Computational Network Mechanisms of Task-Evoked Functional Connectivity

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Presentation Abstract Summary The brain is a network that somehow computes dynamic cognition. Task-evoked network dynamics (functional connectivity changes) are likely a crucial bridge between static brain network organization and cognitive dynamics. Using a neural mass model with a non-linear activation function, we identified core mechanisms underlying task-evoked functional connectivity changes. Specifically, a negative bias allows for sublinear and linear regimes to exist during rest and task states, respectively. Increased population excitability during tasks increases the linear relationship between brain regions, producing a functional connectivity (linear correlation) change. Extending this model to functional MRI (fMRI), we found inflated task-evoked functional connectivity estimates due to the shape of fMRI responses. Correcting for this inflation in empirical fMRI data with humans revealed small but reliable functional connectivity changes across a variety of tasks. Despite their small amplitude, these functional connectivity changes improved prediction of task-evoked activations relative to resting-state functional connections, suggesting a role in shaping cognitively-relevant activations. Together, these results suggest changes in linearity underlie task-evoked functional connections, dynamically altering the network organization that shapes task-evoked activations and associated cognitive dynamics.

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