

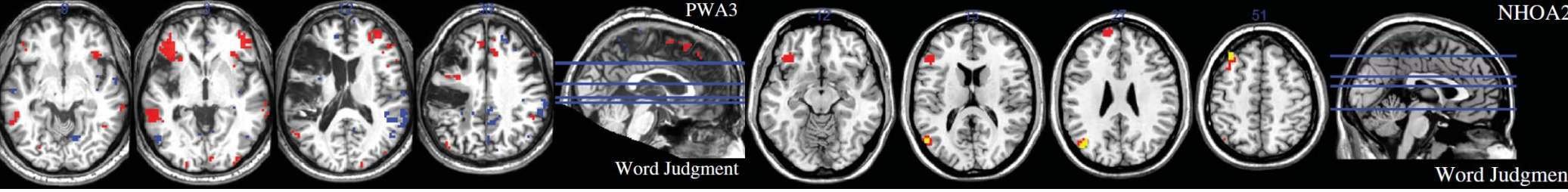
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Introduction

The concreteness effect is a well-known behavioral phenomenon in which there is an advantage for concrete over abstract words in a variety of linguistic tasks.

- Persons with normal language processing and persons with aphasia (PWA) both exhibit this effect
- This effect has been shown to be reversed in some populations (semantic dementia), suggesting a dissociation in the neural organization of abstract and concrete words
- Recent neuroimaging work has shown dissociable activation patterns during abstract versus concrete word processing (Binder et al., 2009; Wang et al., 2010)
- Most neuroimaging work was carried out in healthy young adults, though localization of cognitive processes have been shown to change with age (Cabeza, 2001)
- While there is much overlap between abstract and concrete word processing for both neurologically healthy older adults (NHOA) and PWA, there are differences which seem to be exaggerated in PWA (Sandberg & Kiran, 2013); however this was a small sample size (N = 3)



- No studies to date have used network analysis to examine the concreteness effect in NHOA and/or PWA
- The goal of this work is to examine network properties of abstract and concrete word processing in both NHOA and PWA to gain a better understanding of the organization of the semantic system and how it may change with age or neurological damage.**

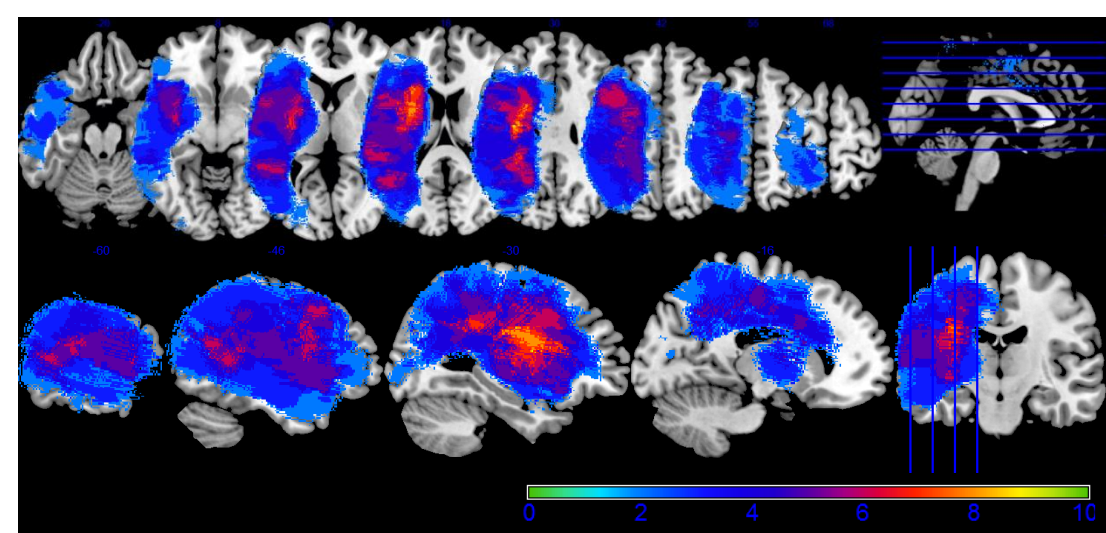
Participants

Neurologically healthy older adults (NHOA)

- N = 10 (5 male)
- Aged 50-67
- No history of neurological disease
- Right handed, native English speakers

Persons with aphasia (PWA)

