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Abstract

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PI Title:	ASSOCIATE PROFESSOR
Project Title:	NEURAL ANALYSIS OF VOCAL LEARNING

Abstract: DESCRIPTION (Adapted from applicant's abstract): The long term goal is to understand the neural basis of learning and memory, particularly how the brain stores and represents complex sensory information, and how it uses sensory information to guide learning of motor behaviors. Vocal learning in songbirds provides a useful system for studying these questions. Birds learn their song from adult "tutors" in two distinct stages, both of which depend on auditory experience and feedback. First, during a critical period for sensory learning, young birds hear the tutor song, and memorize an internal representation, or "template", of this song. Then, during a sensorimotor learning period, they use auditory feedback from their own voice to gradually refine their vocal output so that it matches the stored tutor template. Moreover, birds have specialized brain structures devoted to song learning, in which many of the important neural changes are likely to occur. Finally, because song learning has a number of specific features in common with speech acquisition, it may provide particular insight into mechanisms underlying human vocal learning and critical periods for language development. The anterior forebrain (AF) pathway of the song system is known to play a critical role in song learning, but its exact function remains unclear. Neurons in this pathway respond to sounds, project to the vocal motor pathway, and by adulthood have developed highly selective auditory responsiveness to the bird's own song. These properties suggest that AF neurons might be involved during sensory learning in storage of the sensory template for song, and then, during sensorimotor learning, provide auditory feedback to the motor pathway to guide refinement of vocalizations. The proposed experiments will test these hypotheses. First, study of the neurons of the AF pathway in young finches, at the close of the sensory period, will determine exactly when song selectivity emerges. Second manipulations of the animal's vocalizations during learning will clarify whether the selectivity of these AF neurons is shaped by sensory experience of the tutor, feedback from the animal's own voice, or both. In these experiments, birds' developing vocalizations (plastic song) will also be quantitatively analyzed, and compared to the emerging tuning properties of their AF neurons, to increase our understanding of how neurons encode and discriminate such complex stimuli. Finally, the idea that the AF provides crucial sensory feedback to the vocal motor pathway will be tested by assessing the contribution of AF inputs to neural responses

in its target song motor nucleus, at several different stages of learning.

Thesaurus Terms:
animal communication behavior, auditory feedback, developmental neurobiology, language development, memory, neural information processing, neuron, prosencephalon, verbal behavior, verbal learning
brain electrical activity, early experience, psychomotor function, sensorimotor system
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