# Functional Connectivity Correlates to Individual Difference in Human Brains During Working Memory Task and Resting State

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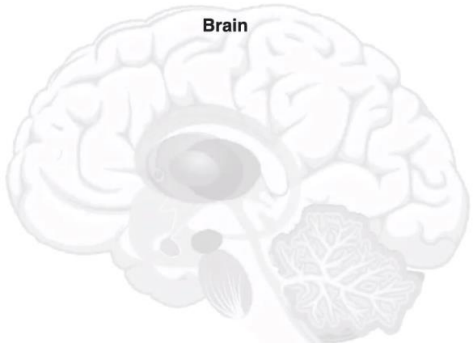
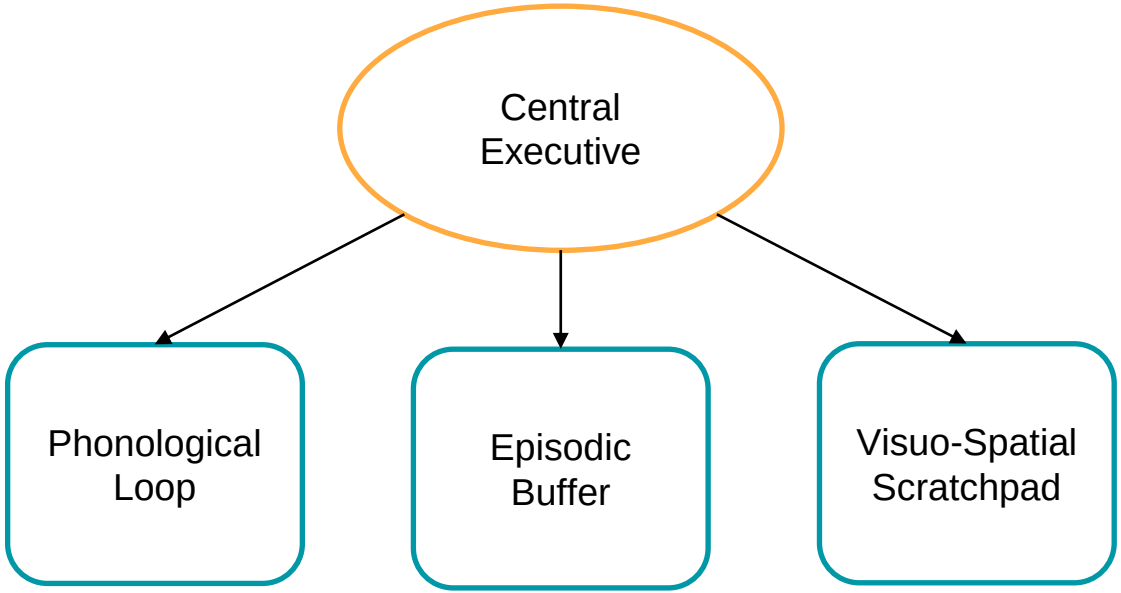
*2021 IEEE EMBS ISC Presentation*




Georgia Institute of Technology

# Working Memory Model

- Working Memory: the processes that are used to temporarily store, organize, and manipulate information



# Background & Current Studies

- How resting-state functional connectivity  was impaired in individuals with abnormal working memory

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- How resting-state functional connectivity  was impaired in individuals with abnormal working memory
- How different types of information was processed by divergent brain networks within the working memory scope

# Motivation

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- How the brain network changes between task and rest states in relation to working memory capacity.