- N = 10 (7 male)
- Aged 47-75
- Aphasia following LH stroke
- Chronic stage of recovery (>6 months)
- Right handed, native English speakers



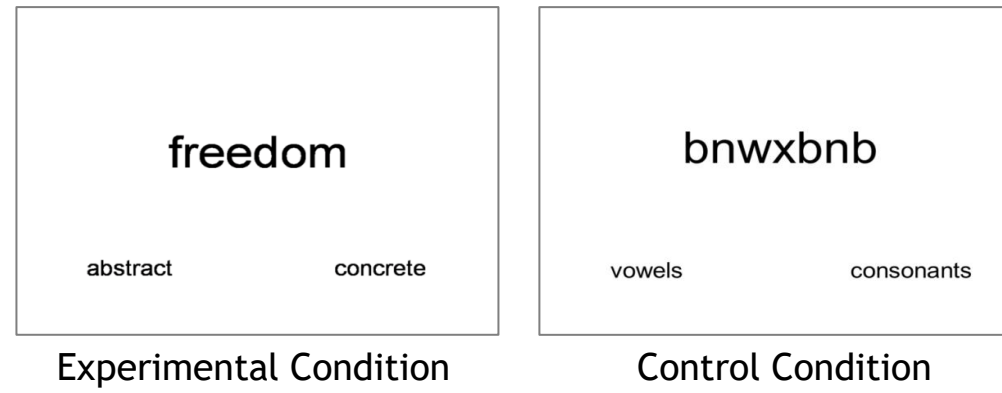
Method

Concreteness Judgment Task

- Event-related design
- NHOA data collected at UT-Austin
- 3T Siemens
- 50 abstract words, 50 concrete words
- 25 vowel strings, 25 consonant strings
- 3 sec stimulus presentation with jittered ISI (1.5, 3, 4.5 sec)
- TR = 2

PWA data collected at BU

- 3T Phillips
- 60 abstract words, 60 concrete words
- 30 vowel strings, 30 consonant strings
- 4 sec stimulus presentation with jittered ISI (2, 3, 4 sec)
- TR = 2.5



Data Analysis

SPM12

- GLM
- MRICroN – statistical overlap

CONN toolbox for SPM12

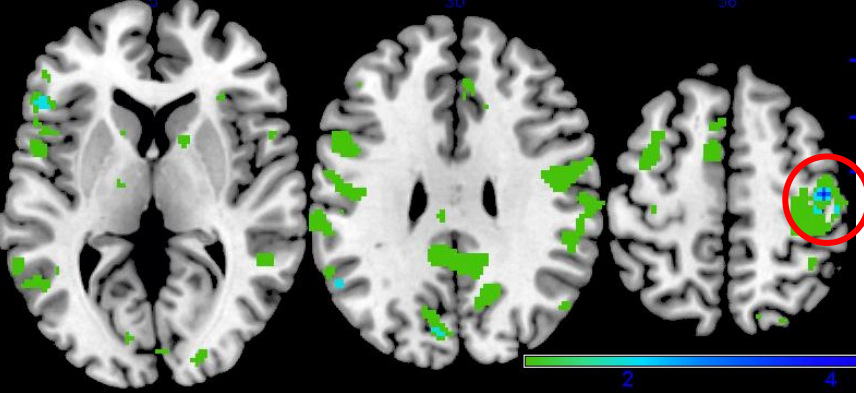
- Structural ROIs
- Bivariate correlations
- Graph theory
 - Cost = .15
 - One-sided positive FDR corrected $p < .05$

Graph Theory Definitions	
Degree	# of edges connected to a node
Betweenness Centrality	# of short paths that pass through a node
Clustering Coefficient	Cliquishness of the regions connected to a node
Local Efficiency	How well connected neighbors are when node is removed

