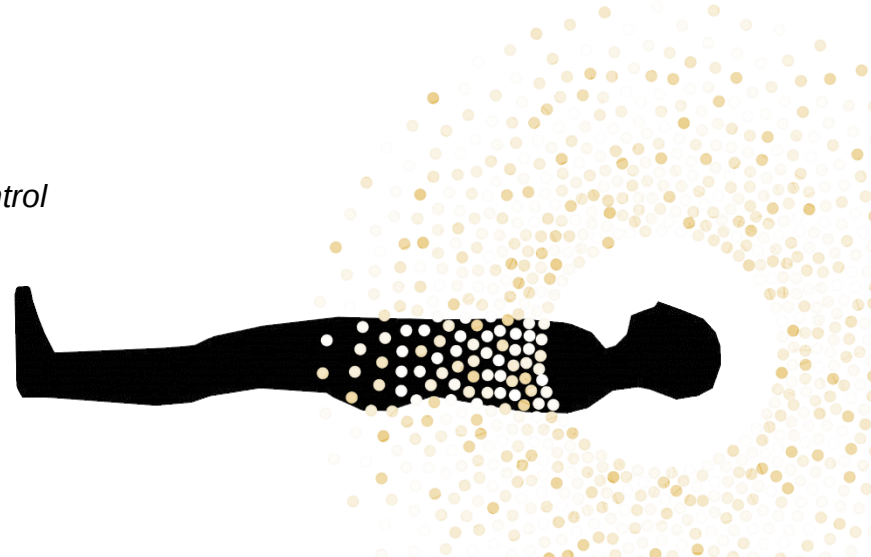
Influence of magnetic vestibular stimulation on self-motion perception

Gerda Wyssen

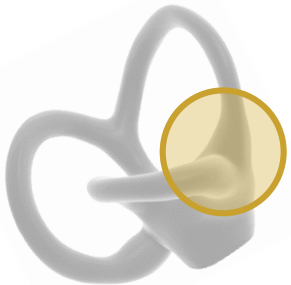
High order vestibular processing, spatial orientation & postural control

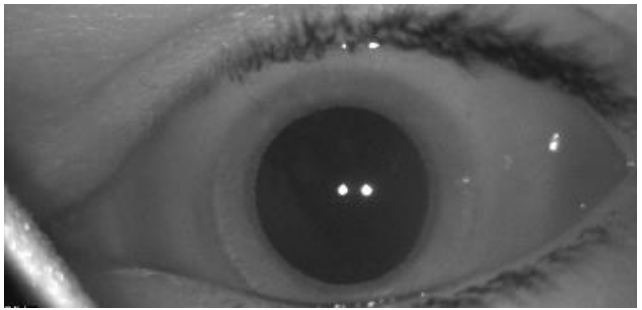
May 11, 2022 - Barany Conference XXXI, Madrid

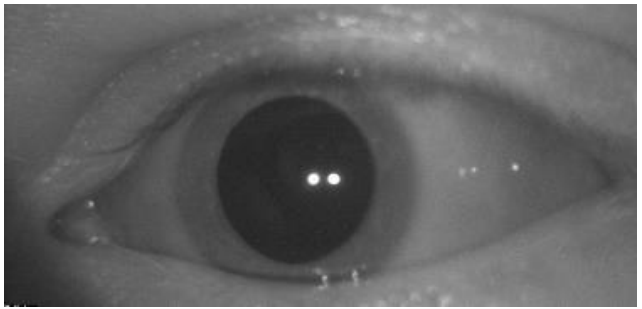


Magnetic vestibular stimulation (MVS)

- inside strong magnetic fields
- elicits nystagmus, dizziness & vertigo
- Lorentz-forces acting on cupula of the SCCs (lateral, superior)







How are nystagmus, self-motion perception and higher cognitive functions affected by MVS?

