

Introduction

- Persons with aphasia (PWA) who are trained to generate abstract words (e.g., justice) in a specific context-category (e.g., courthouse) have been shown to improve not only on the trained items, but also on concrete words (e.g., lawyer) in the same context-category (Sandberg & Kiran, 2014).
- However, the underlying neural mechanisms of this behavioral gain are not fully understood.
- The goal of this study is to compare changes in resting state functional connectivity MRI (rs-fcMRI) in PWA before and after treatment to normal scan-scan changes in rs-fcMRI in healthy age-matched controls to understand treatment-induced neural reorganization.
- Based on Marcotte et al. (2013) and van Hees et al. (2014), we expected increases in connectivity within the default mode network (DMN) and possibly language regions during resting state, respectively.

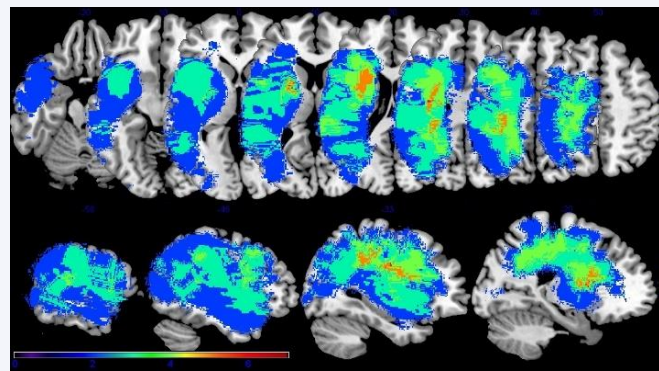
Methods

Participants

Neurologically healthy older adults (NHOA)

- N = 11 (5 male)
 - Aged 50-67
 - No history of neurological disease
 - Right handed, native English speakers
- Persons with aphasia (PWA)
- N = 7 (5 male)
 - Aged 47-75
 - Aphasia following LH stroke
 - Chronic stage of recovery (>6 months)
 - Right handed, native English speakers

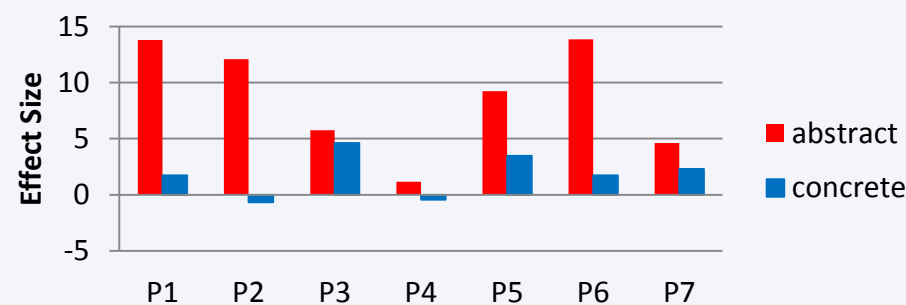
Lesion Overlap



	P1	P2	P3	P4	P5	P6	P7
Age	47	48	74	53	69	56	75
Gender	M	M	F	M	M	F	M
MPO	42	93	134	117	16	7	11
Lesion (cc)	14.24	255.95	101.06	163.12	0.33	3.54	108.64
WAB AQ	95.5	72.5	90.8	41.7	97.1	84.7	67.4
Type	Anomic	Conduction	Anomic	Broca's	Anomic	Anomic	TCM

Treatment

- NHOA did not receive therapy during 10 week interval
- PWA participated in generative naming therapy for 10 weeks
 - Trained abstract words in a specific context-category (courthouse, hospital) and measured both direct training of abstract words and generalization to concrete words in the same category
- Size of treatment effects calculated on percent accuracy pre- vs. post-treatment based on Cohen's *d*
 - 6 participants improved (ESs > 4.6) on trained abstract words (responders)
 - 5 responders generalized (ESs > 1.7) to concrete words (generalizers)