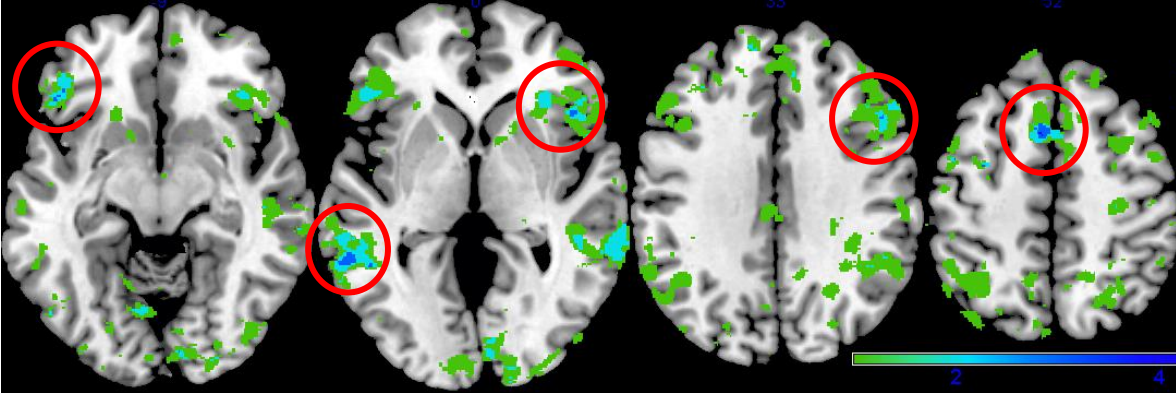
Results

fMRI Activation

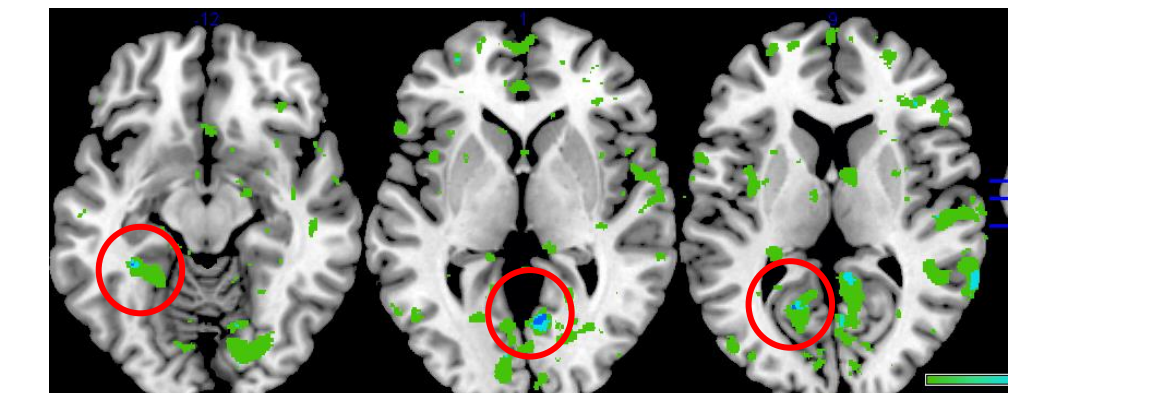
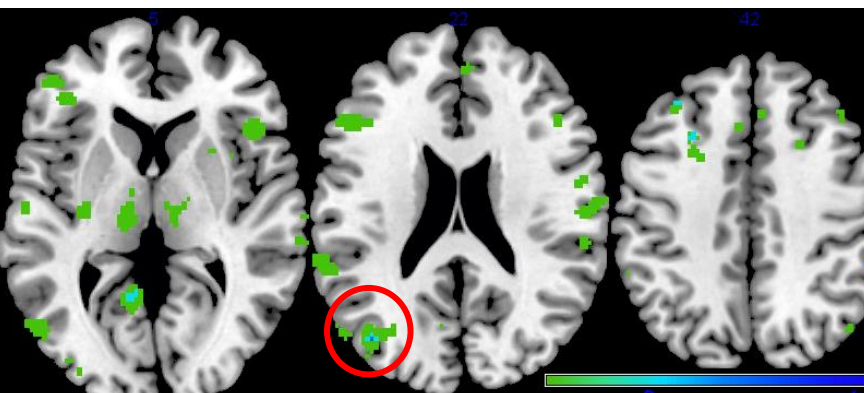
Abstract > Concrete