Glover et al., 2007; Roberts et al., 2011; Mian et al., 2013; Ward et al., 2019

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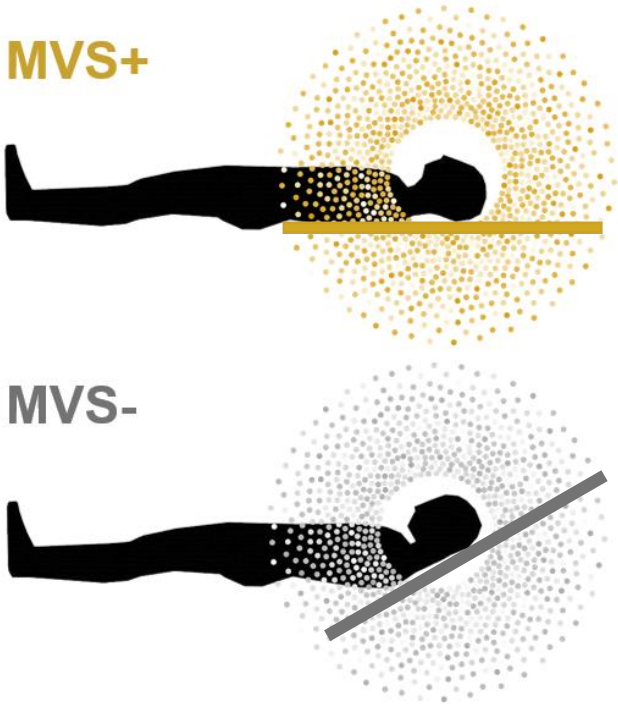
Manipulating MVS strength

- MVS strength depends on the position of the vestibular organ in reference to the magnetic field
- MVS is stronger in supine **(MVS+)** and weaker in head tilted position **(MVS-)**
- In our study we compared nystagmus, self-motion perception and also spatial cognition between these two head positions.



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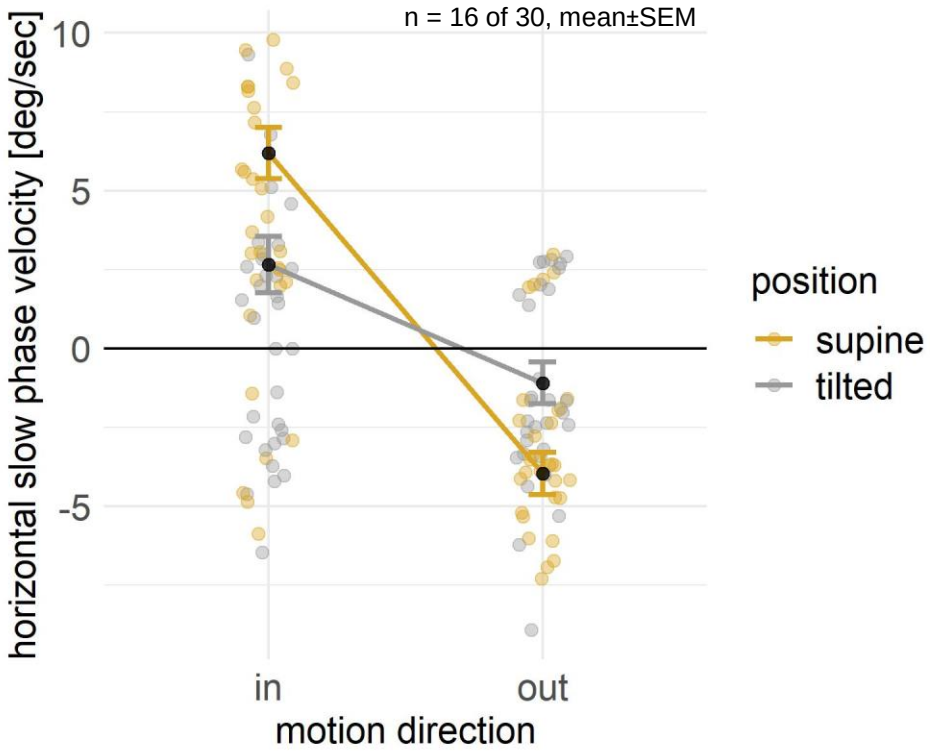
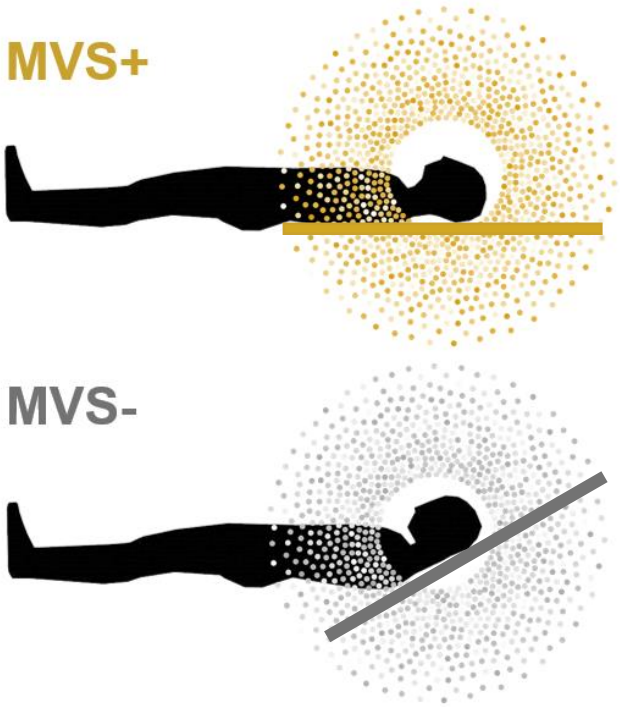
Manipulating MVS strength