Methods

fMRI Data Collection

PWA data collected at BU

- 3T Phillips

NHOA data collected at PSU

- 3T Siemens

6 minute resting state scan: all participants were asked to look at a white dot on a black background

Data Analysis

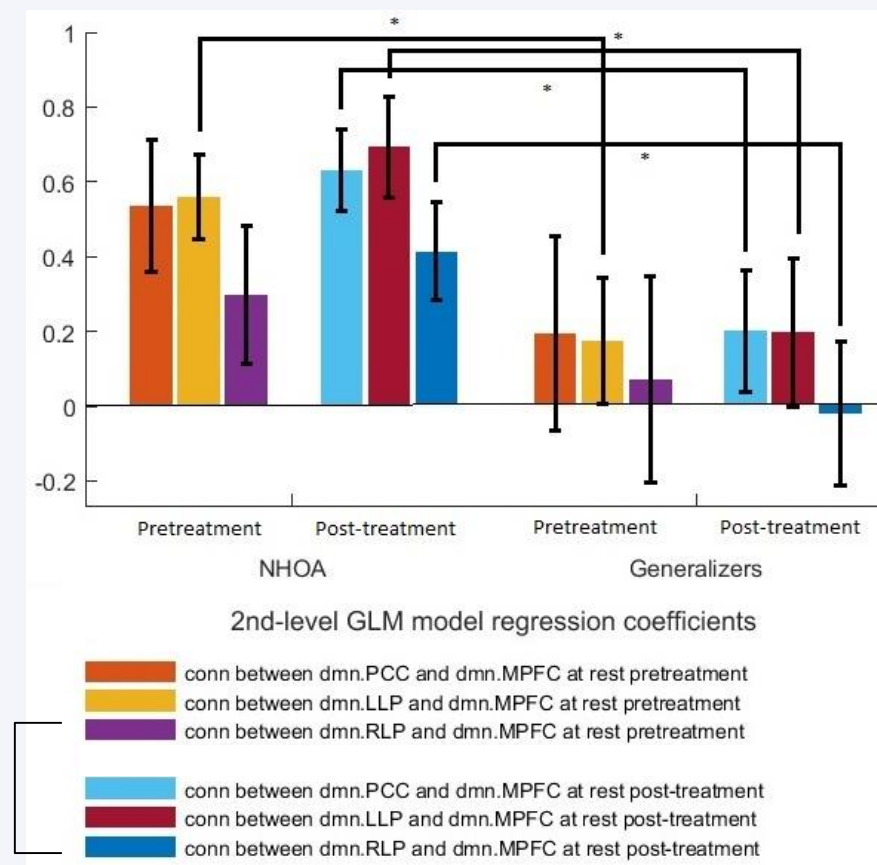
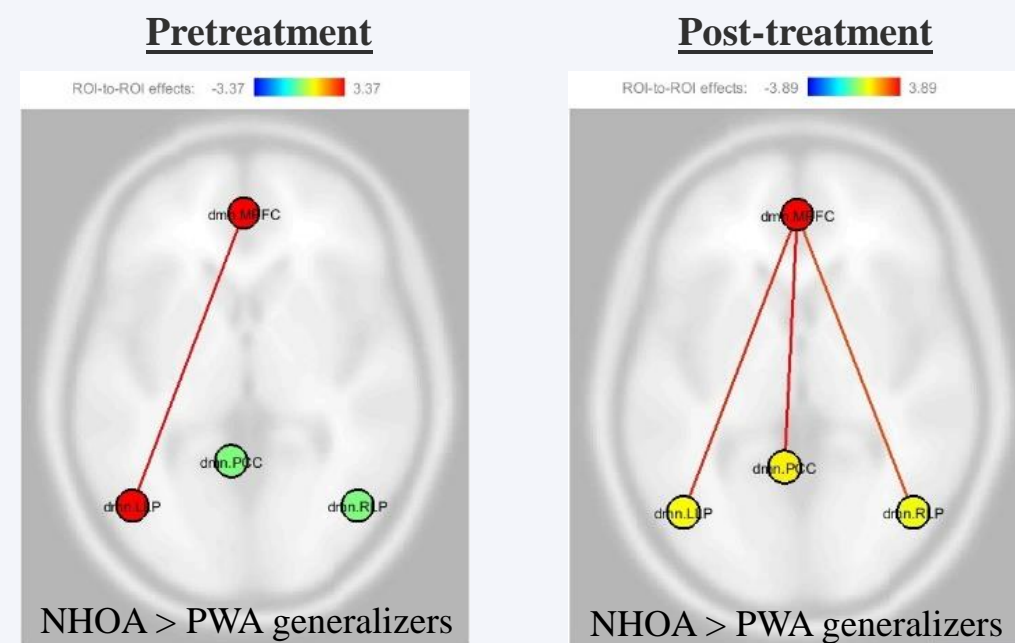
Functional connectivity analysis using CONN toolbox for SPM12