Concrete > Abstract



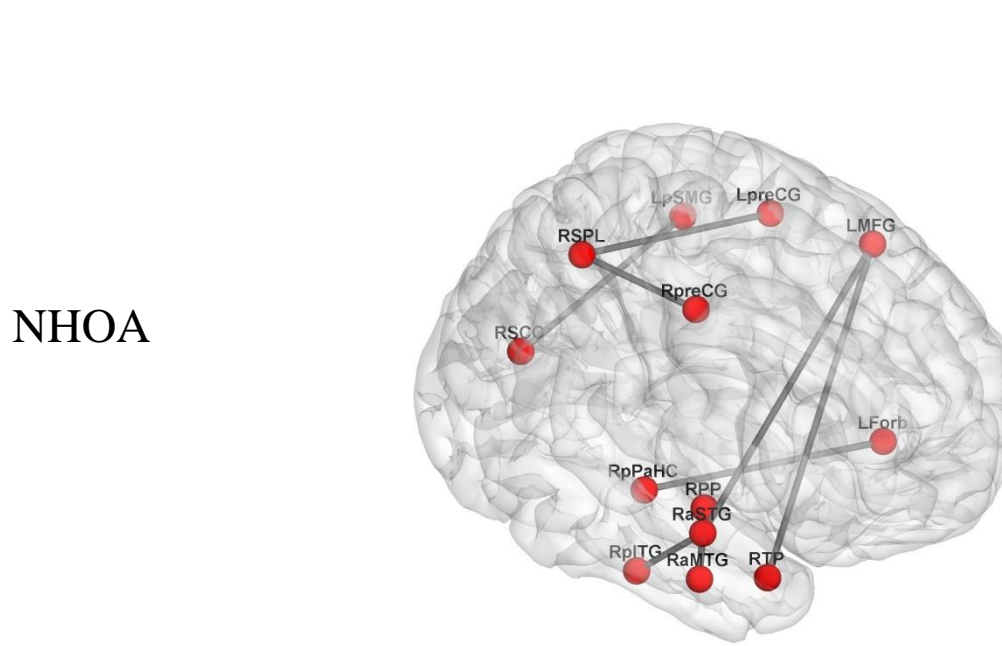
Concrete > Abstract



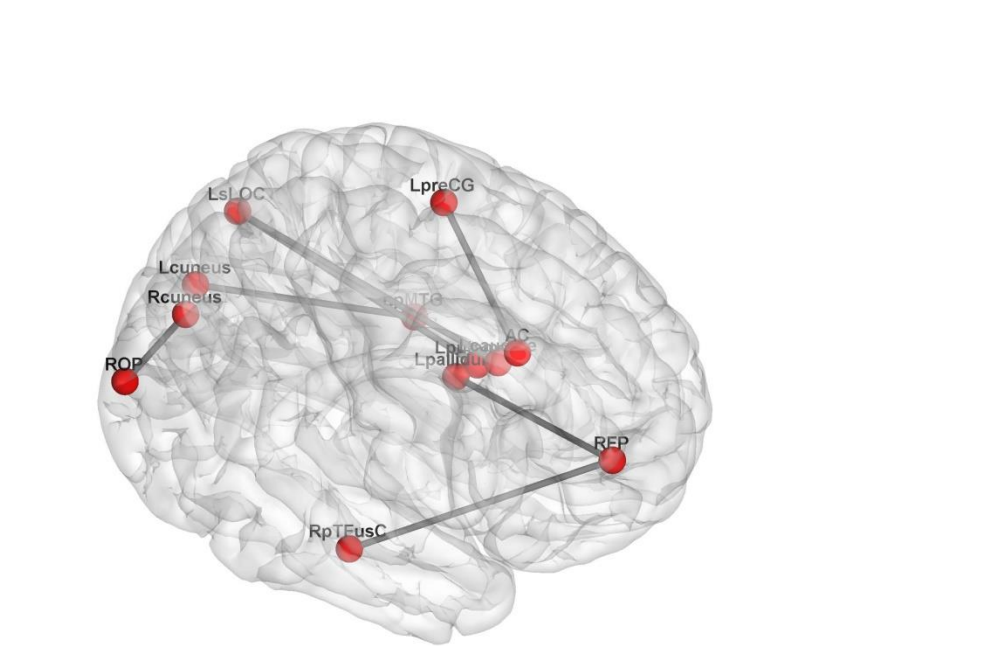
uncorrected $p < .001$

Functional Connectivity

Abstract > Concrete



Concrete > Abstract



