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Presentation Title: Neuronal interactions between sensory and prefrontal cortex during synchronized and desynchronized states

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Abstract:

Brain state is in constant flux and depends on many factors such as arousal and sensory input. While awake or in REM sleep, mammalian brains exhibit a desynchronized state characterized by increased high frequency (>20Hz) oscillations of electrical activity. Conversely, a synchronized state with large amplitude 0.5-3Hz oscillatory activity predominates during slow wave sleep or anesthesia.

Many questions remain as to how brain state affects neuronal population interactions across different cortical areas. To investigate such interactions, we used silicon probes to simultaneously record neuronal populations in somatosensory cortex (S1) and in medial prefrontal cortex (mPFC) of rats under urethane anesthesia. We compared the power spectra and coherence of local field potentials (LFP) within and between these cortical areas during synchronized states induced by urethane, and during desynchronized states induced either by systemic injection of an N-methyl-D-aspartate (NMDA) antagonist (MK-801; 0.2 mg/kg), or d-amphetamine (1 mg/kg), or during spontaneously occurring desynchronized states.

Despite being induced by different mechanisms, in all cases desynchronized states showed similar LFP power spectra and coherence within and between sensory and prefrontal cortical areas. As expected, the LFP power decreased for low frequencies (<10Hz) and increased for high frequencies (>20Hz) in both S1 and PFC during desynchronized periods. In contrast, changes in coherence between recording sites in either S1 or mPFC were dissociated from power and depended on distance between recording sites and the structure. Coherence increased with decreased distance between recording sites within S1 or mPFC in both synchronized and desynchronized states. In addition, the coherence between S1 and PFC in desynchronized periods increased in the 10-20 Hz range, which was unexpected as no such band-specific increase was found within S1 or mPFC alone. In summary, this work suggests that the desynchronized state involves complex interactions between neuronal populations, particularly in the 10-20 Hz frequency range, and that cortical networks settle in a stereotypical mode of interactions when activated.

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