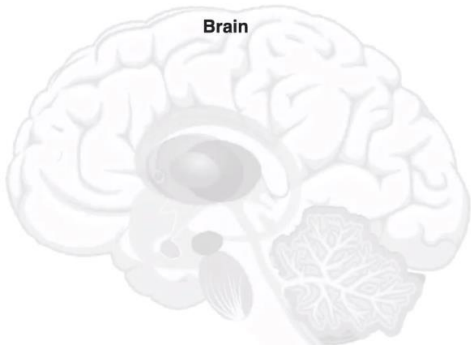


# Functional Connectivity Correlates to Individual Difference in Human Brains during Working Memory Task and Resting State

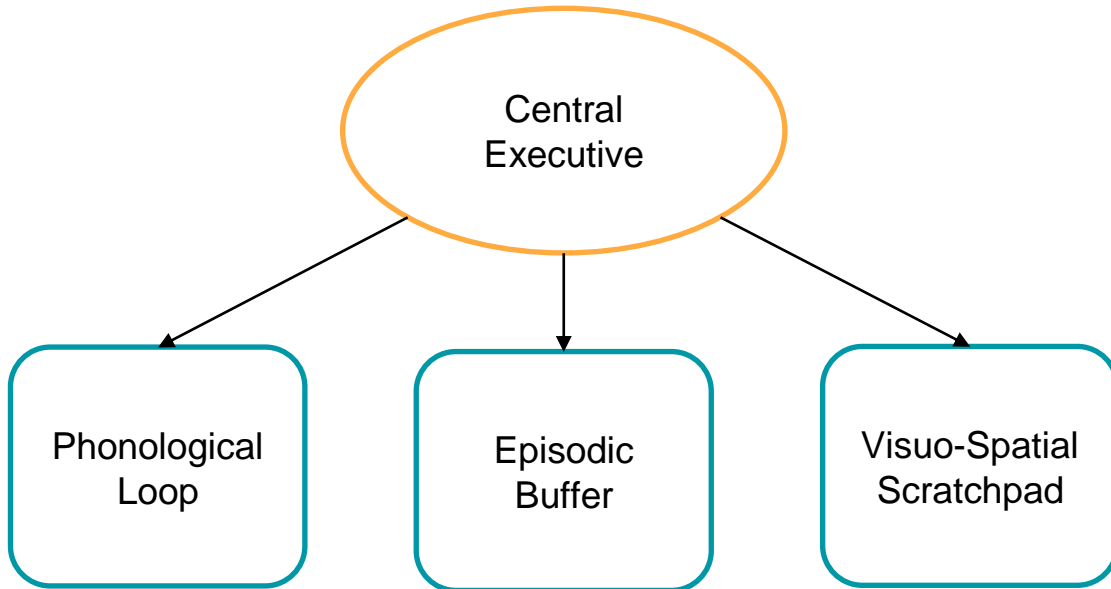
Hao-Lun Hsu

*2021 IEEE EMBS ISC Presentation*



# 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

- A lack of studies asked whether the working memory network dynamics relate to normal individual performance differences

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- A lack of studies asked whether the working memory network dynamics relate to normal individual performance differences
- How the brain network changes between task and rest states in relation to working memory capacity.

# Hypothesis

- Stronger connection between prefrontal cortex, basal ganglia (caudate) and hippocampus