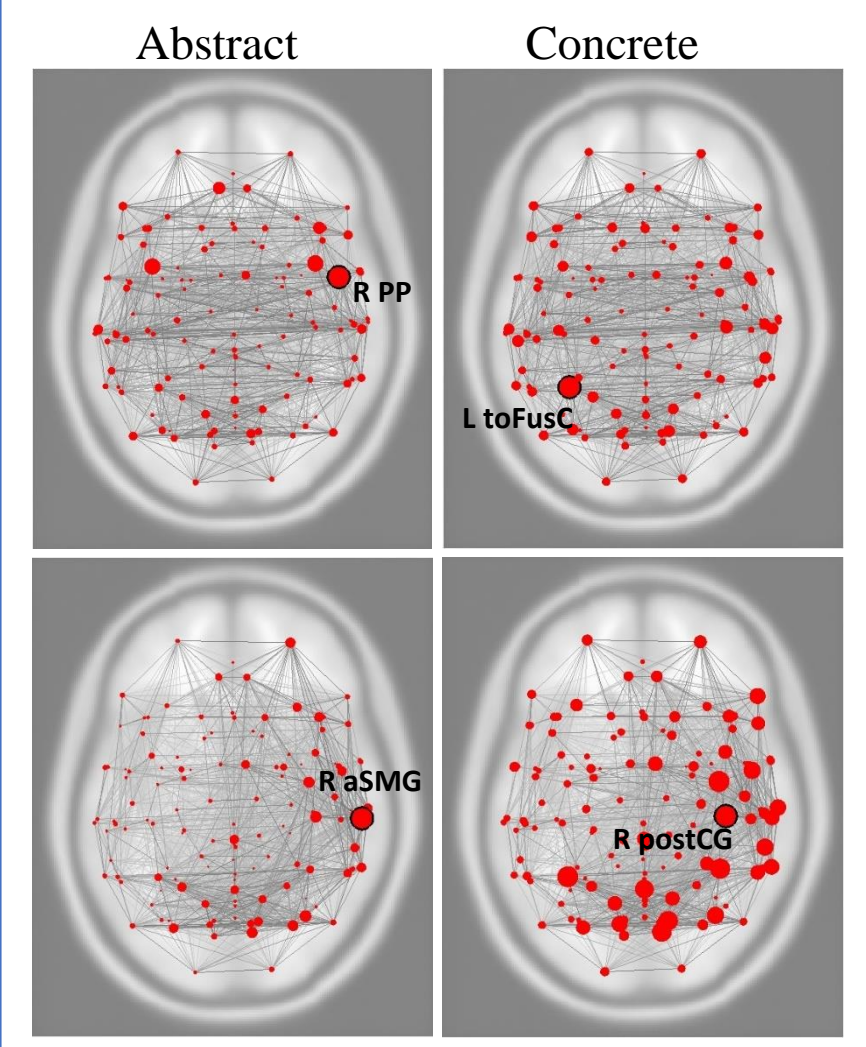
*negative value for concrete, 0 for abstract

uncorrected $p < .001$, one-sided

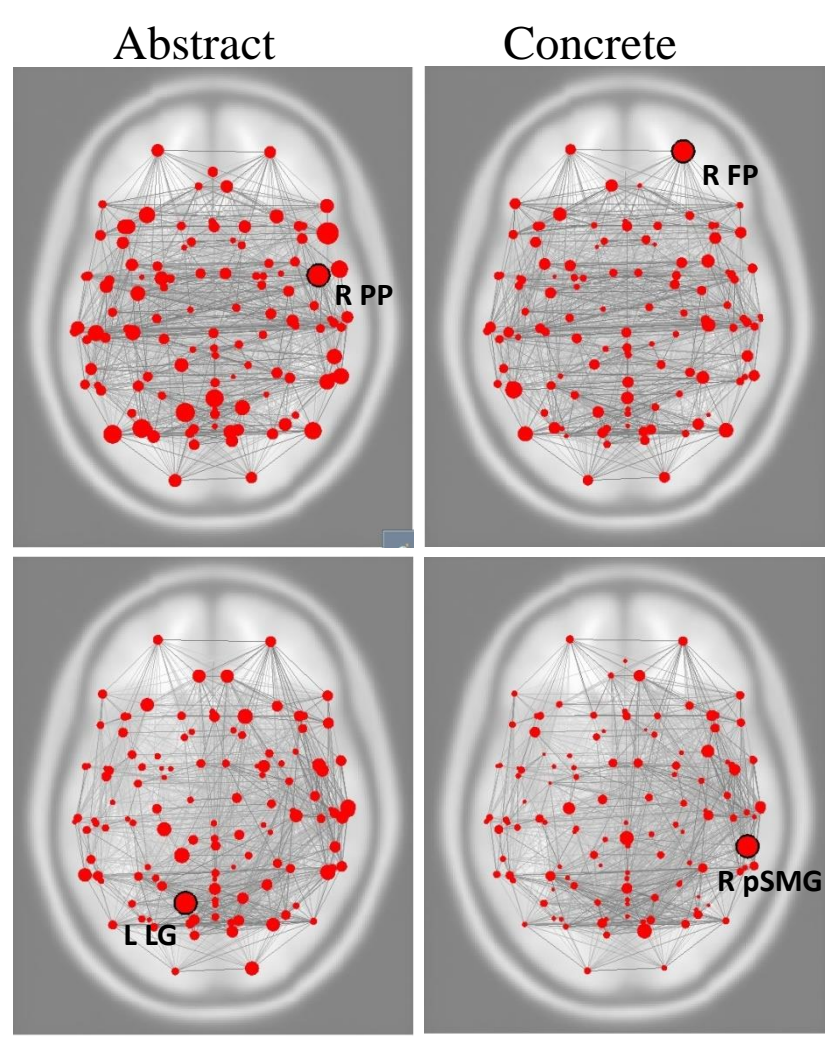
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Graph Theory

