Lesions of Vocal Motor Cortex Impairs Perception of Vocal Sounds

**Introduction**

- Neural circuits for complex behaviors require that sensory and motor representations of a given action be integrated. One example of such sensory-motor integration is the tight linkage between vocal perception and production.
- The “motor theory of speech perception” suggests that the neural circuits for perceiving speech sounds rely in part on circuits that control production of those same sounds.
- My research uses songbirds as a model for testing this idea because, similarly to humans, they learn their vocalizations and specific brain regions control their vocal motor output.

**HYPOTHESIS**: If vocal perception relies in part on neural circuits for vocal production, then lesioning a portion of the brain known to be directly involved in vocal production should hinder the bird’s ability to discriminate between different vocal stimuli.

**Results**:

- One subject examined thus far had 100% of RA lesioned (Fig 4).
- Perception test results (Fig 2) indicate that the lesion led to a decreased ability to distinguish vocal calls that are similar to the habituated stimulus (e.g., 625 and 675 Hz).
- As expected, vocal motor production was severely impaired following lesion of RA (Fig 3).

**Discussion**:

- This result suggests that circuits that control vocal production in RA are integrated with those that process auditory information as birds are discriminating between vocal stimuli.
- Information from both auditory and motor systems contribute to the perception of vocal stimuli.
- This pattern of results supports the idea that the neural circuits for perceiving speech sounds rely in part on circuits that control production of those same sounds.

**Methods**:

- The stimuli used in this experiment are synthetic vocal calls (harmonic stacks) that vary only in their fundamental frequency (FF); they are modeled after normal calls used for individual recognition.
- Zebra finches respond to vocal calls by producing a call of their own (call-back response).
- Habituation: a single call stimulus (650 Hz) was presented repeatedly until the call-back response habituated (the bird no longer responded).
- Test: habituation was followed by randomized presentations of novel test stimuli that varied in FF, interleaved with the habituation stimulus.
- A bird’s ability to perceive the difference between vocal calls was scored by comparing the number of call-back responses to novel test stimuli to the number of call-back responses to the habituated stimulus.
- Following this behavioral test of perception, birds were anesthetized and RA was lesioned; then the perceptual abilities of each bird were tested a second time.