# Examining visual and postural perceptions during Galvanic Vestibular Stimulation

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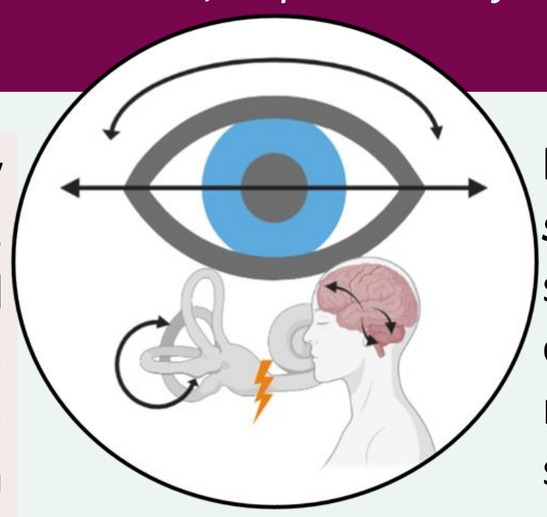
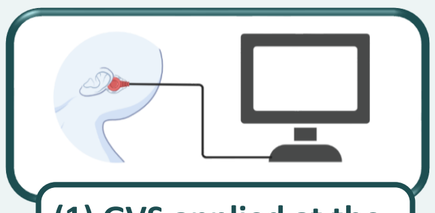
**Purpose:** To understand multisensory control of gaze and posture via ***testing A***, and vestibular attenuation to self generated movements via ***testing B*** by using GVS as an external vestibular input. This serves as a first step to mitigate ***motion sickness*** via GVS.

*Prospect: Using GVS in space-/ air travel to minimise **spatial disorientation** risks by using **eye movements** as biofeedback to the vestibular system via GVS. In collaboration with the European Space Agency.* esa

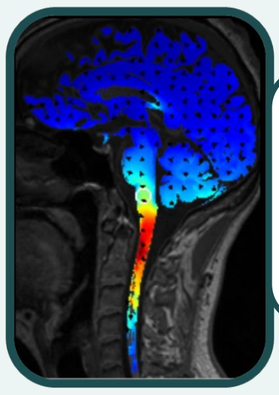


**Methodology:** ***Galvanic vestibular stimulation (GVS)***, a non-invasive electrical stimulation (1-6mA), evokes compensatory oculomotor and postural responses with minimal interference with other sensory systems. It activates the nerves in the vestibular organ in the inner ear.

**(2) Video Eye-tracking Device**

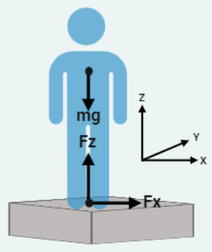


**(1) GVS applied at the back of the ear**

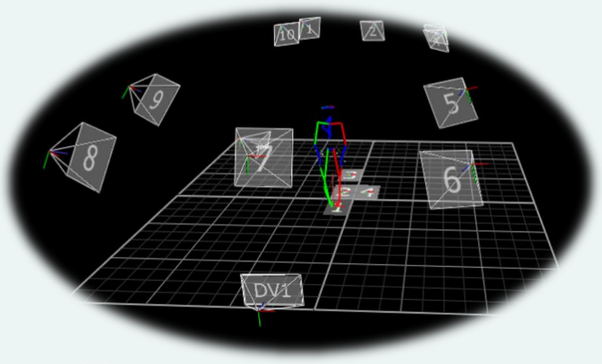


Simulation of GVS on the mastoid is presented on a MRI image of the brain.

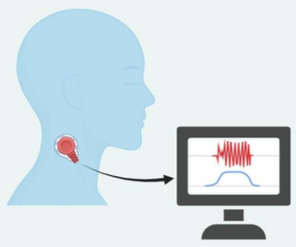
*Test A: (a) Sitting (b) Standing (c) Walking*