- ROI-ROI analysis
- Structural ROIs
- Bivariate correlations
- ANOVA: NHOA vs. PWA; pre-treatment vs. post-treatment; interaction
 - $p < .05$, FDR corrected, two-sided

Results

Default Mode Network ROI-ROI Analysis

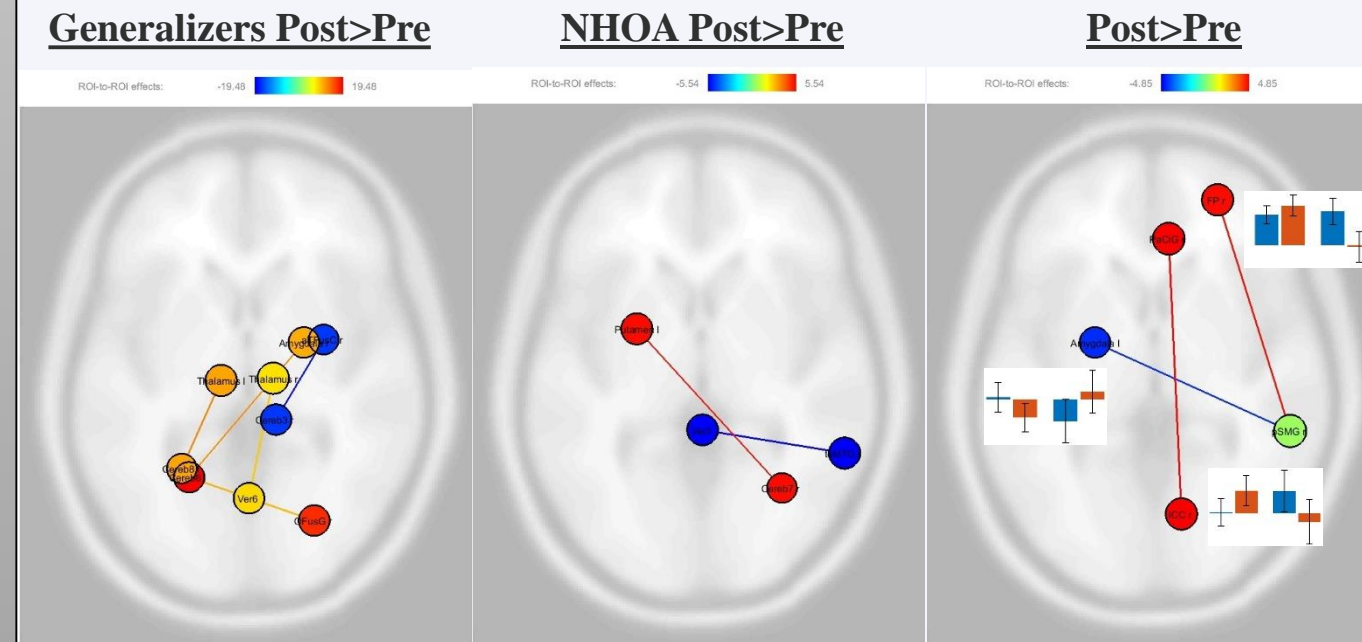
- No significant differences from scan-to-scan for either group
- No interaction between group and time point
- Significant differences between groups at each time point



