Dynamic and multiplexed networks for working memory

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Abstract: Working memory (WM) provides the neurobiological infrastructure for human cognition. Dominant models posit that prefrontal cortex (PFC) supports WM by coordinating control over distributed memory representations. In two studies, multimodal electrophysiology data reveal that PFC control over WM is rhythmic, fundamentally dynamic, and not altogether necessary. Direct brain recordings (n=10) demonstrate that PFC and medial temporal lobe (MTL) theta-band rhythms direct a complex system of higher-frequency neural activity across regions, uncovering initial support for bidirectional PFC-MTL interactions related to WM demands. Then, data from patients with unilateral PFC damage (n=14) challenge dominant models on the central role of PFC (note 8% accuracy decrease in patients). In healthy controls (n=20), delta-theta-band rhythms precess from PFC toward parieto-occipital sites, concurrent with alpha-beta-band rhythms precessing in the opposite direction. All PFC effects are diminished with unilateral damage, revealing an independent posterior WM mechanism. These results reveal that rapid, parallel processing governs WM.