# Hypothesis

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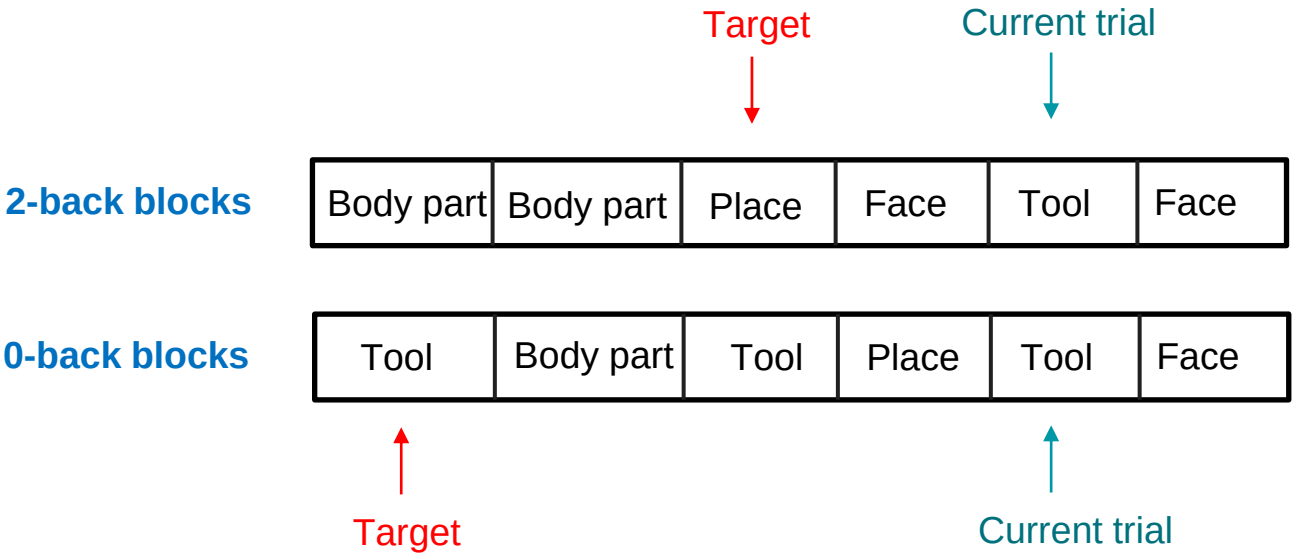
- Stronger connection between prefrontal cortex, basal ganglia (caudate) and hippocampus
- Weaker connective network in resting state compared with in task state

# Working Memory Data

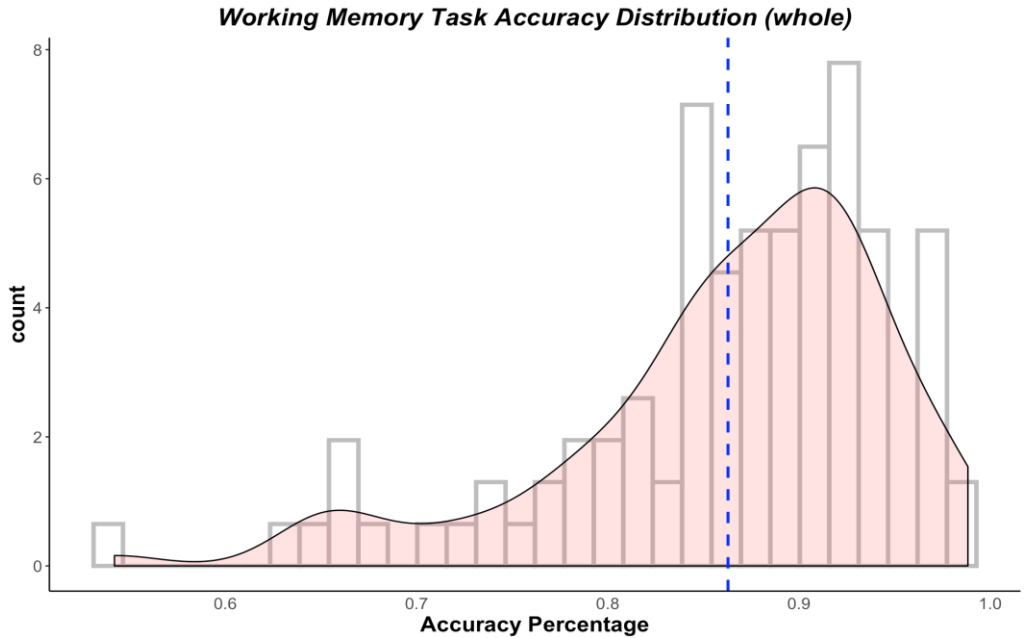
- Each trial presents a single object centered on the screen
- Participants press one of the two buttons to indicate if the object is target