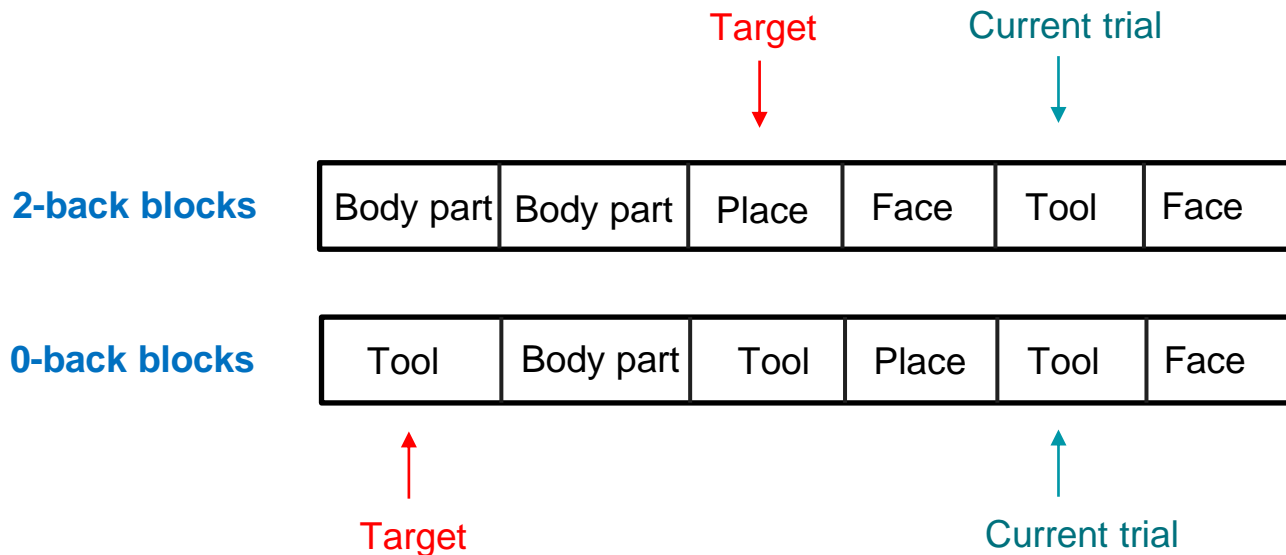
# Hypothesis

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



# Working Memory Data

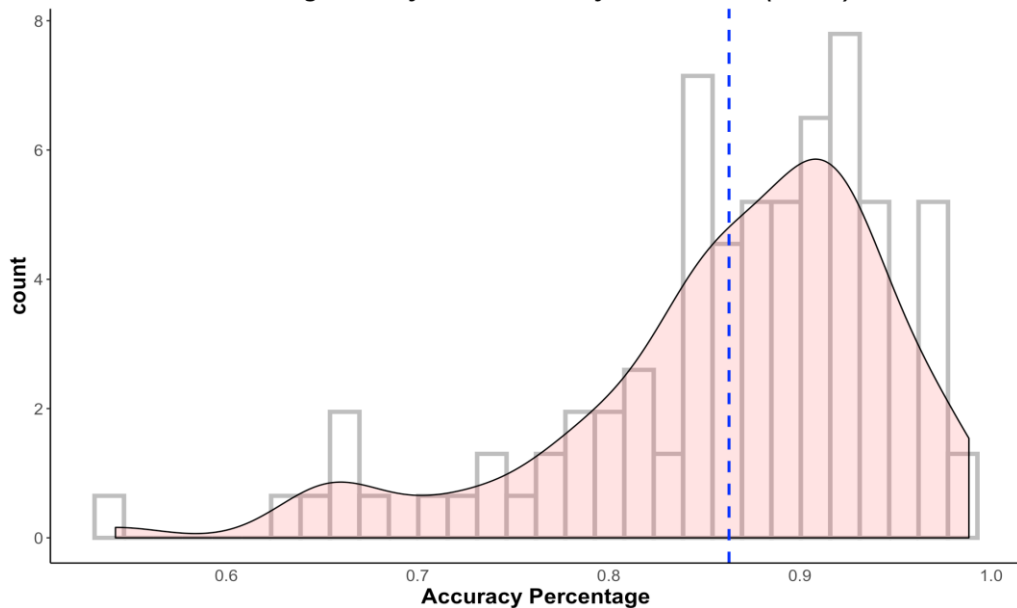
- Each trial presents a single object centered on the screen
- Participants press one of the two buttons to indicate if the object is target



# Working Memory Task Accuracy Distribution

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

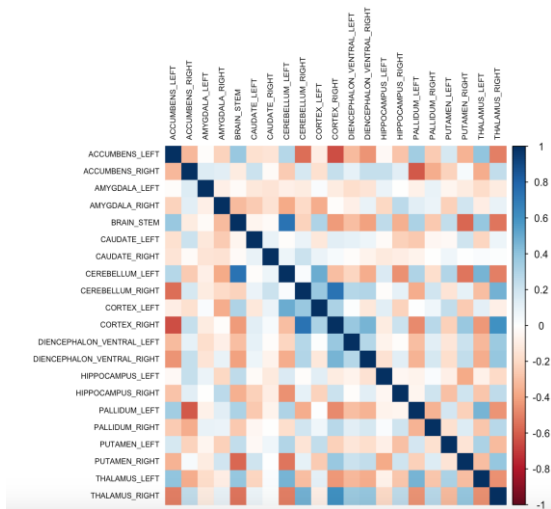
***Working Memory Task Accuracy Distribution (whole)***



