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### **Title**

Interrelations between otoacoustic emission delays and neural tuning in the barn owl

### **Authors**

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### **Background**

While numerous studies have used otoacoustic emissions (OAEs) to estimate cochlear frequency selectivity, controversy remains. Clarification is hampered by outstanding questions regarding the biophysics of OAE generation. Here, we examined stimulus-frequency emission (SFOAE) properties for the barn owl, a bird species with a known "auditory fovea" (i.e. expanded high frequency representation; Köppl et al., 1993, *J Comp Physiol A* 171:695-704). The auditory fovea does not correlate with enhanced frequency resolution at the neural or behavioral level (Köppl, 1997, *J Neurophysiol* 77:364-377; Dyson et al., 1998, *J Comp Physiol* 182:695-702). This provides a unique case for investigating the interrelationship between SFOAE delays, neural frequency selectivity, and cochlear space constants.

### **Methods**

Nine adult barn owls (*Tyto alba*) were lightly anesthetized with ketamine/xylazine. The middle ear was vented on one side, and an Etymotic ER-10C probe sealed to the ear canal. SFOAEs were evoked by swept tones, generally between 1 and 11 kHz, and extracted using a suppression paradigm (Kalluri and Shera, 2013, *JASA* 134: 356-68). Probe levels varied from 0-50 dB SPL.

### **Results**

Owls exhibited robust SFOAE activity, most prominently over the range of 3-11 kHz, which correlates well with the frequency region of their auditory fovea. SFOAEs were detectable down to probe levels of 0 dB SPL. Their behavior was clearly level-dependent, with both linear and nonlinear features. Delays typically decreased above moderate levels (>30 dB SPL). SFOAE phase-gradient delays for a 40 dB SPL stimulus were slightly larger than in other birds (chicken and parakeet), typically decreasing from 2 to 1 ms with increasing frequency. A tuning

ratio' (Shera et al. 2010, JARO 11:343-365) was computed and found to vary between 1 and 2 across frequencies, similar to mammals but lower than in chickens.

### **Conclusions**

The present study confirmed a basic relationship between SFOAE delays and neural frequency selectivity for the barn owl, consistent with their unremarkable frequency tuning in the auditory nerve. As a visual fovea is associated with improved acuity, a larger cochlear space constant is often assumed to correlate with enhanced frequency resolution. This is clearly not the case in the barn owl, whose tonotopic map deviates significantly from exponential. These data provide further insight into what role cochlear spatial representation plays in hearing and how this compares across broad classes of morphologies, including the mammalian cochlea.

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