Sensory Reweighting in Response to Visual Perturbations: Insights at the Biomechanical and the Cortical Levels

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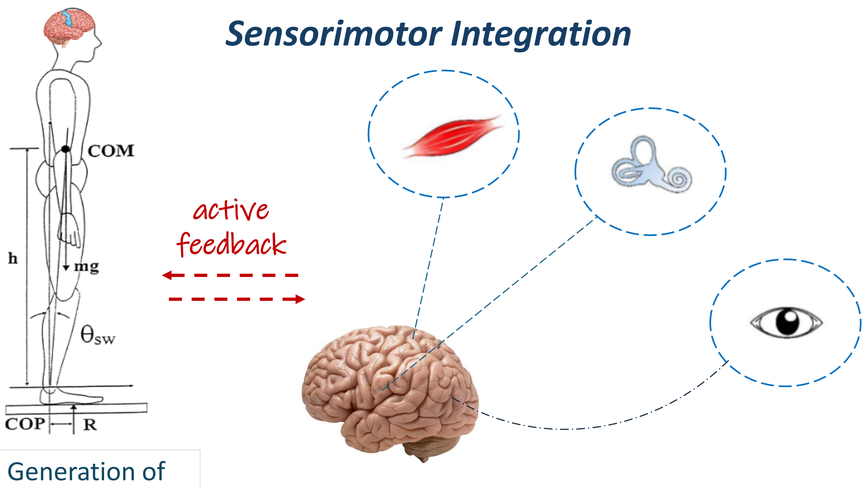
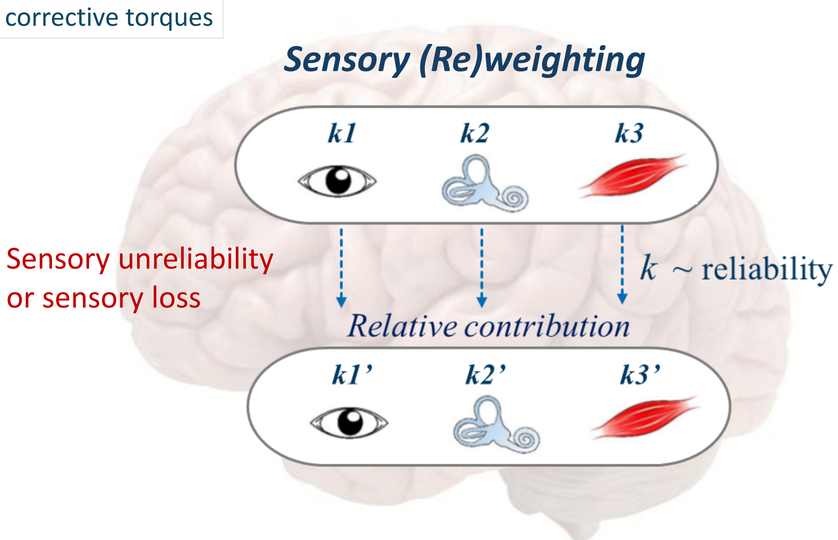
INTRODUCTION

Sensorimotor Integration



Generation of appropriate corrective torques

Sensory (Re)weighting



Sensory reweighting has been classically assessed with kinetic measurements.
How *it* is encoded in the brain is less known.

Investigate the effect of the amplitude of visual sensory perturbations on *sensory reweighting* **AT THE CORTICAL LEVEL.**

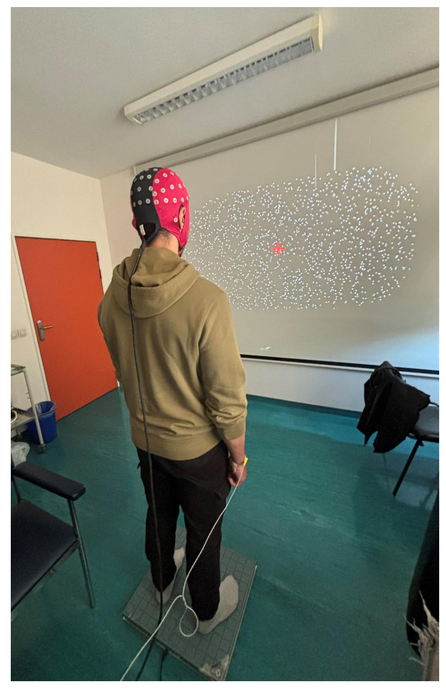
METHOD

Participants

- Eight healthy young participants (age 26.2 ± 2.2 years; 4 females)