*Data is from Human Connectome Project*

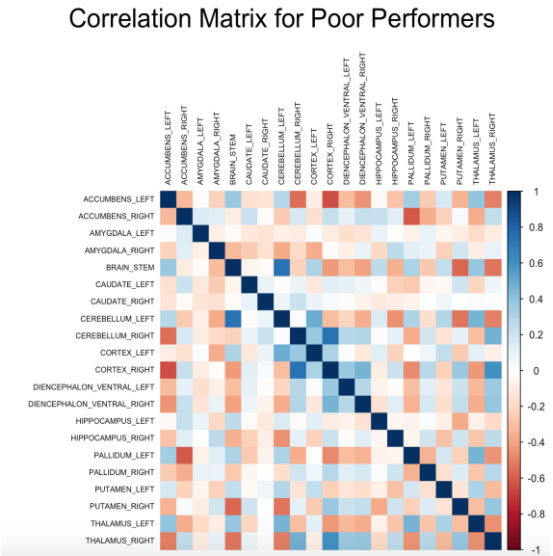
# Working Memory Task Accuracy Distribution

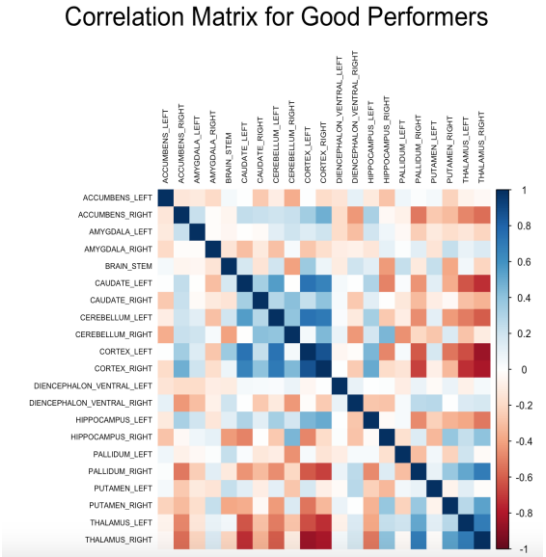
- Split the subjects into two groups using the mean as mid-line
- 40 good performers, 60 poor performers



# Correlation Matrix in Task State

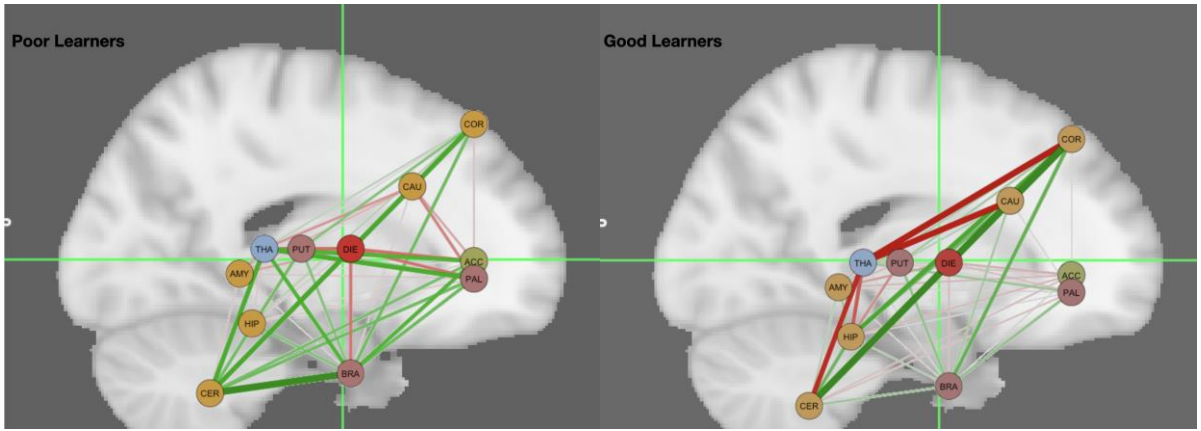
- Higher level of correlation distance in good performers compared with in poor ones
- High correlation between cortex and hippocampus as well as between cortex and caudate



# Hierarchical Clustering in Task State

- **Node**: parcellation of the left hemisphere
  → same cluster with same color
- **Edge**: correlation distance (negative: red, positive: green)
  → thickness/ translucency  represents the strength of connection



