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Local Cortical Activity is Phase-Entrained on Low-Frequency Rhythmsin a Gyrally-Specific Manner

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Abstract

The functional significance of electrical rhythms in the mammalian brain remains uncertain. To investigate the relationship of the spatially distributed beta (12-20Hz) and theta (4-8Hz) rhythms to localized neuronal dynamics, we measured macroscale electrophysiology from using arrays of subdural electrocorticographic (ECoG) electrodes in 14 human patients performing simple fixation. By looking at pair-wise phase coherence, we first examined to what degree brain rhythms represent a distributed process versus many adjacent processes with common spectral properties. By keeping the complex portion of the coherence, the effects of introduced coherence by re-referencing, or shifts in coherence at anatomic boundary, can be appreciated. These measures reveal that phase coherence follows gyral anatomy, and is sharply delineated at sulci. In addition to rhythmic brain processes ECoG potentials also reveal a spectrally broadband component that reflects the aggregate neural population activity beneath each electrode. We find that the amplitude of this broadband spectral change is modulated with the phase of the theta and beta rhythms during fixation. This rhythmic entrainment also follows gyral boundaries, but is constrained to more focal patches of cortex.

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