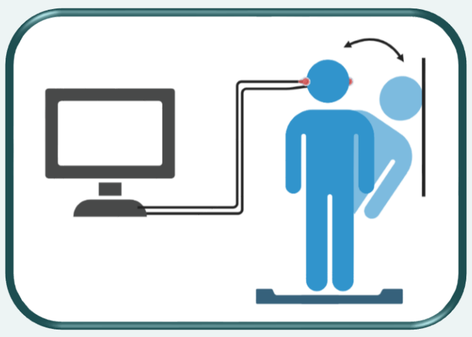

*(3) Force plate*



*(4) Motion capture camera system Subject standing in the middle as a skeleton*



*(5) EMG*

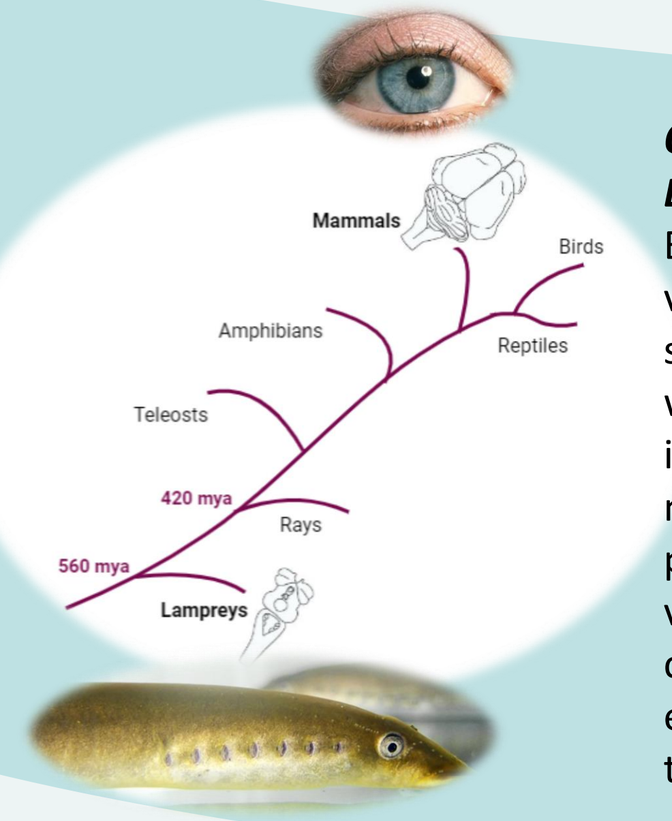


*Test B: Subject repeating movement while GVS is applied*

**Test A.** We measure ***oculomotor*** and ***postural responses*** to altered vestibular input. Subjects sitting (a), standing on a force plate (b), and walking on a treadmill (c) as exposed to GVS via an electrode on the mastoid bone **(1)**. We record ***gaze-stabilizing eye-movements*** via video ***eye-tracking*** device ***(2)***; postural and gait shifts via ***force plate (3)*** and ***motion capture*** camera system ***(4)*** respectively; vestibulocollic reflex via **electromyography (*EMG) (5)*** on the neck.

**Test B.** We measure human vestibular system's efficiency in ***adapting*** to altered baseline vestibular information. GVS is activated on losing contact with the platform. Outcome measures are the velocity and position of the motion recorded via force plate (3), motion tracking system (4) and gyroscope.

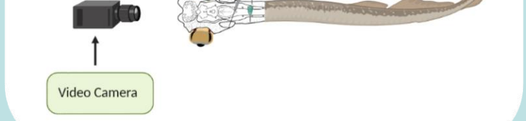
→ **<u>Preliminary results</u>** have shown increased body sway to the side of anode after stimulation starts on the standing test subject while 6mA bilateral bipolar direct current is applied.




## - Animal Trials -

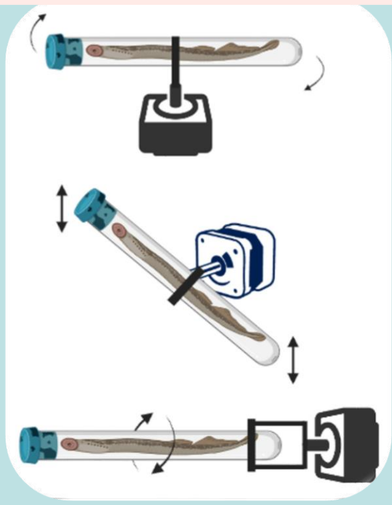
***On the neural mechanisms***

***Lampreys***, the oldest extant vertebrates on Earth, have largely conserved visual, vestibular***,*** ***visuo-vestibular*** gaze stabilization capacities similar to humans, which allow carrying out trials not possible in humans. The experiments include mapping the neural circuitry involved in posture stabilization during visual and vestibular stimulations on lamprey, constructing a GVS compatible to lamprey, evaluating subcortical plasticity to exposure to weeks of artificial vestibular stimulation.




Semi-intact lamprey preparation. ***Video tracking of eye*** and body, ***vestibular stimulation*** via electrodes, and electrophysiological recordings of key neural structures.

Applying vestibular stimuli by rotation in different axes, while ***recording eye movements*** to measure ***vestibulo-ocular reflex (VOR)*** gain.



*Figures: Created in BioRender*

*References: Grillner, S. (2018). Evolution: Vertebrate limb control over 420 million years.*
*Wibble, T., et al. (2022) Conserved subcortical processing in visuo-vestibular gaze control.*

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**Want to be a participant in the experiments?**

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