

Chen Institute Symposium 2025

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Talk title: *Intermittent rate coding and cue-specific ensembles support working memory*

Abstract: Persistent, memorandum-specific neuronal spiking activity has long been hypothesized to underlie working memory. However, emerging evidence suggests a possible role for ‘activity-silent’, synaptic mechanisms. This issue remains controversial because evidence for either view has largely relied on datasets that fail to capture single-trial population dynamics or on indirect measures of neuronal spiking.

We recently addressed this by examining the dynamics of mnemonic information on single trials obtained from large, local populations of prefrontal neurons recorded simultaneously in monkeys performing a working memory task. We found evidence that mnemonic information does not persist in the spiking activity of neuronal populations during memory delays, but instead alternates between coordinated ‘On’ and ‘Off’ states. At the level of single neurons, Off states are driven both by a loss of selectivity for memoranda and a return of firing rates to baseline.

Further exploiting the large-scale recordings, we show that mnemonic information is available in the patterns of functional connections among neuronal ensembles throughout the memory delay, even during Off states. Our results suggest that intermittent periods of memoranda-specific spiking coexist with synaptic mechanisms to support working memory.