**Project title: Multisensory Integration in Gaze Orienting**

**Project: Ongoing non-project-based study** in the field of psychophysics, multisensory integration, sensorimotor neuroscience

**Project description**

Have you ever wondered how our brain seamlessly integrates visual and auditory cues, allowing us to swiftly direct our attention in a bustling environment? Interestingly, our brain initially processes sounds in a head-centred reference frame and lights in an eye-centred frame. How might these distinct initial reference frames shape our eye and head movements? In this internship, you will dive into the world of multisensory interactions and their profound impact on our gaze behaviour (Fig. 1).

In this project, extending the seminal work of Corneil et al. (2001), we aim to explore the intricate interplay between eye and head movements when presented with combined auditory-visual stimuli in complex scenes. Given the initial reference frames, we hypothesize that such stimuli not only affect rapid eye movements (saccades) but also influence the full eye-head coordination system in a unique way. Bayesian inference might offer a lens to understand this multisensory integration, explaining how the brain weighs and combines information from both modalities. Using state-of-the-art eye-tracking and motion capture systems in our labs (Fig. 2), we'll investigate the latency, accuracy, and coordination of these gaze shifts, unlocking deeper insights into the neural pathways governing multisensory integration.

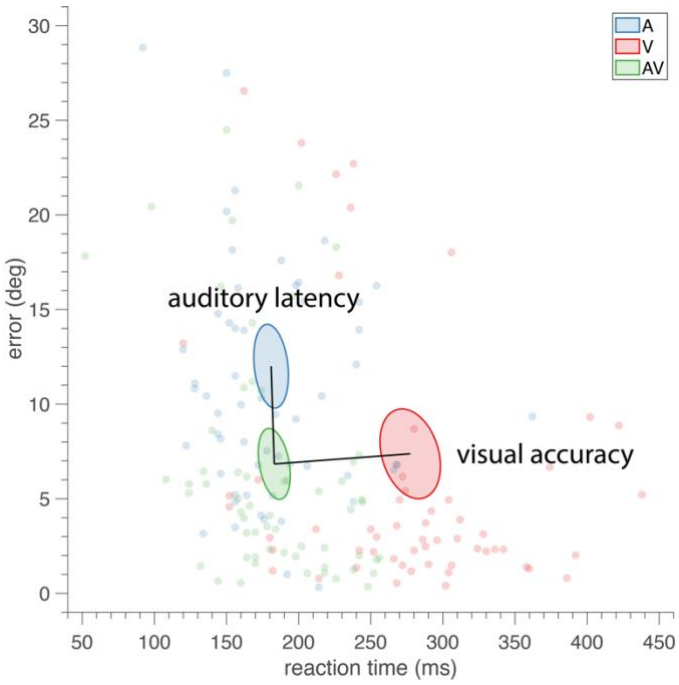


**Figure 1. Best of both worlds.** Saccadic orienting to audio-visual targets typically leads to visual accuracy at auditory reaction times.

**Figure 2. The Sphere.** One of the sensorimotor labs.

**Project Alternatives**

- Ventriloquist After-Effect
- *Clinically oriented (Medical Biology, Biomedical Sciences)*: listeners using hearing aids, cochlear implants and bimodal cochlear implant users (in collaboration with the Otorhinolaryngology department of the Radboudumc), individuals with Usher syndrome, individuals with Glaucoma
- *Modelling oriented (Physics or AI)*:
    - Modelling reaction times (e.g., LATER, race, Time Window of Integration, Bayesian inference)
    - Modelling localization accuracy and precision
- *Thesis/Article Review/Research Proposal:* How can localization behaviour to audio-visual targets be explained?

**Key words**

Humans | Sound | Audiovisual Integration| Reaction Time | Localization | Psychophysics | Perception | Action | Sensorimotor system | Bayesian Inference

## Relevant literature


- Corneil, B. D., Van Wanrooij, M., Munoz, D. P. & Van Opstal, A. J (2002) *Auditory-visual interactions subserving goal-directed saccades in a complex scene*. J. Neurophysiol. 88, 438–54.
- Van Wanrooij, M. M., Bell, A. H., Munoz, D. P. & Van Opstal, A. J. The effect of spatial-temporal audiovisual disparities on saccades in a complex scene. *Exp. Brain Res.* **198**, 425–37 (2009).
- Van Wanrooij, M. M., Bremen, P. & John Van Opstal, a. Acquired prior knowledge modulates audiovisual integration. *Eur. J. Neurosci.* **31**, 1763–71 (2010).
- Bremen, P., Massoudi, R., Van Wanrooij, M. M. & Van Opstal, A. J. Audio-Visual Integration in a Redundant Target Paradigm: A Comparison between Rhesus Macaqueand Man. *Front. Syst. Neurosci.* **11**, 89 (2017).

- Ege, R., Opstal, A. J. Van & Van Wanrooij, M. M. Accuracy-Precision Trade-off in Human Sound Localisation. *Sci. Rep.* **8**, 16399 (2018).

**Tasks & skills**

You will become familiar with psychophysics and eye tracking. At the end of this internship, you will be able to:

- Design and develop multisensory orienting tasks in state-of-the art sensorimotor labs
- Measure eye movements
- Analyze data in Matlab and quantify gaze behavior (through regression, generalized linear models)
- Write a report in the form of an academic paper (IMRaD)

**Background**

Master Cognitive Neuroscience: Perception and action track
Bachelor/Master Biology/Sciences/Physics: Psychophysics I and II, Neurobiophysics, Neural Basis of Cognition and Perception, The Auditory System

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