Multiple Activity Patterns Uncovered by Temporal Decomposition May Explain Non-Stationary Network Dynamics

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Introduction

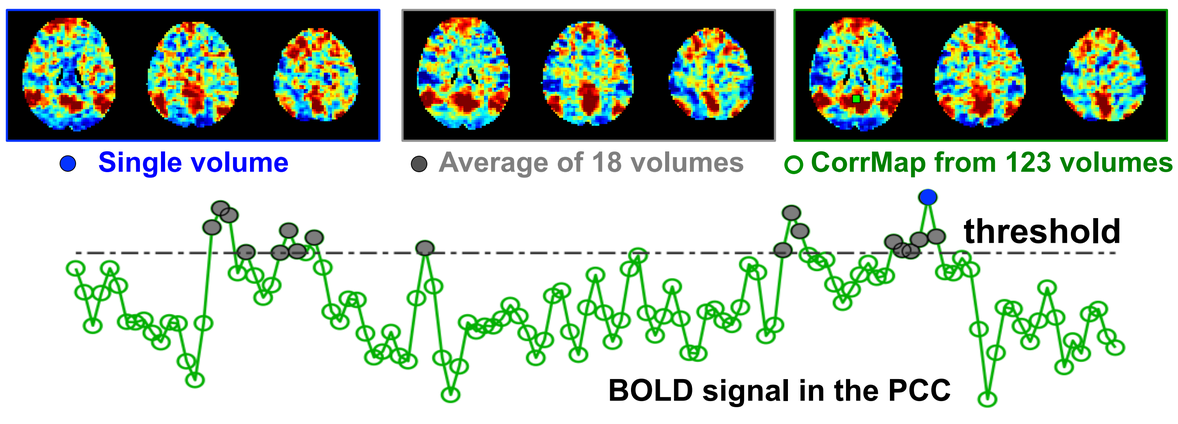
Resting-state functional connectivity, measured via blood-oxygenation-level-dependent (BOLD) signal correlations, has been shown to vary significantly even over the duration of a typical scan session (Chang et al., 2010). However, it is still unclear whether such temporal variation reflects solely changes in the relative levels of signals and noise or dynamic interactions among brain regions. In this study, we apply a novel technique to temporally decompose resting-state network (RSN) patterns into multiple spontaneous co-activation patterns (CAPs) with the purpose to understand the temporal dynamics of RSNs.

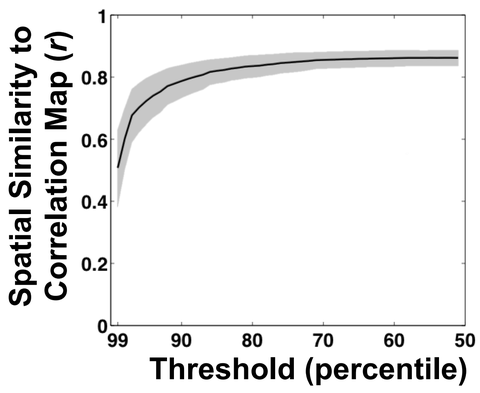
Methods

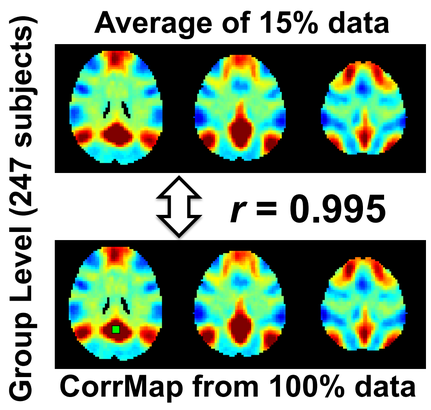
Resting-state data from 247 participants were selected from the "1000 functional connectomes project" (FCP). The RSN patterns obtained with conventional seed-based correlation maps were first replicated by selectively averaging 15% fMRI volumes with highest signal at the seed regions. These volumes were further classified into multiple groups based on their spatial similarity and then averaged within groups to generate corresponding CAPs, each of which corresponds to a distinct set of time points.

