What is the neural representation of a speech code as it evolves in time? How do listeners integrate temporally distributed phonemic information into coherent representations of syllables and words? How does the brain extract invariant properties of variable-rate speech? More generally, what sorts of mechanisms encode temporal order during a complicated task like speech perception? This talk will describe an emerging neural model, variously called the PHONET, ARTPHONE, and ARTWORD model, that suggests answers to these questions, while quantitatively simulating challenging data about speech and word recognition. In this model, rate-dependent category boundaries emerge from feedback interactions between a working memory for short-term storage of phonetic items and a list categorization network for grouping sequences of items. The conscious speech and word recognition code is suggested to be a resonant wave, and a percept of silence is proposed to be a temporal discontinuity in the rate with which such a resonant wave evolves. Such a wave emerges when sequential activation and storage of phonemic items in working memory provides bottom-up input to unitized representations, or list chunks, that group together sequences of items of variable length. The list chunks compete with each other as they dynamically integrate this bottom-up information. The winning groupings feed back to provide top-down support to their phonemic items. These top-down expectations amplify and focus attention on consistent working memory items, while suppressing inconsistent working memory items. Feedback establishes a resonance which temporarily boosts the activation levels of selected items and chunks, thereby creating an emergent conscious percept. Because the resonance evolves more slowly than working memory activation, it can be influenced by information presented after relatively long intervening silence intervals. Variations in the durations of speech sounds and silent pauses can hereby produce different perceived groupings of words, and future sounds can influence how we hear past sounds. What functional reason explains why multiple levels of auditory processing may use resonant dynamics? A proposed answer is indicated by the fact that all the models have the acronym ART in their names. This is because they are special cases of Adaptive Resonance Theory. ART proposes how the processes whereby our brains continue to learn about a changing world in a stable fashion throughout life lead to conscious experiences. These processes include the learning of top-down expectations, the matching of these expectations against bottom-up data, the focusing of attention upon the expected clusters of information, and the development of resonant states between bottom-up and top-down processes as they reach an attentive consensus between what is expected and what is there in the outside world. It is suggested that all conscious states in the brain are resonant states, and that these resonant states trigger learning of sensory and cognitive representations. Thus, the speech models outlined above are proposed to be specialized versions of ART mechanisms for stably learning about temporally evolving information about the world.

Refreshments will be available
Everyone is welcome!

For information please call the Cognitive Science Office at (716) 645-3794 or check http://wings.buffalo.edu/cogsci/html/2002spring.htm