Experimental Protocol

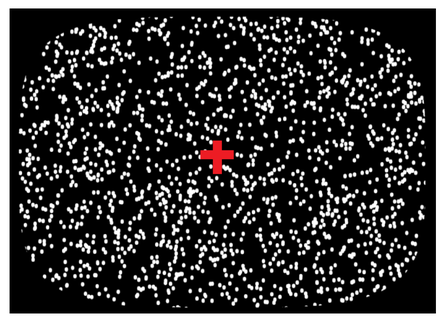
- Participants underwent EEG while standing on a force plate in a dark and silent room. While standing, they were watching a moving visual scene projected on a screen as a visual disturbance.
- Two sets of 5 minutes recording for 4 perturbation conditions.
- Body sway kinetics and cortical activity were simultaneously recorded by a **force plate** and a **64 channel EEG system**, respectively.



Perturbation Signals

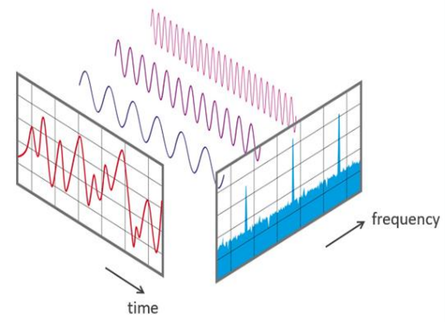
1. **Baseline Signal:** Sinusoidal oscillation at 0.5 Hz with 0.3° amplitude
2. **Baseline Signal** + random noise of amplitude 0.5 °
3. **Baseline Signal** + random noise of amplitude 1.0 °
4. **Baseline Signal** + random noise of amplitude 1.5 °

had no energy at 0.5 Hz and its harmonics !



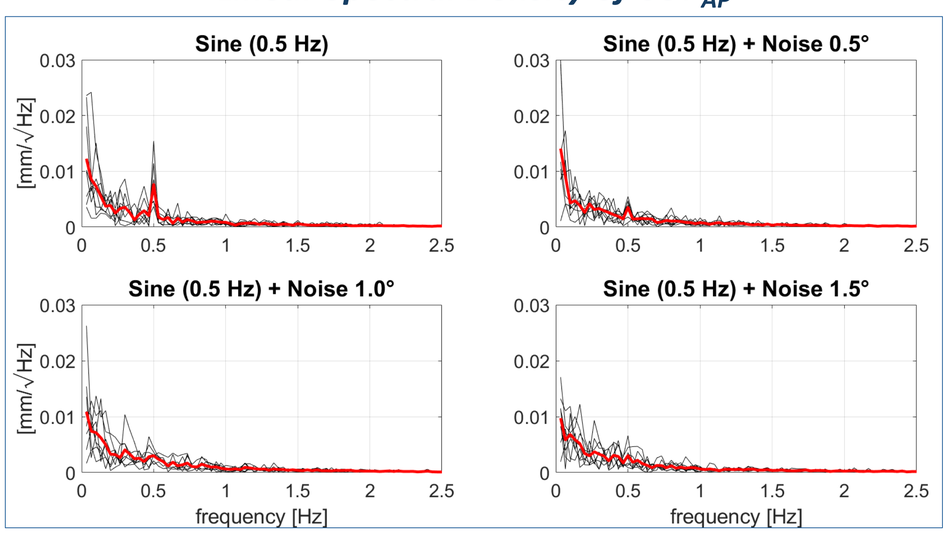
Data Analysis

- Preprocessing: **Independent Component Analysis**
- **Fast Fourier Transform Analysis** quantified linear spectral density of the steady-state response for the center of pressure in anteroposterior direction (COP_{AP}) and EEG signals.
- **Signal to noise ratio (SNR)** assessed as the spectral density at a given frequency relative to that at neighboring frequencies.
- The statistical significance of the SNR at 0.5 Hz was assessed in comparison with surrogate data.

