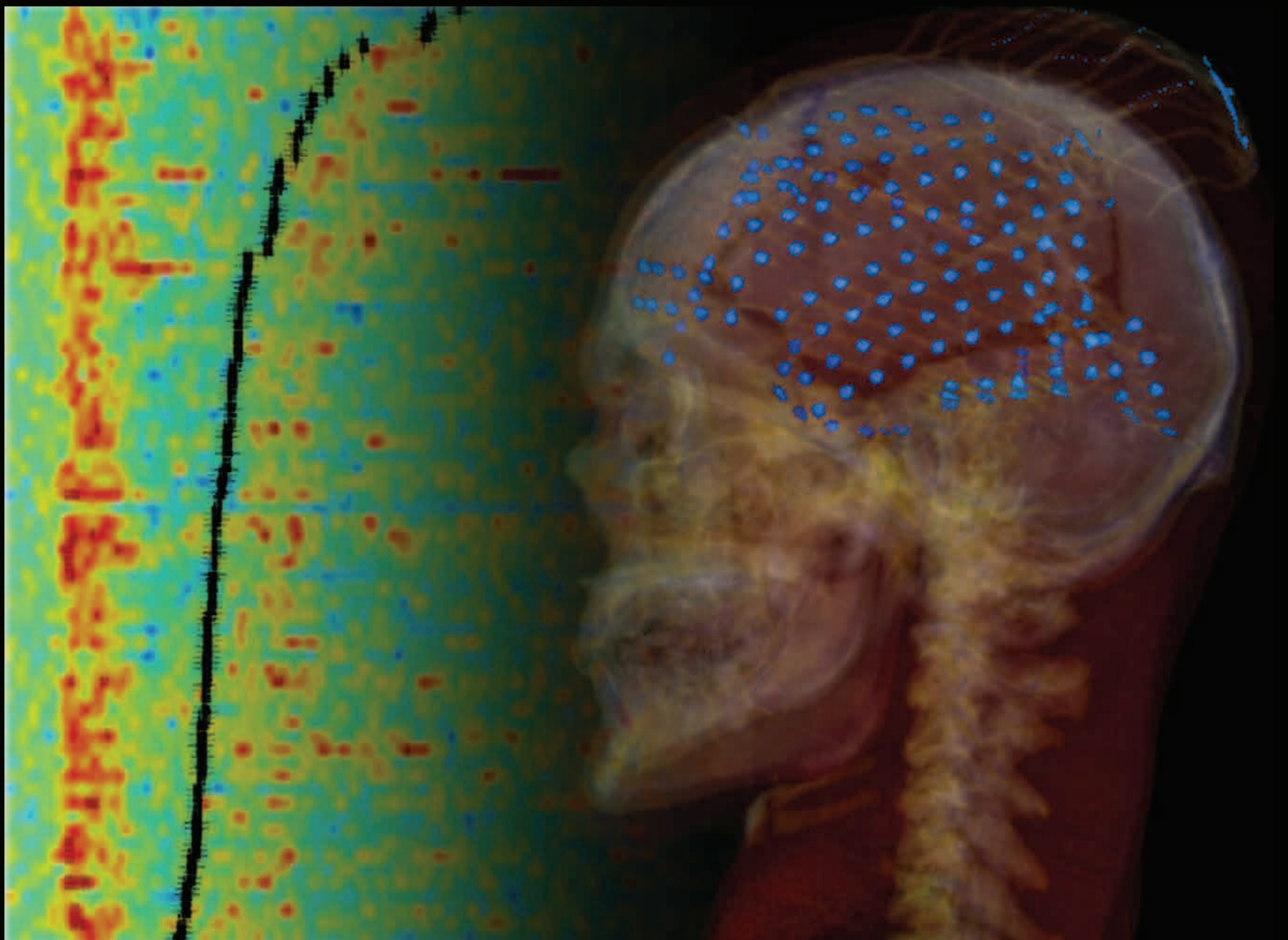
Robert T. Knight, M.D.
Helen Wills Neuroscience Institute
Department of Psychology
University of California, Berkeley



Insights into Cognition from Intracranial Recording in Humans

Since the discovery of the EEG in 1920's, neurophysiological dogma has claimed that the human cortex did not generate oscillations above 50-60 Hz. However, research in the last decade reports neural activity up to 250 Hz in the human cortex in multiple tasks. Indeed, every cognitive process examined including language, attention, memory and motor control generates high frequency oscillatory activity in the range of 70-250 Hz (high gamma, HG). Importantly, the HG band of the human elecrtocorticogram (ECoG) has the most precise spatial localization and task specificity of any frequency band in the cortex. The high gamma response in the ECoG precisely tracks auditory processing in the neocortex and we have used HG to study word representation, speech suppression, categorical representation of phonemes and the timing of language evolution in peri-sylvian language regions. Presentation of a word to be repeated generates robust HG activity in Wernicke's area in the temporal lobe onsetting at 50 msec. Surprisingly, the presentation of the word also generates HG activity in Broca's area in the frontal lobe at 200 msec well before speech onset. During repetition of the same word HG activity is evident in Broca's area preceding speech articulation but no activity is observed in Broca'a area during actual speaking. Thus, in contrast to classic notions of language organization these results reveal that both Wernicke's and Broca'a areas are involved in speech perception and Broca's area is not involved in the actual articulation of speech. The HG response has also defined the role of PFC in working memory and response selection and these results will be reviewed. Importantly, HG is phase locked to the trough of cortical theta rhythms and this coupling occurs in a task specific manner with different PFC dependent tasks eliciting uniquely distributed spatial patterns of HG-theta coupling. These results indicate that transient coupling between low- and high-frequency brain rhythms provide a mechanism for effective communication in distributed neural networks engaged during cognitive processing in humans and highlight the power of electrocorticography in understanding human cognition.

Neuroscience Graduate Seminar

Wednesday, March 28, 2012

4:10 p.m. · 1220 MRB III

Sponsored by Center for Integrative and Cognitive Neuroscience and Vanderbilt Brain Institute