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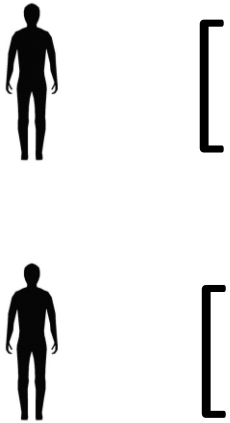
Measuring MVS in the 7 Tesla Scanner

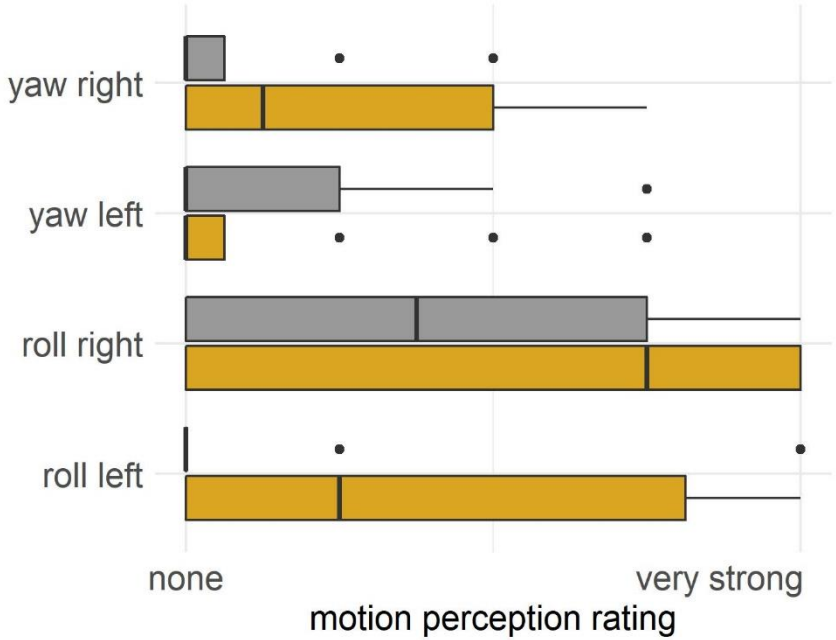
- MRI scanner Magnetom Terra 7T, Siemens
- Eyetracking Visual Eyes 515b, Interacoustics, OpenIris (Otero-Millan et al. 2015)
- Inner ear imaging CISS sequence
- Magnetic field strength Magnetometer THM1176-HF, Metrolab
- Self-motion perception ratings
- Spatial cognition task

