Rhythmic Entrainment in Primates: Behavioral and Neurophysiological Observations

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Rhythmic entrainment refers to the ability to align motor actions with an auditory beat, where a beat corresponds to the perceived pulse that marks equally spaced points in music or a sequence of auditory stimuli. For long, humans have been considered the only species capable of spontaneous synchronization of body movements with an auditory rhythmic pulse. However, here we present evidence supporting the Gradual audiomotor evolution hypothesis. This hypothesis accommodates the fact that nonhuman primates performance is comparable to humans in single interval tasks (such as interval reproduction, categorization, and interception), but show differences in multiple interval tasks (such as rhythmic entrainment, synchronization and continuation). Furthermore, it is in line with the observation that macaques can synchronize in the visual domain, but show less sensitivity in the auditory domain. Finally, while macaques are sensitive to interval-based timing and rhythmic grouping, the absence of a strong coupling between the auditory and motor system of nonhuman primates might be the reason why macaques cannot rhythmically entrain in the way humans do.

In the second part of the presentation, I will show the results of single cell and LFP recordings in different nodes of the motor cortical-basal ganglia-thalamic circuit (mCBGT) of monkeys performing a synchronization and continuation task (SCT). Our findings in the medial premotor areas suggest that the sequential and temporal structure of rhythmic behavior in macaques is represented by different neural codes that are organized hierarchically: starting with ramping activity, which is highly linked with the movement execution, followed cell tuning as an abstract signal of the actual duration and serial-order structure of the task in relation to reward, and ending with the neural dynamics of cell populations that encodes all the parameters of the task. Finally, the analysis of LFPs in the putamen during the SCT suggest that gamma-oscillations reflect local computations associated with stimulus processing, whereas beta-activity involves the entrainment of large putaminal circuits, probably in conjunction with other elements of mCBGT, during internally driven rhythmic tapping.