipital and parietal areas
- ✓ **Results in simulator conditions ↔ real driving conditions**



Need to complete these results with further studies implying reinforcement of sensory integration



Thank you for your attention