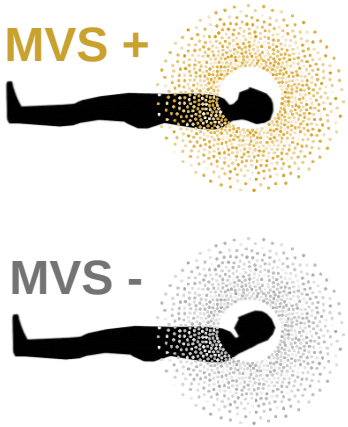
Self-motion perception under MVS

Which illusory self-motion do participants perceive when being moved inside?



seen from above

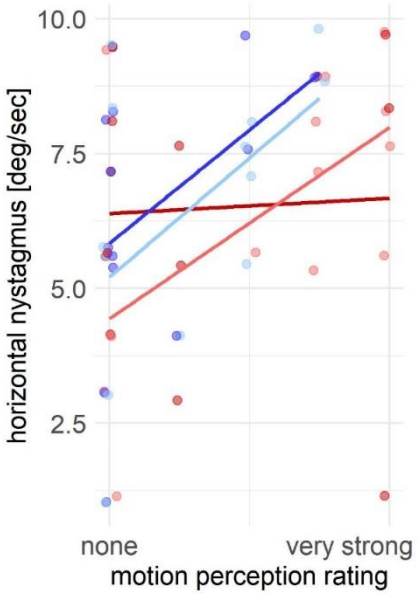


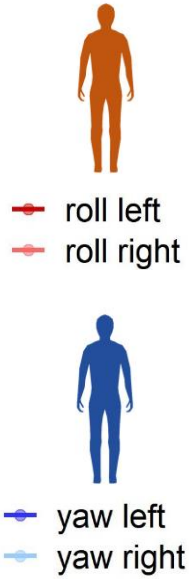


Mian et al., 2013

Self-motion perception & nystagmus

Does horizontal and torsional nystagmus predict self-motion perception direction?





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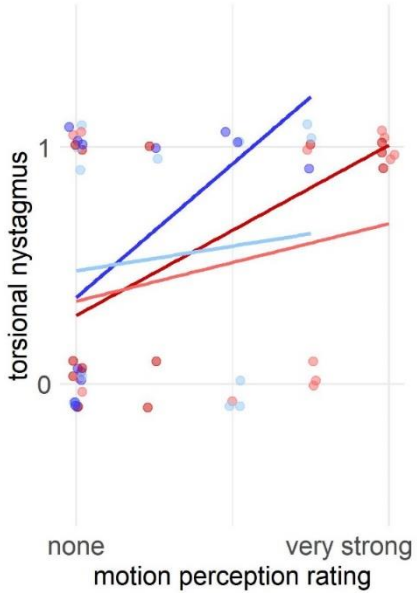

Spatial cognition under MVS

- MVS influences higher order processes: resting state activity and spatial attention

- Does MVS influence performance in cognitive tasks relying on vestibular information?

Which arm is stretched out?