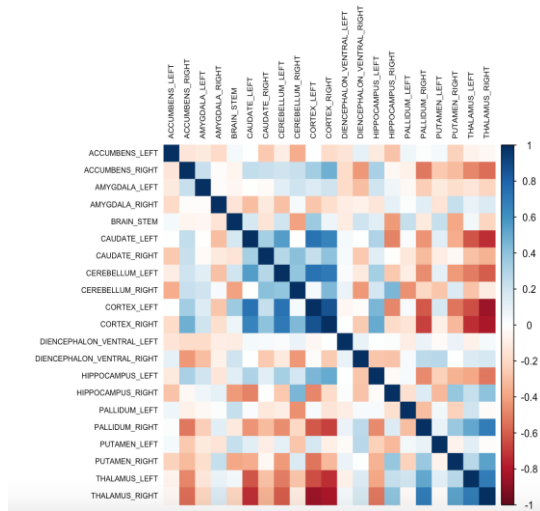
# Correlation Matrix in Task State

- 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

Correlation Matrix for Poor Performers

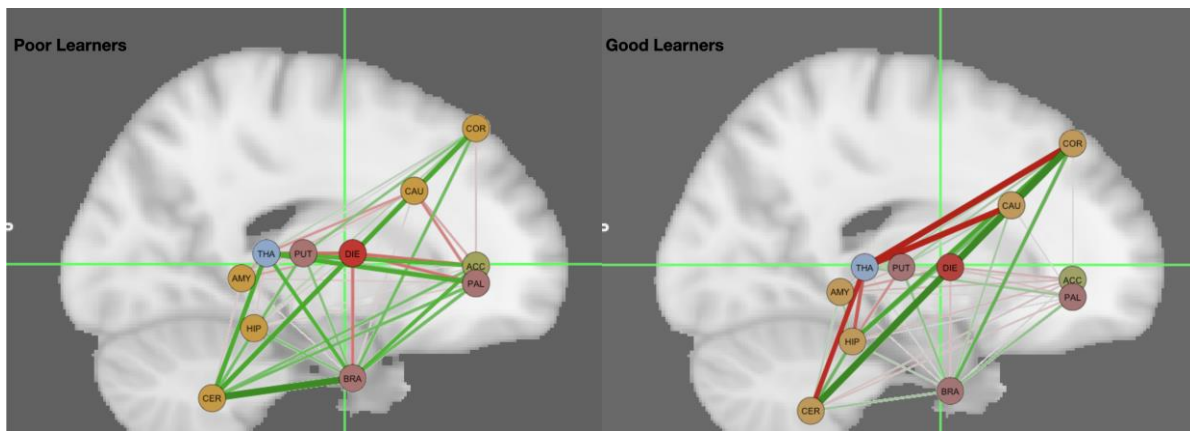


Correlation Matrix for Good Performers



# Hierarchical Clustering in Task State

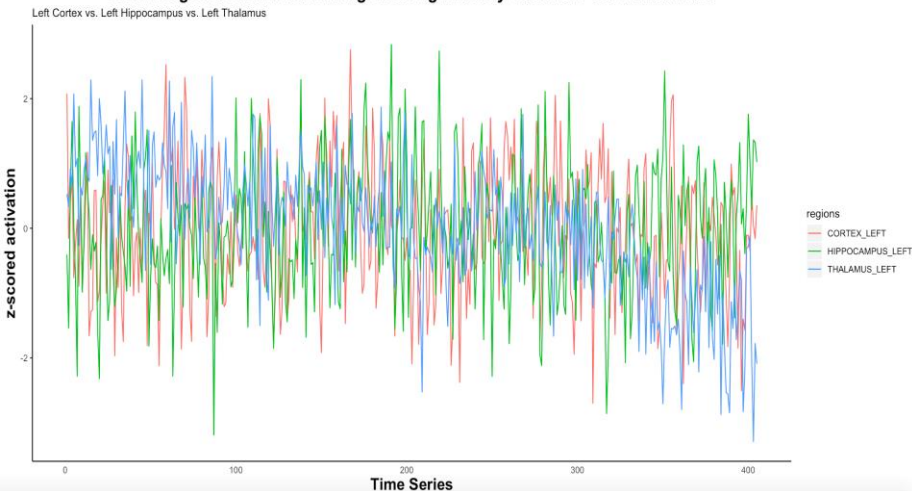
- **Node:** parcellation of the left hemisphere  
→ same cluster with same color
- **Edge:** correlation distance (negative: red, positive: green)  
→ thickness/translucency represents the strength of connection



