



# Graph Theoretical Approaches Show a Relationship Between Resting State Functional Connectivity in Younger and Older Adults and Phonological Aspects of Language Production

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## Introduction

- Older adults experience cognitive decline (Salthouse, 2010).
- Language functions change with age: speech production declines (Burke & Shafto, 2008).
  - Increased word retrieval failures
  - Slower speech rates
- Prior studies show neural networks strongly correlated during tasks are also strongly correlated during rest (Greicius, Krasnow, Reiss, & Menon, 2003; Rosazza & Minati, 2011).
- Resting State Functional Connectivity (RSFC) is predictive of behavior during tasks (Mennes et al., 2010; Tian, Ren, & Zang, 2012).
- Older adults exhibit gray and white matter decline, yet increased task-based fMRI activation (Reuter-Lorenz & Cappell, 2008).

## The Present Study

### Motivation

- Few studies have examined:
  - The language network during resting state in younger and older adults.
  - If RSFC within language regions is predictive of functional activation.

### Questions

- Are there age differences in the resting state language network?
- Does functional connectivity in the left hemisphere language network and homologous right hemisphere regions predict behavior and task-based functional activation across the lifespan as tested with regression analyses?

### Predictions

- Older adults will exhibit decline in RSFC in the language network.
- Older adults will exhibit increased connectivity in the right hemisphere.

## Methods

### Participants

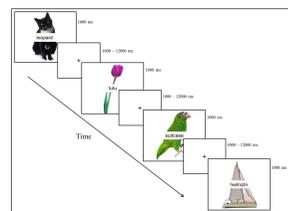
	Younger Adults	Older Adults
N	20	19
Age	M = 23.7 (4.32)	M = 67.32 (6.33)
Gender (M/F)	10/10	5/14
Education (years)	M = 16.6 (2.72)	M = 16.84 (2.19)

Numbers in parentheses represent standard deviation

### Resting State Parameters

- Run time: 6 minutes
- TR = 2500 ms
- TE = 25 ms

### Task Design



Rizio, Moyer, & Diaz (2017)

Picture Word Interference Task.  
Four conditions: Categorical, Phonological, Unrelated, and Non-word.

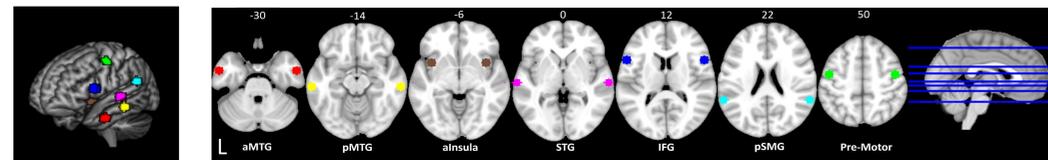
### Graph Theory Network Measures

Network Measure	Description
Betweenness Centrality	Measure of the most essential or influential nodes in a network
Clustering Coefficient	Proportion of a region's neighbors that are neighbors with each other
Degree	Number of connections to a node
Efficiency	Measure of how efficiently a network exchanges information

All network measures calculated using the Brain Connectivity Toolbox

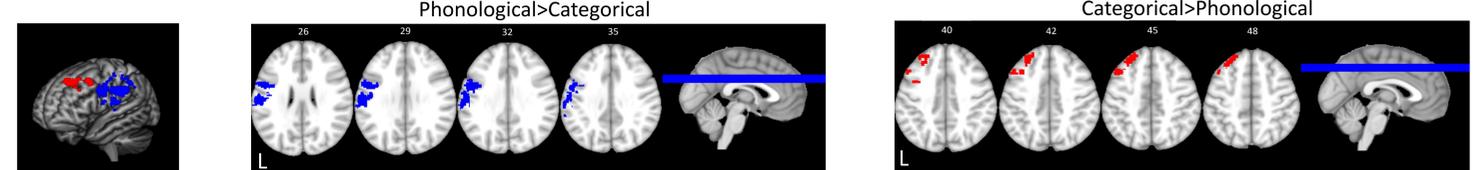
## Regions of Interest

### Resting-State Language Network:

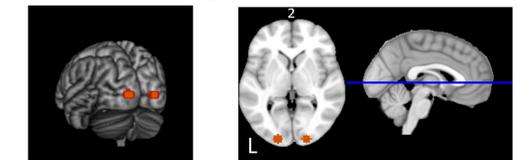


Regions of Interest selected using meta-analyses and confirmed using the Harvard-Oxford Cortical Structural Atlas.

