**Unraveling the Neural Mechanisms of Decision-Making in Uncertain Environments: Insights from a Probabilistic Foraging Task in Mongolian Gerbils**

**Vishal Kannan1, Parthiban Saravanakumar1, Frank Ohl1,2,3, Max Happel1,3,4**

1Department of Systems Physiology of Learning, Leibniz Institute for Neurobiology, Magdeburg, Germany; 2Institute of Biology, Otto-von-Guericke University, Magdeburg, Germany; 3Center for Behavioral Brain Sciences (CBBS), Magdeburg, Germany; 4MSB Medical School Berlin, Faculty of Medicine, Berlin, Germany

Decision-making can be challenging when faced with uncertain situations. Optimal decision-making typically involves understanding past events and complex statistical computations. However, in constantly changing environments with limited information, we rely on simplified rules to make judgments about probabilities and predictions. While researchers have investigated the impact of these simple heuristic approach on decision-making through different behavioural experiments, little is known about how they are implemented in the brain. Therefore, our study aims to explore the neural mechanisms involved in decision-making under uncertainty using an animal model.

We utilized data from Mongolian gerbils engaged in a probabilistic foraging task (*adapted from* Lottem et al., 2018*, Nat Comm.*). The task presented the gerbils with an exploitation/exploration dilemma, where they had to decide whether to continue exploiting a current food source or explore an alternative source, suffering travel costs but benefit from potentially higher food density. This decision required the gerbils to consider probabilistic information about food availability in a changing environment. Previous studies showed the decisive role of the frontopolar cortex in humans during exploratory decisions in gambling (Daw et al., 2006). Based on this, in our study, we chronically recorded from the anterior frontal field A (FrA) of gerbils with laminar multielectrode, while gerbils perform the probabilistic foraging task.

Analysis of the current source density (CSD) profiles from the FrA revealed distinct cortical activity related to task (pokes) and rewards. The root mean square (RMS) of the CSD's average rectified signal showed a gradual increase in cortical activity before the switch to exploration, consistent with random walk models of evidence accumulation (Gold & Shadlen, 2007). Moreover, layer-specific CSD profiles demonstrated the selective recruitment of infragranular and supragranular layers in the FrA, correlating with exploitation and exploration behaviors, respectively. Our findings provide the initial evidence in rodents that the FrA neural circuitry orchestrates the choice between exploitation and exploration strategies in a layer-dependent manner, shedding light on the neural mechanisms underlying decision-making in uncertain situations.