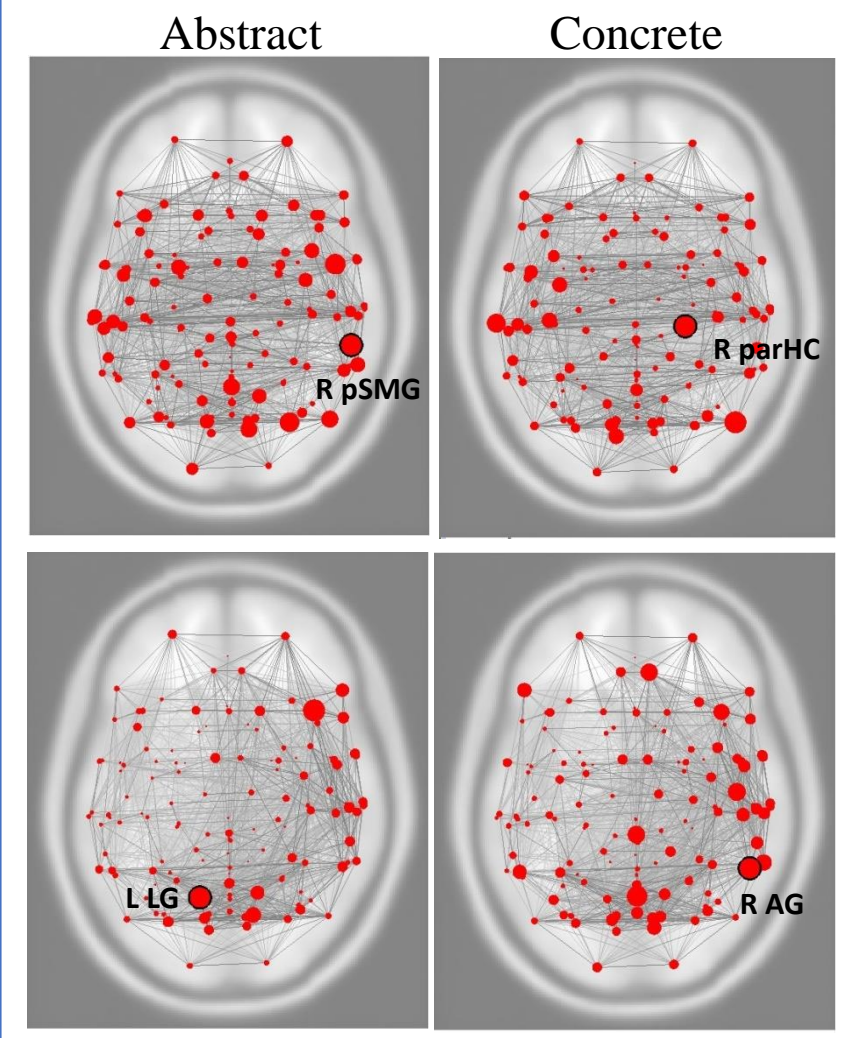
Node Degree



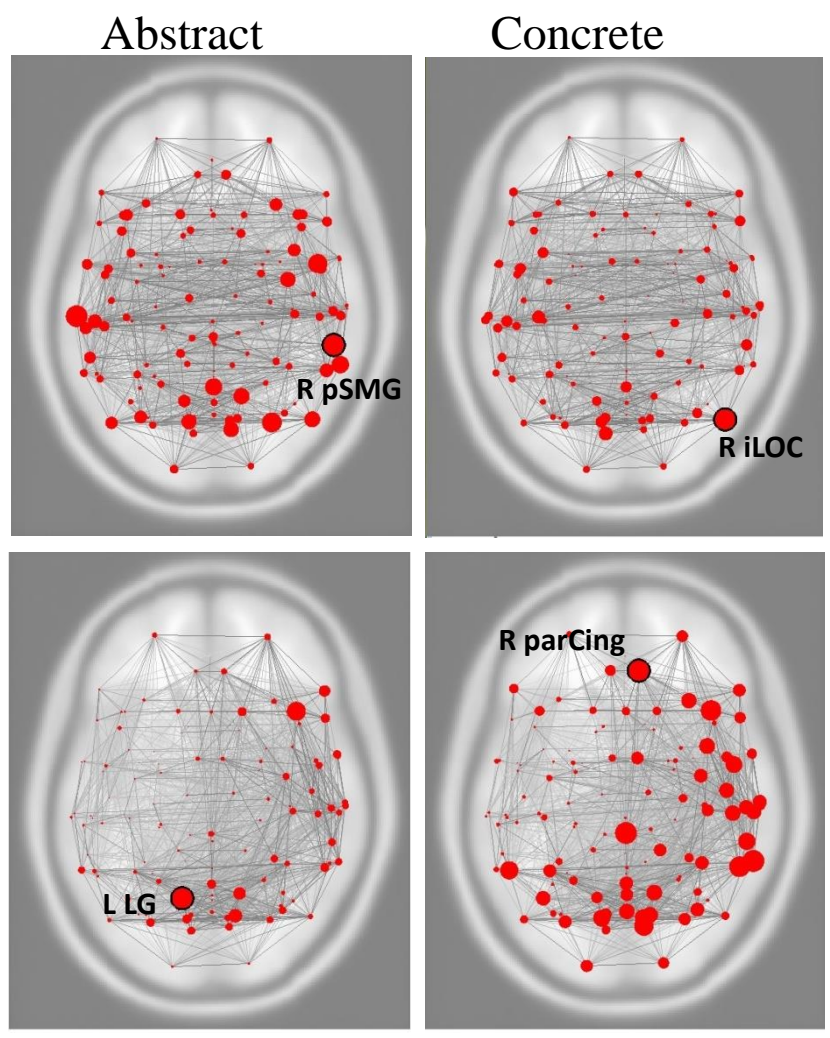
Betweenness Centrality



Clustering Coefficient



Local Efficiency



Conclusions

- Both NHOA and PWA exhibit differential activation and functional connectivity patterns for abstract vs. concrete words, showing some consistency with previous work
- RH appears to be more important in both abstract and concrete word processing for both NHOA and PWA than expected, but not at odds with aging and aphasia literature
- Both NHOA and PWA exhibit more connectivity in the right operculum for abstract than concrete words, while there was more widespread connectivity for concrete than abstract words
- Differences between NHOA and PWA included:
 - Right planum polare appears to be an important node in the abstract network for NHOA, with a functional cluster around right supramarginal gyrus
 - Left lingual gyrus appears to be part of an important cluster in the abstract network for PWA
- This helps us to frame future work examining the roles of concreteness and aging in recovery of word-finding in aphasia

References

Binder, J. R., Desai, Rutvik H., Graves, William W., & Conant, Lisa L. (2009). Where Is the Semantic System? A Critical Review and Meta-Analysis of 120 Functional Neuroimaging Studies. *Cereb. Cortex*, 19(12), 2767-2796.

Cabeza, R. (2001). Cognitive neuroscience of aging: Contributions of functional neuroimaging. *Scandinavian Journal of Psychology*, 42, 277-286.

Sandberg, C. & Kiran, S. (2013). Analysis of abstract and concrete word processing in persons with aphasia and age-matched neurologically healthy adults using fMRI. *Neurocase* 20(4), 361-388.

Wang, Jing, Conder, Julie A., Blitzer, David N., & Shinkareva, Svetlana V. (2010). Neural representation of abstract and concrete concepts: A meta-analysis of neuroimaging studies. *Human Brain Mapping*, 31(10), 1459-1468.

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