Boegle et al., 2017, 2020; Lindner, Wiesen & Karnath, 2021; Klaus et al., 2020

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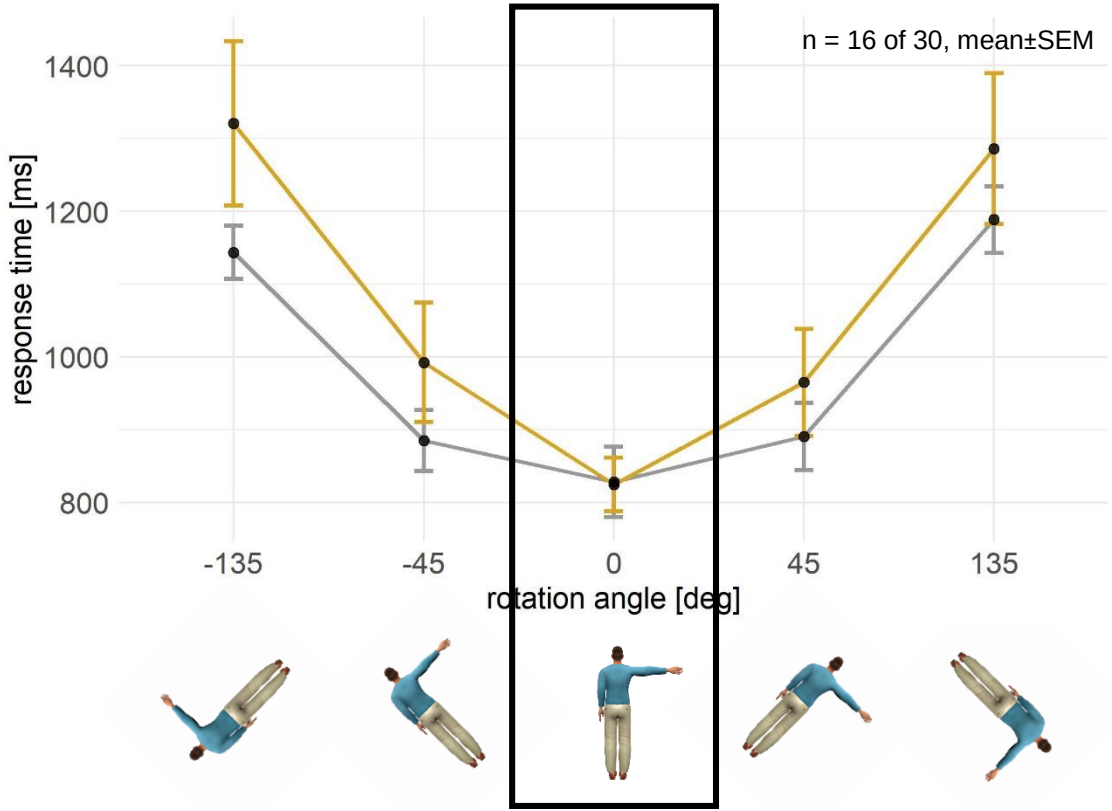
Spatial cognition under MVS