Results

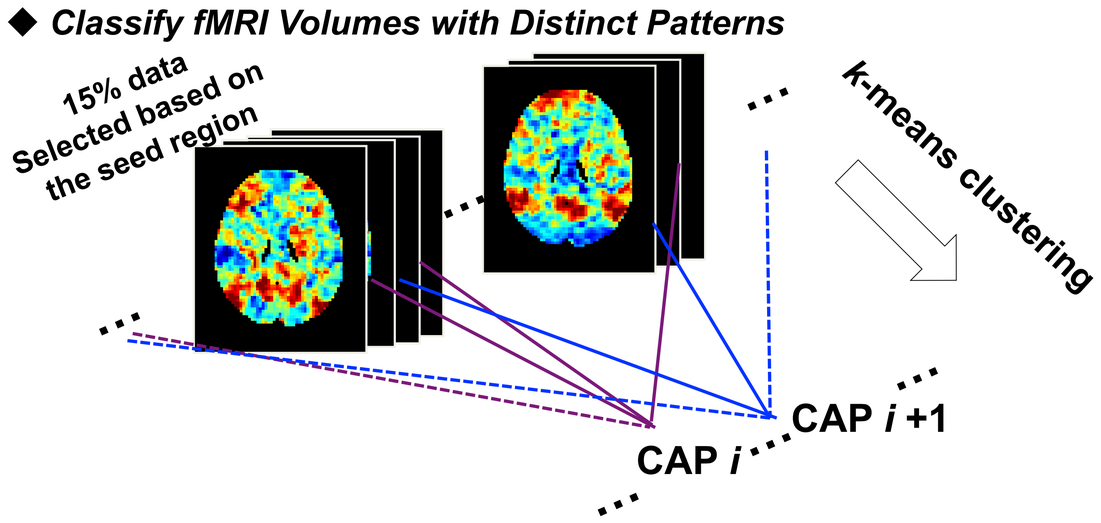
◆ *Replicate RSN Patterns with A Small Portion of Time Points*