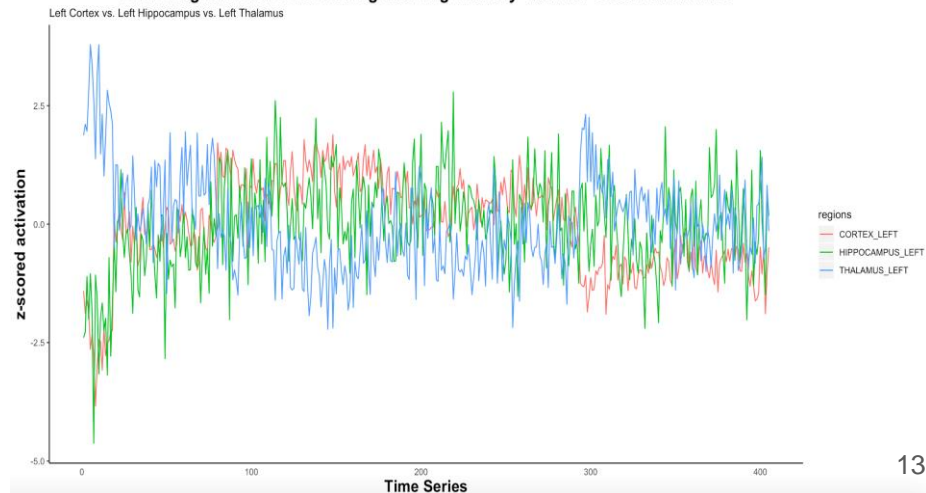
# Brain Activation during Task State

- **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

*Brain Regions Activation During Working Memory Task for Poor Performers*



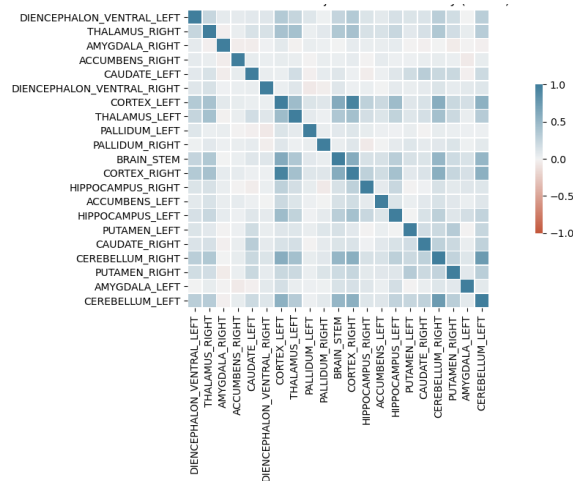
*Brain Regions Activation During Working Memory Task for Good Performers*



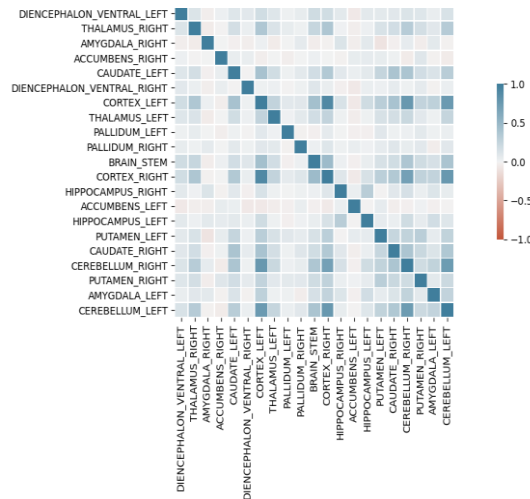
# Correlation Matrix in Resting State

- Tiny difference in the correlation between two groups

Correlation Matrix for Poor Performers

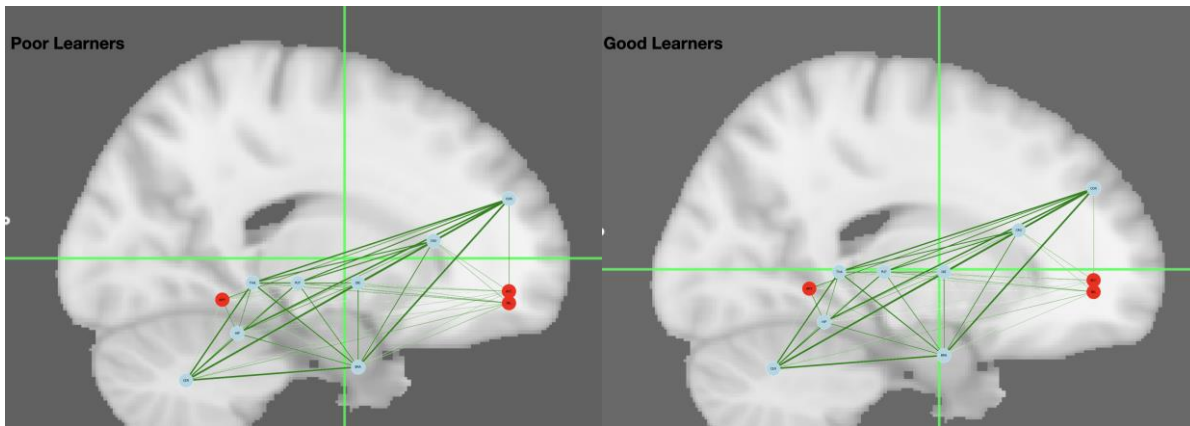


Correlation Matrix for Good Performers



# Hierarchical Clustering in Resting State

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



# Conclusion

- Strong connection between cortex, and caudate in good performers via fMRI in working task



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# Conclusion

- Strong connection between cortex, and caudate in good performers via fMRI in working task
- 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