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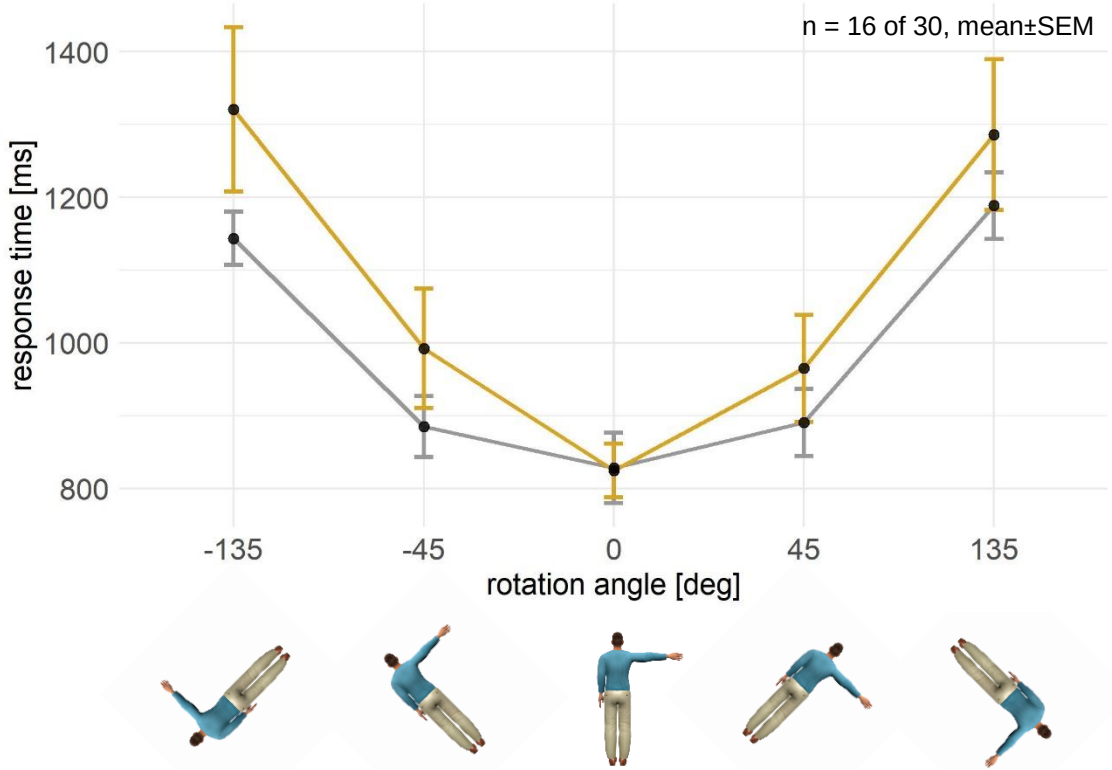
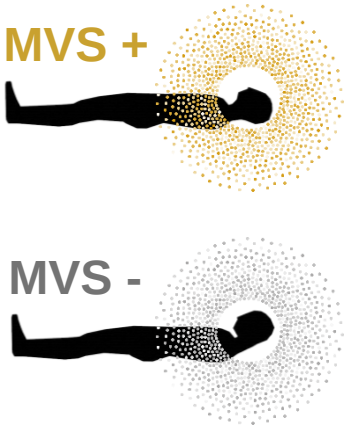
Spatial cognition under MVS





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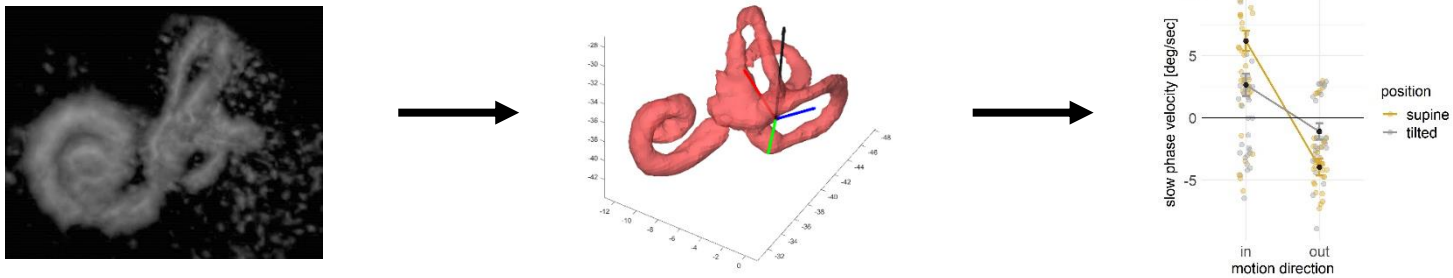
Conclusions and outlook

- First evidence for an MVS effect on spatial cognition tasks such as mental rotation: MVS is relevant for fMRI studies investigating spatial cognition and vestibular patients
- Role of prior knowledge on self-motion perception?
- Next step: connecting orientation of inner ear structures from MR data to measures of nystagmus, perception and mental rotation task



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