INSTITUT PARIS DESCARTES NEUROSCIENCES COGNITION

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SCIENCES FONDAMENTALES ET BIOMÉDICALES

Neuroscience Seminar Series

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Salle des Conferences (R229)
Centre Universitaire des Saints-Pères
45 rue des Saints-Pères, 75006 Paris

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Neural, behavioral, and biomechanical approaches to vocal motor control and sensorimotor learning

Our lab uses the songbird vocal control system to investigate how the brain generates behavior and learns from experience. The neural circuits governing the learning and production of song are easily accessible to measurement and manipulation, providing a rich system in which to study the interplay between sensory feedback, motor control, and neural plasticity. However, although much is known about both song behavior and the functional anatomy of the songbird brain, we know very little about how the brain uses sensory feedback signals to rewire the neural circuits driving vocal behavior. In my talk I will present studies that employ a range of behavioral and physiological techniques to investigate sensorimotor learning and vocal control. First, by developing a system for manipulating auditory experience in the singing bird, we have demonstrated that adult birds maintain vocal performance by a process of error correction and defined the computational rules governing vocal learning. Shifting the pitch (fundamental frequency) of auditory feedback leads to compensatory changes in the pitch of song. This result suggests that song is constantly evaluated relative to an auditory target and that the resulting error signals are used to correct vocal output. Furthermore, quantitative analysis of learning across conditions (error size, animal age) suggests that songbirds use the statistics of their prior sensorimotor experience to constrain their behavioral responses to sensory errors, reflecting a robust strategy for optimizing behavior. Second, neural recordings from premotor neurons in the songbird brain have revealed how these neurons contribute to the moment-by-moment control of vocal output. Third, studies using electromyographic (EMG) recordings, single-muscle electrical stimulation, and in vitro approaches allow us to quantify the mechanics of acoustic production. Together, these approaches allow us to investigate the relationship between vocal learning, the neural encoding of motor commands, and the transformation of neural activity into vocal behavior by the motor periphery.