Results

Whole Brain ROI-ROI Analysis

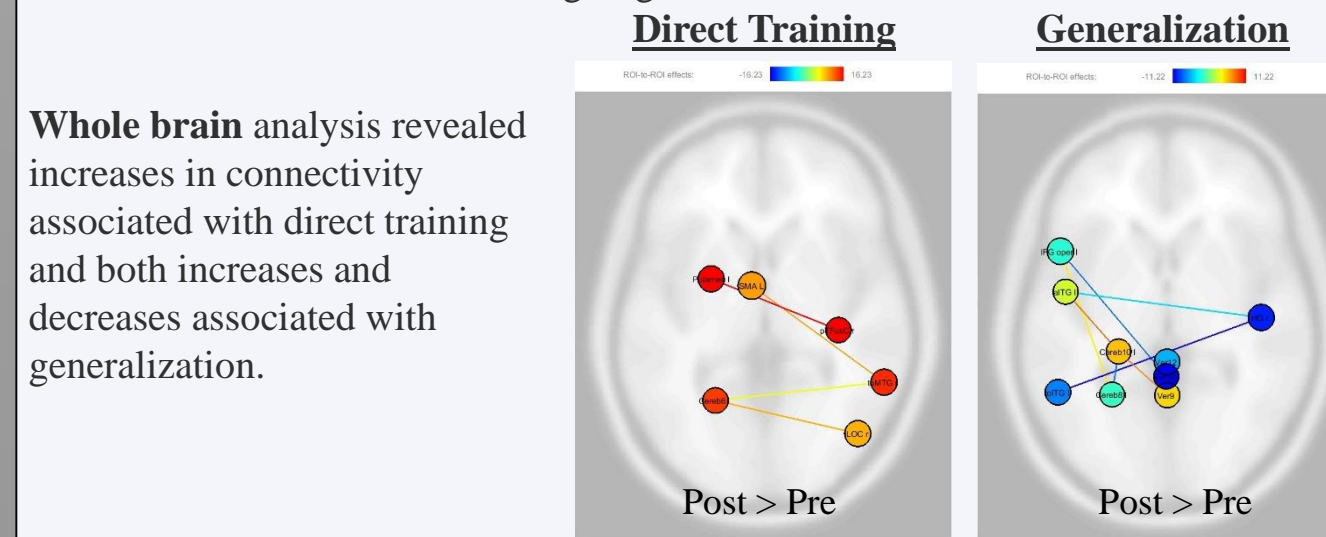
- Significant differences from scan-scan for each group
- Interaction between group and time point



