**University of Maryland Baltimore Graduate School**

# Announcement of Doctoral Dissertation Defense*

Candidate: Heather D Dobbins

Date, Time, and Place: April 25, 2008; 10:30 am; Davidge Hall

Dissertation Title: Tuning Dynamics in the Awake Auditory Cortex

Dissertation Abstract**:

Patterns of neural activity are used by the brain to encode, process and decode relevant information allowing a neural system to interact with its environment. Therefore, neural codes must be consistent, reproducible, and reliable. Cortical firing rates are correlated with stimulus features in every sensory modality demonstrating that cortex likely uses a rate code. The overall goal in this project is to examine neural tuning and its dynamics in the auditory cortex of an awake animal.

Does the central auditory system utilize latency in its code for parameters such as stimulus intensity? In past studies, latency was shown to be inversely related to the level or maximum acceleration of peak pressure of an auditory stimulus. But these studies were performed under anesthesia with low spontaneous and evoked firing, and reliable spike times. The awake cortex displays non-negligible spontaneous rates and less precise spike timing in evoked responses. I decided to perform a systematic investigation of the latency of the first spike and of the increase in firing rate as a function of stimulus level in the awake animal to determine whether either can provide a realistic coding mechanism of stimulus level. I discovered that there is not a significant change in mean first spike time, showing it does not provide a reliable code. I also discovered there is no consistent correlation between stimulus level and the latency of firing rate increase for the entire cortical population, invalidating response latency as a code for stimulus level.

The topographical organization present in primary auditory cortex is consistent with a rate-place code. Past studies of cortical tuning curves assumed implicitly that they do not change during the course of the response. However, there is evidence from the visual system that cortical tuning curves change significantly during the peri-stimulus time. In addition, there is evidence for three temporal regions in auditory cortical responses. Therefore, I compared tuning curves from three temporal regions, to measure dynamics in tuning. I discovered that tonal cortical tuning does not remain constant. Cortical tuning as measured by the best frequency and bandwidth from any temporal region of the response cannot be predicted using tuning from another temporal response region.

Responses to broadband sounds are typically only reported from the sustained portion of the response. However, evidence from the visual system and awake studies of the auditory system demonstrate that cortical tuning is comprised of more than a sustained response. I measured onset tuning to broadband sounds and whether it changed significantly during the course of the response. I discovered that there is a significant onset tuning within 20 - 40 msec of the stimulus, and that 95% of the cells exhibit a subsequent change in tuning during the steady-state response.

The sum results of this study demonstrate the complex nature of cortical tuning with heterogeneous and non-static response properties. A neural response can no longer be thought of as the reflection of a "one-step" instantaneous process. Instead, we must think of tuning as a complex and time-evolving process. Responses are truly spread out over time, and the evoked firing of a neuron depends not only on the spectral content of the stimulus presented, but also the temporal location of the spectral content within the stimulus.

Dissertation Committee Chair (name and title): Dr. Didier Depireux, Assistant Professor

Dissertation Committee Members (names and titles):
Dr. Joel Greenspan, Assistant Professor
Dr. Asaf Keller, Professor
Dr. Patricio O'Donnell, Professor
Dr. Geoff Schoenbaum, Assistant Professor

**The Open Presentation is open to the university community and invitees of the candidate. Any member of the Graduate Faculty may observe the Final Examination. Only committee members may vote. For more information, see* ***Procedures for Examination of the Doctoral Dissertation.***

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*Updated: February 24, 2006*