

## **Spatio-temporal representation of the pitch of complex tones in the auditory nerve and cochlear nucleus**

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Traditional models for pitch processing have relied on either a purely spatial representation based on the tonotopic mapping in the cochlea, or a purely temporal representation dependent on neural phase locking. The cochlear traveling wave also introduces spatio-temporal phase cues to the resolved harmonics of a complex tone that might be used in pitch extraction. In the auditory nerve (AN), these cues are robust with stimulus level and are more consistent with psychophysical data than the traditional rate-place or temporal cues. This study aims to evaluate whether the spatio-temporal cues are extracted in cochlear nucleus (CN) neurons.

Our results are based on single unit recordings from AN fibers and CN neurons in anesthetized cats in response to acoustic stimuli. We used transient complex stimuli (“Huffman sequences”) designed to manipulate the relative timing between AN fibers tuned to neighboring frequencies (Carney J Neurophys 64:437). CN neurons were said to be phase-sensitive (PS) if their rate responses changed more with Huffman phase manipulations than did AN fibers at the same stimulus levels. Even though most CN units were not PS, several primary-like-with-notches, onsets, and a few phase-locked low-frequency units were PS in the direction consistent with cross-frequency coincidence detection. The few primary-like and chopper units that were PS tended to be sensitive in the opposite direction.

We also recorded responses of CN units to harmonic complex tones with missing fundamentals. We hypothesized that PS CN neurons would either have rate representations of pitch similar to spatio-temporal representations in the AN, or show an enhancement of the spatio-temporal phase cues. While we found a few units that maintained salient pitch cues at high stimulus levels, there was no obvious correlation between spatio-temporal sensitivity and robust rate cues to pitch.

Supported by an NDSEG fellowship and NIH grants RO1 DC002258 and P30 DC005209.