Dynamics of synchronized neural activity in prefrontal-hippocampal networks during behavioral sensitization

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Neural synchrony exhibits temporal variability, therefore the temporal patterns of synchronization and desynchronization may have functional relevance. This study employs novel time-series analysis to explore how neural signals become transiently phase locked and unlocked during repeated injections of the psychostimulant, D-Amphetamine (AMPH). Short (but frequent) desynchronized events dominate synchronized dynamics in each of the animals we examined. After the first AMPH injection, only increases in the relative prevalence of short desynchronization episodes (but not in average synchrony strength) were significant. Throughout sensitization both strength and the fine temporal structure of synchrony (measured as relative prevalence of short desynchronizations) were similarly altered with AMPH injections, with each measure decreasing in the pre-injection epoch and increasing after injection.

Decoupling between locomotor activity and synchrony was observed in AMPH, but not saline, animals. The increase in numerous short desynchronizations (as opposed to infrequent, but long desynchronizations) in AMPH treated animals may indicate that synchrony is easy to form yet easy to break. These data yield novel insight into how synchrony is dynamically altered in cortical networks by AMPH and identify neurophysiological changes that may be important to understand the behavioral pathologies of addiction.