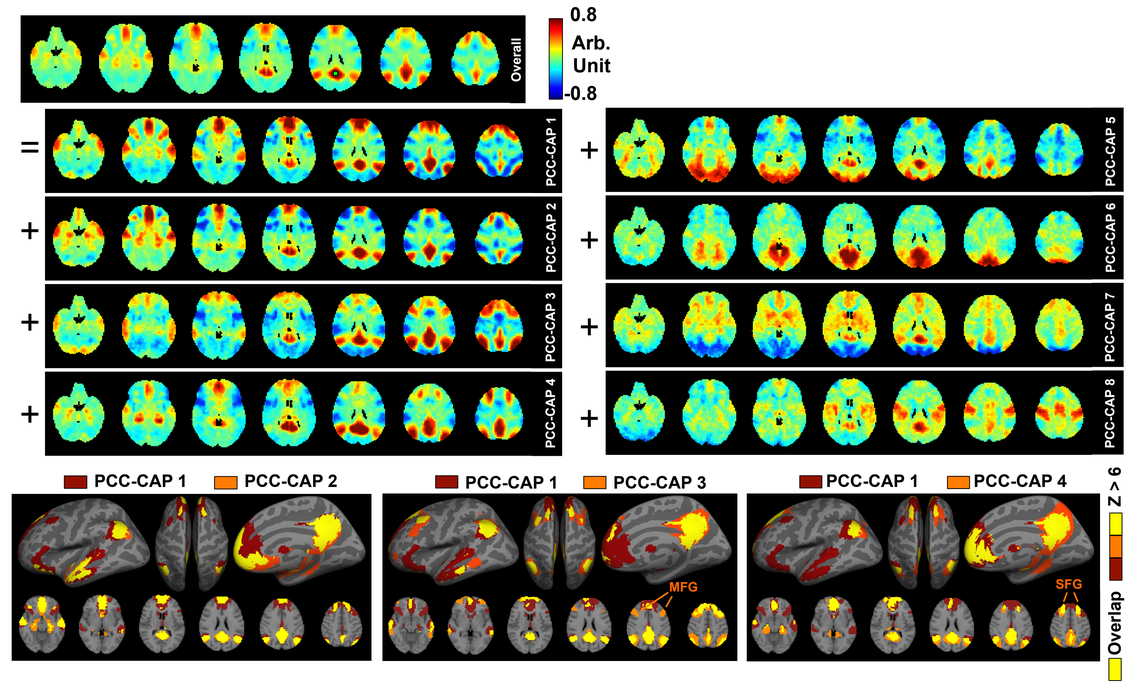




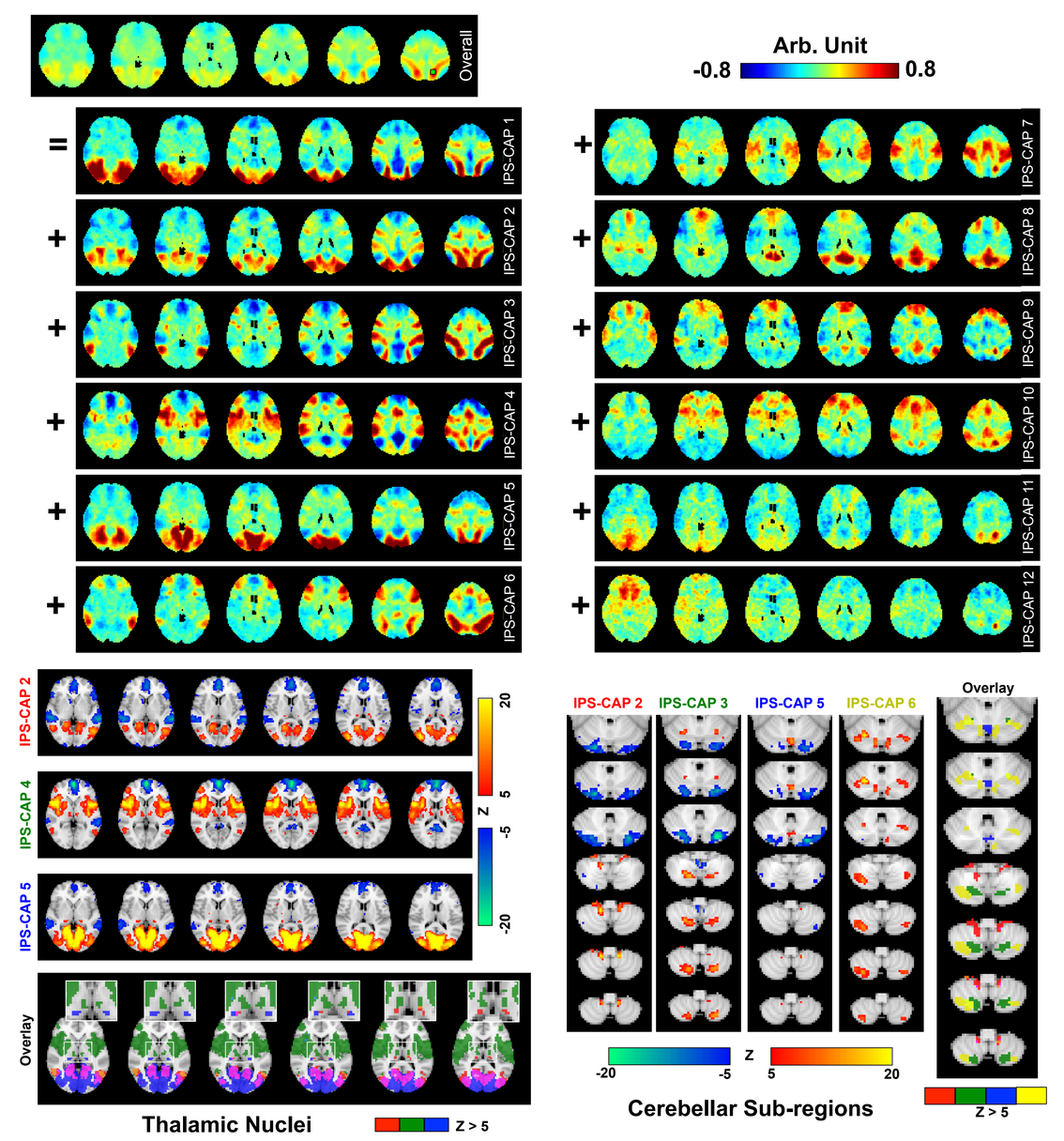
◆ *Classify fMRI Volumes with Distinct Patterns*



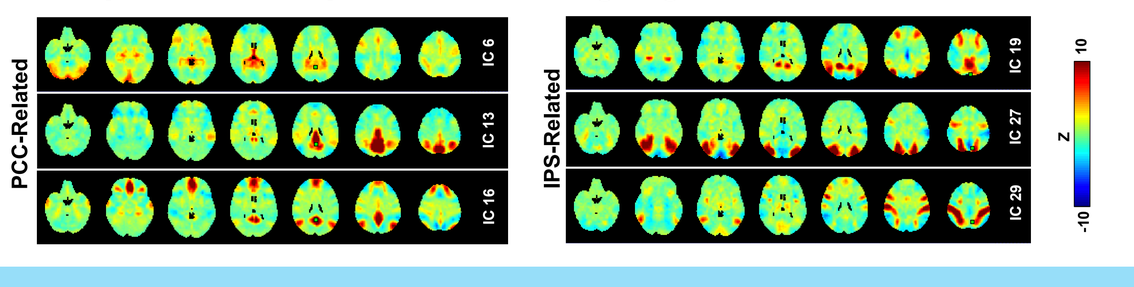
◆ *Temporal Decomposition of Default Mode Network*



◆ *Temporal Decomposition of Dorsal Attention Network*



◆ *Independent Components Showing High Scores at Seeds*



Discussion

RSN patterns found with the conventional seed-based correlation map appears to be a summation of multiple distinct CAPs appearing at different times. These CAPs could not be identified using the ICA approach because their spatial patterns are not distinct from each other enough to satisfy its strict "independence" constraints. Switching between these CAPs over time may account for, at least partially, the non-stationary characteristic of the resting-state functional connectivity.

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