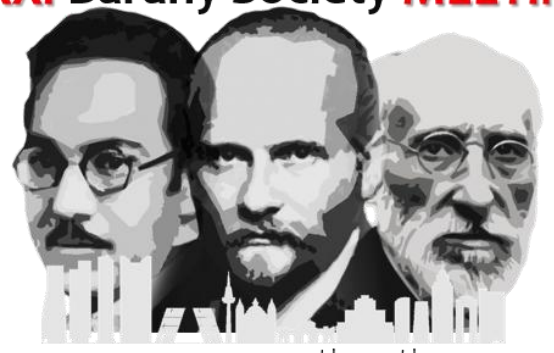
XXXI Bárány Society MEETING



MADRID, MAY 9th-11th 2022

SP09

SYMPOSIUM FORM

- ORGANIZER'S NAME and SURNAME: LOPEZ Christophe
- ORGANIZER'S E-MAIL: christophe.lopez@univ-amu.fr
- ACADEMIC/HOSPITAL AFFILIATION: French National Center for Scientific Research (CNRS) and Aix Marseille University, Marseille, France
- SESSION TITLE: From vestibular cartography to vestibular cognition

3 or 4 SPEAKERS PER SYMPOSIUM:

- SPEAKER 1
  NAME AND SURNAME: Prof Peter ZU EULENBURG
  TOPIC DESCRIPTIVE TITLE: Bottom-up mapping of the human vestibular system
  ACADEMIC / HOSPITAL AFFILIATION: German Center for Vertigo and Balance Disorders, Ludwig-Maximilians-University Munich, Munich, Germany

- SPEAKER 2
  NAME AND SURNAME: Dr Elisa Raffaella FERRE
  TOPIC DESCRIPTIVE TITLE: Vestibular system: from sensory encoding to perception
  ACADEMIC / HOSPITAL AFFILIATION: Department of Psychological Sciences, Birkbeck University of London, London, United Kingdom

- SPEAKER 3
  NAME AND SURNAME: Prof Fred W. MAST
  TOPIC DESCRIPTIVE TITLE: Mental simulation and the brain's vestibular network
  ACADEMIC / HOSPITAL AFFILIATION: Department of Psychology, University of Bern, Switzerland

- SPEAKER 4
  NAME AND SURNAME: Dr Christophe LOPEZ
  TOPIC DESCRIPTIVE TITLE: Distorted own-body and self representations in patients with dizziness
  ACADEMIC / HOSPITAL AFFILIATION: CNRS and Aix Marseille University, Marseille, France

- **A BRIEF** (<300 WORDS) DESCRIPTION OF THE THEME AND TARGET AUDIENCE:

This symposium aims at providing an update on the vestibular cortical network and links these anatomical findings to high-level cognitive functions. The different contributions present results from recent research in neuroimaging, otoneurology, cognitive psychology and cognitive neuroscience. The range of contributions includes the largest neuroimaging study of the human vestibular cortex to date, which identified ten cortical homologues to known vestibular representations in non-human primates (P. zu Eulenburg). Moreover, we will present data about sensory integration for self-motion perception in the multisensory cortical vestibular network (E. Ferrè). The vestibular system is ideal to study how the brain makes sensory inference, and we will combine computational approaches with cognitive studies (F. Mast). The symposium will close with studies showing that sensory conflicts in the multisensory vestibular system can lead to perceptual incoherence and deteriorates own-body and self representations, adding to the complex symptomatology of patients with dizziness (C. Lopez). This symposium provides a multidisciplinary approach of high-order vestibular functions, their neural underpinnings and their clinical implications. The talks will cover topics that are relevant to clinicians, physiotherapists and basic scientists alike, and

it serves as a platform for those interested in understanding the cognitive and perceptual aspects of the vestibular system.

- A 150-WORD **ABSTRACT FROM EACH OF THE SPEAKERS:**

ABSTRACT 1

The majority of human cerebral regions receiving vestibular information originating from our so-called sixth sense have evaded a definitive localization for more than two decades. Neuron recordings and tracer studies in several primate species had previously established a cortical vestibular network of at least seven regions per hemisphere. Multiple unaddressed confounders have impeded the delineation of a human vestibular cortex. These included underpowered group studies, somatosensory side effects, unaccounted head motion artifacts, unnaturalistic vestibular percepts and spatio-temporal signal limitations in neuroimaging. We have overcome these obstacles and delineated and replicated the entire human vestibular cortex and its nodes in a large-scale study (discovery sample n=75, replication sample n=150). We were able to identify ten cortical homologues to known vestibular representations in non-human primates. The talk will summarize these findings and will suggest a potential role for each delineated cortical vestibular region with respect to vestibular cognition.

ABSTRACT 2

Moving through the environment elicits a constant stream of sensory signals about self-motion. Head rotation is coded through information from the three semicircular canals, while head translation is detected by the otoliths. Although rotation and translation can provide an accurate percept of self-motion, where these cues are represented in the human brain and how they interact with other sensory inputs is not yet clear. We have combined innovative methods for eliciting virtual rotation and translation sensations with fMRI to identify brain areas representing vestibular self-motion signals. We have identified a bilateral inferior parietal, ventral premotor/anterior insula and prefrontal network and confirmed that these areas reliably possess information about the perceived rotation and translation. We have also investigated how vestibular signals are integrated with other sensory cues to generate a self-motion percept. Our results demonstrate that vestibular-multisensory interaction within the cortical vestibular network in the human brain.

ABSTRACT 3

The brain makes use of prior knowledge in order to extract information provided by the vestibular senses. Bayesian filtering requires a dynamic generative model, which describes both the dynamics of head movements and how vestibular sensory data are generated as a function thereof. We implement the distinction between active and passive movements. Interestingly, knowledge of cognitive origin can inform sensory inference, and the same probabilistic model used for active self-motion (e.g., efference copy) can also be applied when self-motion is passive but predictable. Offline usage, such as running a simulation or planning a head movement correspond to sampling from the prior and performing inference conditioned on certain target states, respectively. We simulate motion when we imagine actions, take the spatial perspective of someone else or when we travel in time. Higher cognitive operations rely on mechanisms that are an integral part of sensory inference in the vestibular domain.

ABSTRACT 4

Vestibular disorders evoke complaints reaching far beyond imbalance and oscillopsia. Yet, how they affect own-body representations has been overlooked. In a first study in 60 patients with dizziness, we found that 12% of the patients have experienced distorted own-body representations (their hands or feet felt larger or smaller), 37% reported abnormal sense of agency and 35% reported disownership for the body. These proportions were larger in patients than in healthy controls. A second study aimed at testing whether caloric vestibular stimulation (CVS) produced comparable distortions in healthy volunteers. In a proprioceptive pointing task, the perceived length of the dorsum of both hands increased during Left-warm/Right-cold CVS. A third, prospective study in 420 participants showed a higher occurrence of out-of-body experiences in patients with dizziness (14%) than in healthy participants (5%). Altogether, our studies show a vestibular contribution to own-body representations and help understand the complex symptomatology of patients with dizziness.