Behavioral Correlations Post>Pre

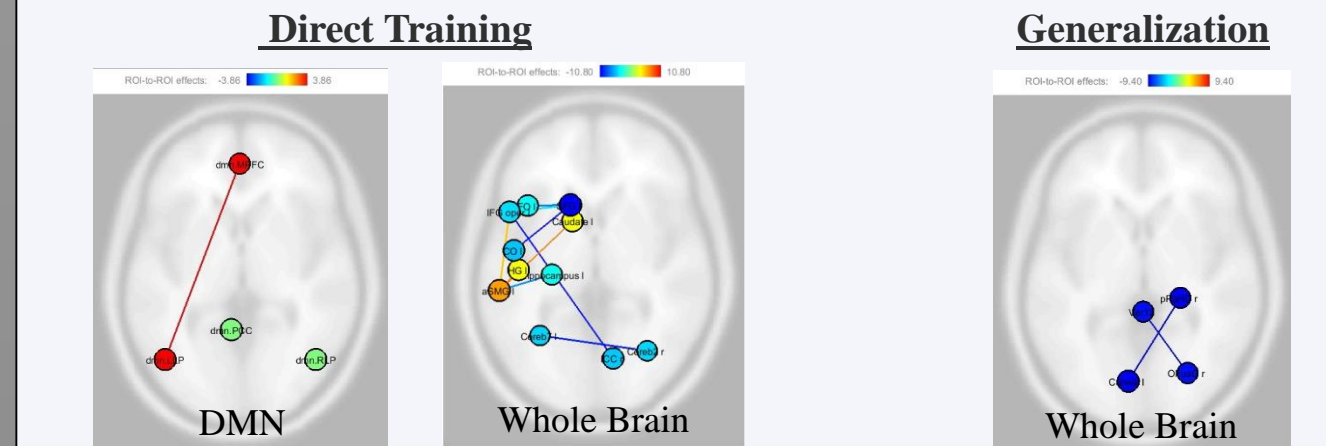
No significant correlations between connectivity changes in DMN and treatment effect size for either direct training or generalization.

Whole brain analysis revealed increases in connectivity associated with direct training and both increases and decreases associated with generalization.



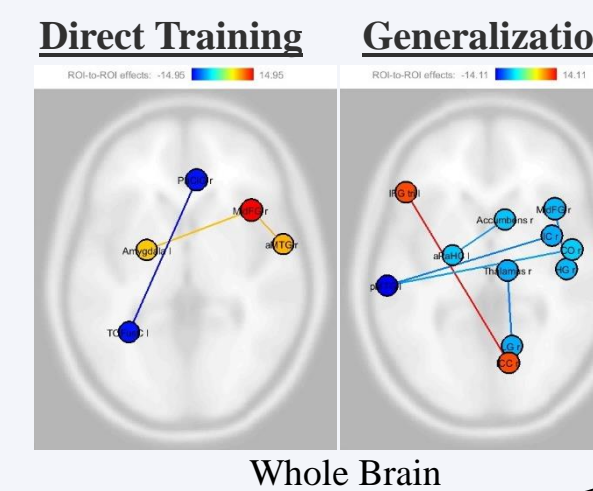
Pretreatment Behavioral Correlations

Significant correlations were found in the DMN for direct training effects, and in the whole brain analysis for both direct training and generalization effects



