Overlapping Intrinsic Connectivity Networks Relate to Emotion, Memory, and Motor Suppression

NILCAMP
Neuroimaging Laboratory of Cognitive, Affective, and Motoric Processes

Karisa Hunt, Lindsay Knight, Teodora Stoica, Jessi Kane, Olivia Cook, Brendan Depue
Department of Psychological and Brain Sciences

UNIVERSITY OF LOUISVILLE

Background:

Goal-directed behavior benefits from self-regulation of cognitive and affective processes, such as emotional reactivity, memory retrieval and prepotent motor response.

Dysfunction in self-regulation can be observed in many psychiatric disorders involving these systems, such as post-traumatic stress disorder and ADHD.

Due to the entwined nature of these domains, it is highly probable that their regulation involves common neural networks.

Objective:

To determine (using Independent Component Analysis) which overlapping intrinsic connectivity networks (ICNs) contribute to inhibitory regulation across the three task domains (emotion, memory, and motor).

Methods:

Sample: Eighteen adults were analyzed in this study. All participants were right-handed native English speakers with normal or corrected-to-normal vision.

Tasks: Participants underwent neuroimaging while completing three inhibitory tasks: an emotion regulation (ER) task, a memory suppression (think/no-think; TNT) task, and a motor response inhibition (stop-signal; SS) task.

Analysis: ICA (CONN; MATLAB) was conducted, and corresponding components were selected from the task data based on interrelated patterns of activation across-task.

The resulting components were assessed for relationships with not only their own behavioral measures, but also the behavioral measures of other tasks.

Results:

Across-task commonalities indicated by ICA included:

- A medial prefrontal network
- A striatal network
- A frontoparietal executive control network
- Down-regulation in task-specific ROIs

Task activation was found to be related not only within each task's own behavioral measures, but also across the other two tasks' behavioral measures.

These findings suggest that each common ICN may play a role in the synergic process of downregulating task-specific effector areas.

For example, the medial prefrontal network may exert control over reward motivation, while the striatal network modulates the updating of the flow of goal-congruent information from subcortical to cortical areas, and the frontoparietal executive control network maintains individual goal representations.

As a result, these areas together likely facilitate the downregulation observed in task-specific effector areas: the amygdala for ER (see *Fig. 1*), the hippocampus for TNT (see *Fig. 2*), and the primary motor cortex for SS (see *Fig. 3*).

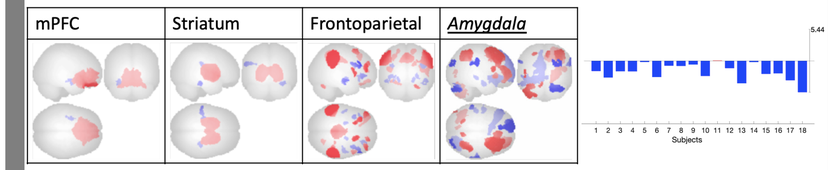

Fig. 1. Common ER ICNs across-task, ER-specific ROI (amygdala) network, and individual subject component loading levels for ROI peak

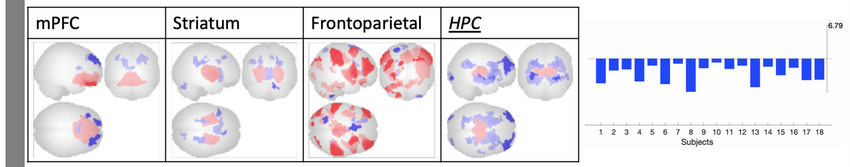

Fig. 2. Common TNT ICNs across-task, TNT-specific ROI (hippocampus) network, and individual subject component loading levels for ROI peak

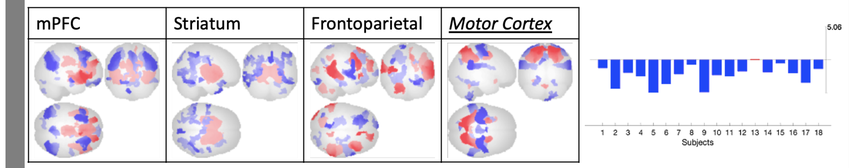

Fig. 3. Common SS ICNs across-task, SS-specific ROI (primary motor cortex) network, and individual subject component loading levels for ROI peak

Conclusions:

Emotion, memory, and motor suppression are related to the recruitment of some common neural networks.

These results indicate shared variance in ICNs during the regulation of emotional reactivity, memory retrieval, and prepotent motor response, as measured through ICA.

Activation in these ICNs was also related to behavior both within- and across- task, linking all ICNs to suppression behavior.

While previous research has shown that inhibitory control across various domains requires frontoparietal control of executive function, these results illustrate that additional ICNs (such as striatal and medial prefrontal networks) are often utilized during these inhibitory processes, as well.