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Supervised by
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“Characterization of Physiological Response Properties in Single Neurons of the Budgerigar Inferior Colliculus”

Seminar Abstract:

Amplitude modulation (AM) is an important acoustic property of speech and many nonhuman animal communication signals. The budgerigar is an avian species with complex temporally modulated vocalizations and human-like behavioral AM detection capabilities. The inferior colliculus (IC) is a major AM processing center in the midbrain. Previous IC studies in other animal models have largely focused on species with poor behavioral AM detection abilities compared to humans. Meanwhile, IC studies in budgerigars have focused on multi-unit recordings. The present study aimed to characterize single-unit IC response properties of budgerigars for comparison to published multi-unit recordings and auditory-nerve data.

Single-unit responses were recorded from the IC of anesthetized budgerigars. Tuning curves were determined through an automated algorithm, to identify the lowest tone level that reliably elicited rate excitation as a function of frequency. Frequency response maps were evoked by tones at different sound levels and frequencies to identify excitatory and inhibitory regions. Modulation transfer functions (MTFs) were measured in responses to AM tones of varying modulation frequency. MTFs identified excitatory and inhibitory AM frequency ranges with respect to the unmodulated stimulus response. Finally, PSTHs quantified the temporal response patterns of IC single units to tones.

Budgerigar IC units showed increasing tuning sharpness with higher characteristic frequencies. Response maps showed either monotonically increasing rate with sound level, or less commonly, nonmonotonic decreases at the highest sound levels tested. MTFs revealed band-enhanced, band-suppressed, hybrid, and flat shapes. MTFs obtained with a noise carrier (versus tone) more often showed a band-suppressed characteristic. PSTHs varied in onset response amplitude with the onset response often followed by inhibitory notches.

Frequency tuning of IC single units in budgerigars was consistent with auditory-nerve responses and IC multi-unit recordings. Whereas IC multi-unit MTFs are band enhanced, our single-unit recordings revealed a broader range of MTF types consistent with other species. IC single-unit PSTHs also showed greater diversity than multi-unit data. These findings highlight diverse strategies for AM encoding in the budgerigar IC. Our results also show that single-unit recordings reveal a wider range of responses properties compared to multi-unit recording techniques.

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<https://rochester.zoom.us/j/98109763474>

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