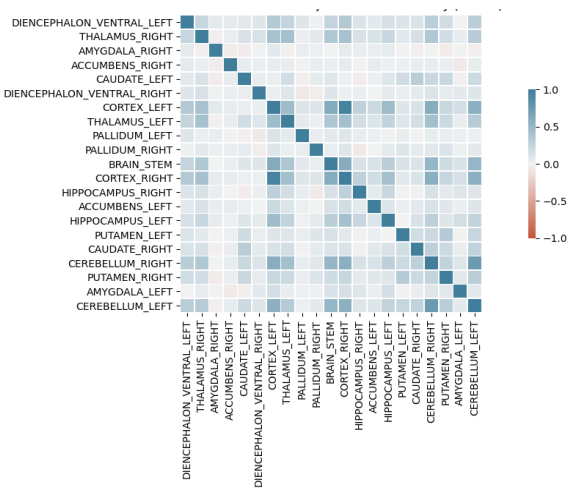
# Brain Acitvation during Task State

- **Poor performers**: weak correspondence among these three areas
- **Good performers**: the thalamus showed opposite activity direction from cortex while hippocampus showed similar trends to cortex

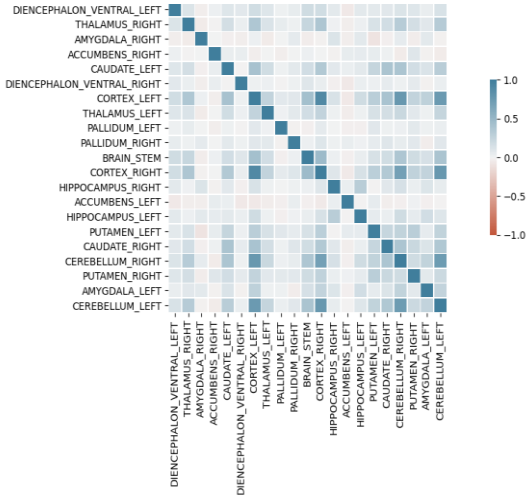

# Correlation Matrix in Resting State

- Tiny difference in the correlation between two groups

Correlation Matrix for Poor Performers

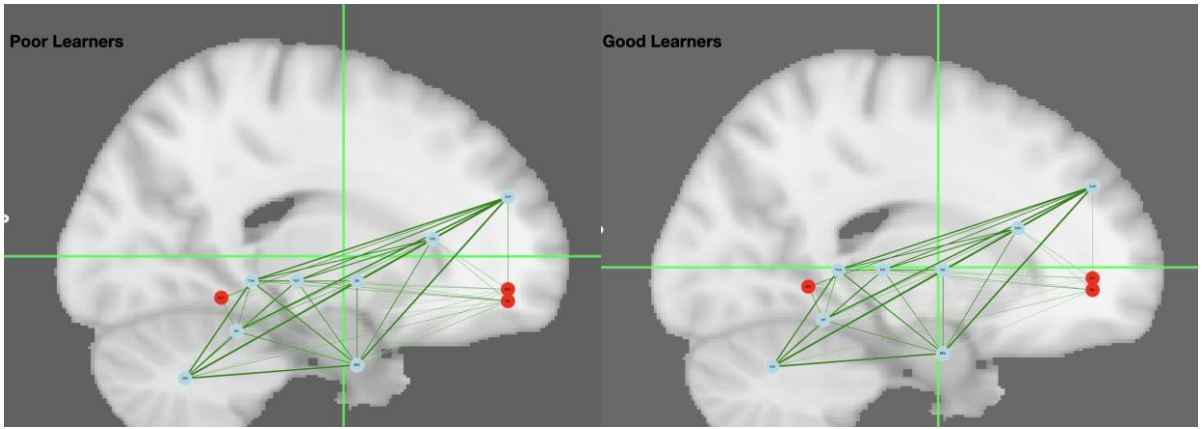



Correlation Matrix for Good Performers



# Hierarchical Clustering in Resting State

- Node: parcellation of the left hemisphere
  → hard for clustering
- Edge: correlation distance (only positive)
  → thickness/ translucency  represents the strength of connection



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  → related to emotion or motor tasks → *sleep* mode

# Conclusion

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- Working memory is supported by an interconnected network
- Difficult to tell the difference between two groups via resting fMRI
- Amygdala, caudate and putamen were less activated during rest
  → related to emotion or motor tasks → *sleep* mode
- Brain network becomes more activate from resting to task state in good performers