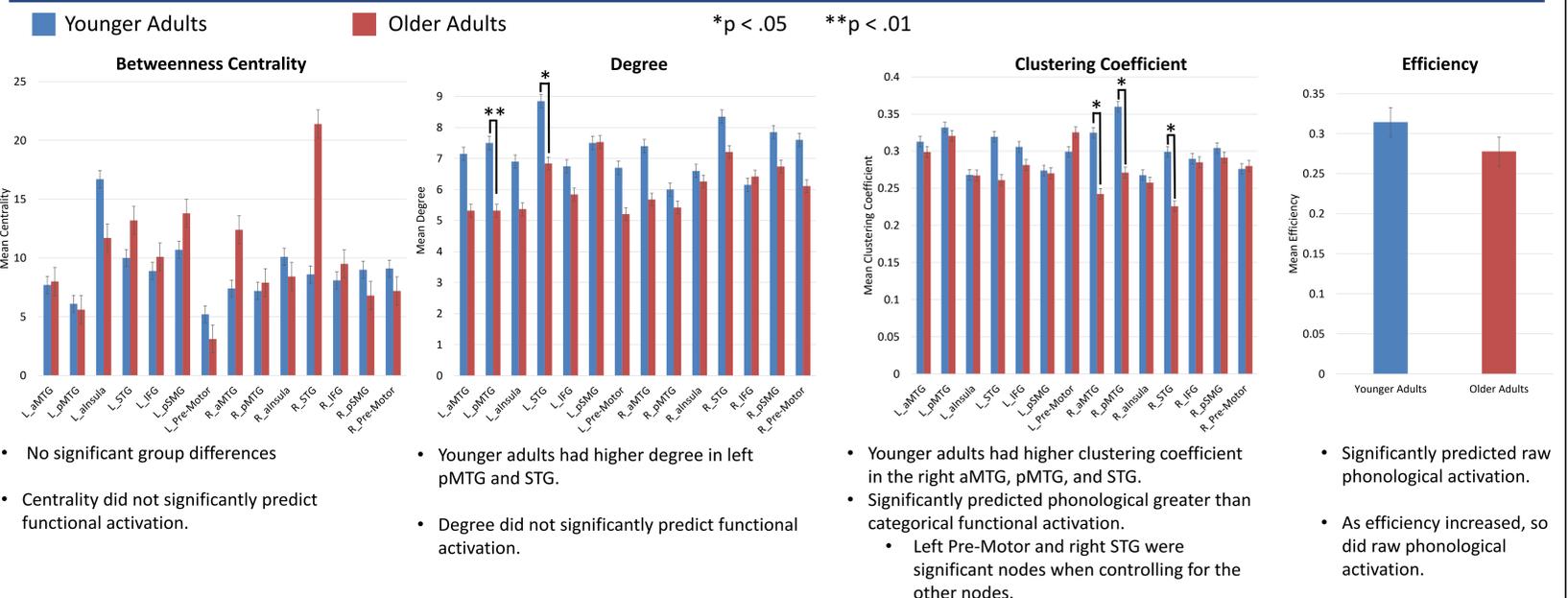
### Functional Activation ROIs:



### Visual Control Regions:



## Results



## Discussion & Conclusions

### Age Differences

- Significant group differences in degree in left pMTG and left STG; younger adults have higher degree in these regions.
- Significant group differences in clustering coefficient in right aMTG, pMTG, and STG; younger adults have higher clustering coefficient.
- No group differences in centrality or efficiency.
  - Suggests overall structure of the resting state language network is not declining but the relationships between regions are showing age-related differences.
- There were no group differences in RSFC in the visual control regions. These regions did not predict functional activation. This demonstrates that results are a function of differences in the language network and not solely due to aging.

### Relationship between RSFC and Task-based Functional Activation

- Clustering coefficient and efficiency of the resting-state language network are predictive of functional activation during a picture word interference task.
  - For clustering coefficient, left Pre-Motor node is a significant node when controlling for other nodes. As clustering coefficient of this node increases, functional activation decreases.
  - The right STG node is a significant predictor of functional activation when controlling for other nodes. As clustering coefficient increases, functional activation increases.

## References & Acknowledgments

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