Post-treatment Behavioral Correlations

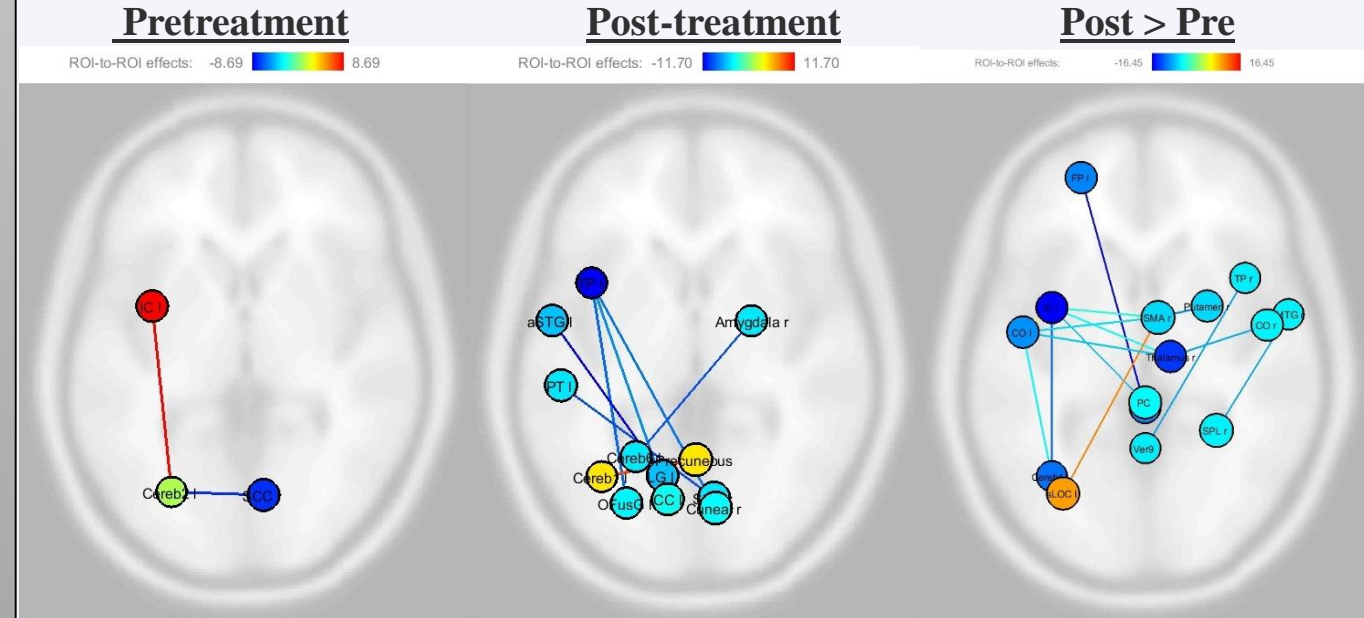
Significant correlations were found in the whole brain analysis for both direct training and generalization treatment effects



Results

Lesion Correlations

For DMN, no significant correlations between lesion size and connectivity at each time point or as a function of treatment



Whole brain analysis revealed bilateral decreases in connectivity associated with increased lesion size.

Whole brain analysis revealed significant correlations at each time point

- Before treatment, a larger lesion was associated with higher L insula – L cerebellum connectivity
- After treatment, a larger lesion was associated with lower posterior LH connectivity

Conclusions

While no significant changes in the default mode network were observed for either group from scan 1 to scan 2 (hypotheses not confirmed), some interesting patterns emerged from additional analyses:

- Differences between groups changed as a function of time
 - All connections with MPFC increased slightly in NHOA
 - MPFC-RLP connection decreased slightly in PWA
 - Possibly indicates increased rumination in NHOA; decreased use of RH during self-reflection in PWA
- Whole brain analyses revealed changes in
 - Subcortical, cerebellar, and temporal regions for both groups, more so for PWA
 - Possibly indicates general recruitment of these regions for PWA
 - Interaction revealed possible RH pruning for PWA and recruitment for NHOA
- Behavior and lesion correlations revealed
 - Cross-hemisphere recruitment for direct training; pruning and LH recruitment for generalization
 - LH connectivity in DMN may predict treatment outcomes (direct training)
 - Lesion size correlates with decreased connectivity in general, especially in LH

References

- Marcotte, K., Perlberg, V., Marrelec, G., Benali, H., & Ansaldi, A. I. (2013). Default mode network functional connectivity in aphasia: Therapy-induced neuroplasticity. *Brain and Language*, 124(1), 45–55.
- Sandberg, C., & Kiran, S. (2014). How justice can affect jury: Training abstract words promotes generalisation to concrete words in patients with aphasia. *Neuropsychological Rehabilitation*, 1–32.
- Sandberg, C., Bohland, J. W., & Kiran, S. (2015). Changes in functional connectivity related to direct training and generalization effects of a word finding treatment in chronic aphasia. *Brain and Language*, 150, 103–116.
- van Hees, S., McMahon, K., Angwin, A., de Zubicaray, G., Read, S., & Copland, D. A. (2014). A functional MRI study of the relationship between naming treatment outcomes and resting state functional connectivity in post-stroke aphasia. *Human Brain Mapping*, 35, 3919–31.

This work was partially funded by an NIH NIDCD F31 grant and an ASHF New Century Scholars award
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