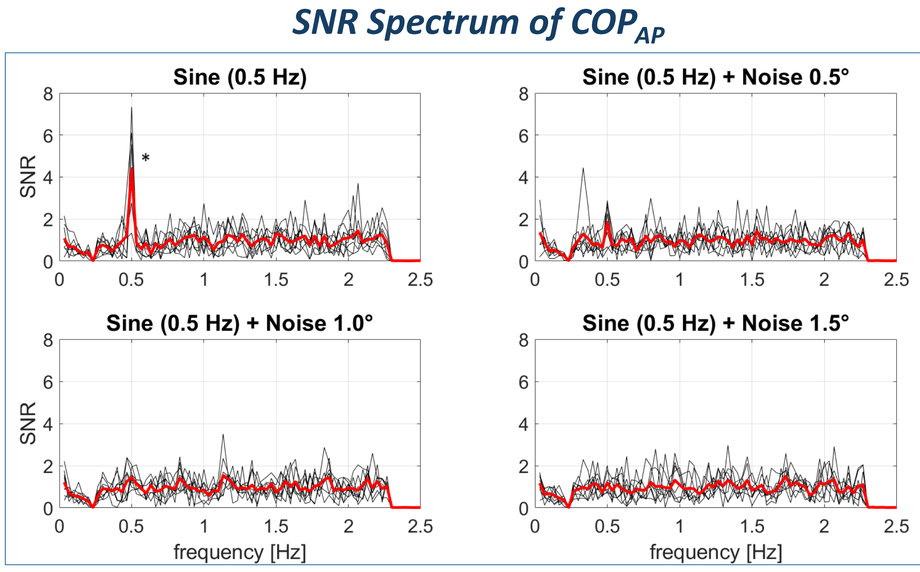


RESULTS

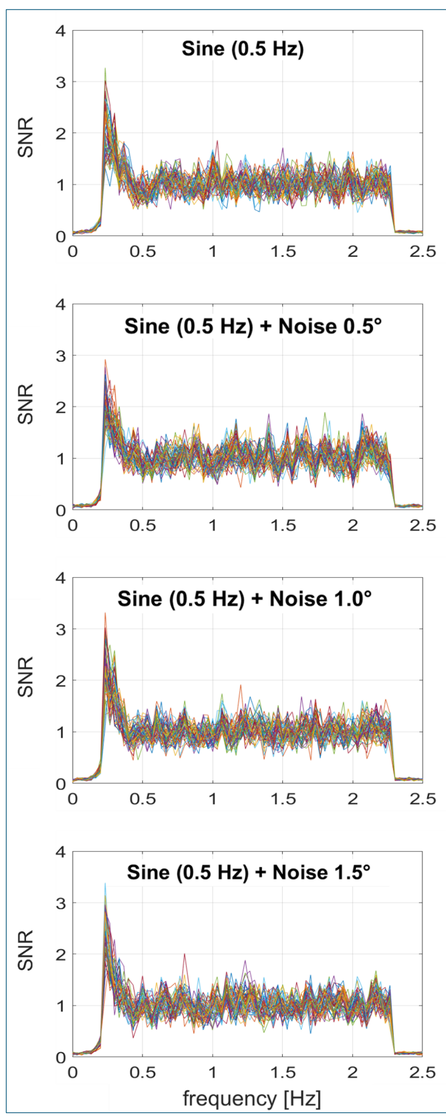
Linear Spectral Density of COP_{AP}



SNR Spectrum of COP_{AP}



SNR Spectrum of EEG



DISCUSSION

- COP results are in line with the classical decrease in the weight assigned to the visual system as vision becomes increasingly less reliable.
- Surprisingly, visual disturbances did not entrain brain activity captured by EEG.
- Therefore, reweighting of vision could not be assessed at the cortical level using our approach.
- Future studies aiming to assess brain-centered reweighting should explore higher dot speed and higher contrast, as well as the influence of the presence or absense of a gaze fixation cross.
- Besides, other recording methods or types of analyses might be needed to identify the cortical correlates of sensory reweighing.

REFERENCES

- Peterka (2002). Sensorimotor integration in human postural control. *Journal of neurophysiology.*
- Assländer & Peterka (2014). Sensory reweighting dynamics in human postural control. *Journal of neurophysiology*.
- Mahboobin et al. (2005). Sensory re-weighting in human postural control during moving-scene perturbations. *Experimental brain research.*
- Jeka et al. (2006). Multisensory information for human postural control- integrating touch and vision. *Experimental brain research.*
- Kabbaligere et al. (2017). Balancing sensory inputs: Sensory reweighting of ankle proprioception and vision during a bipedal posture task. *Gait & posture.*
- Holten et al. (2016). Interaction effects of visual stimulus speed and contrast on postural sway. *Experimental brain reseach.*

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