Carsickness in real driving conditions induces changes in EEG activity

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

• Low frequency **lateral** movements induce **car sickness** symptoms
Simulator sickness and Cerebral activity

**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

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Objectives

Simulator conditions ≠ 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**

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

**Protocol**

<table>
<thead>
<tr>
<th>Baseline - Parking</th>
<th>Baseline - Straight Road</th>
<th>Slaloms – Round Trip (RT)</th>
<th>Recovery – Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 min</td>
<td>5 min</td>
<td>20 min</td>
<td>5 min</td>
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</tbody>
</table>

**Measurements**

- Bas.
- $RT_{\text{start}}$
- $RT_{\text{stop}}$
- Recov.

$n = 9$ participants

(41.8 ± 9.1 yo)

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**Carsickness ratings**

- **Method**
  - EEG recordings

- **System EEG**
  - 14 electrodes

- **Time-frequency analysis**

- **Introduction**

- **Results & Discussion**

- **Conclusion**

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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*
EEG recordings

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