TMS in the Treatment of Post-stroke Aphasia

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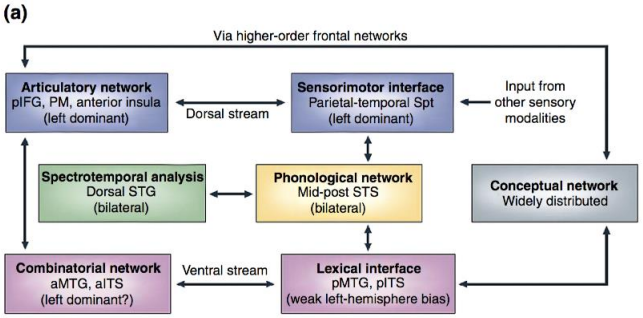
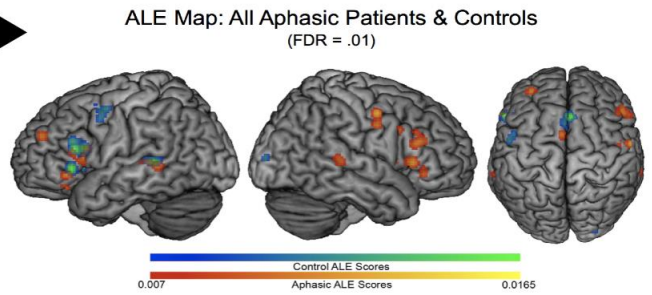
Brain stimulation in cognitive neurorehabilitation: a model system in translational cognitive neuroscience

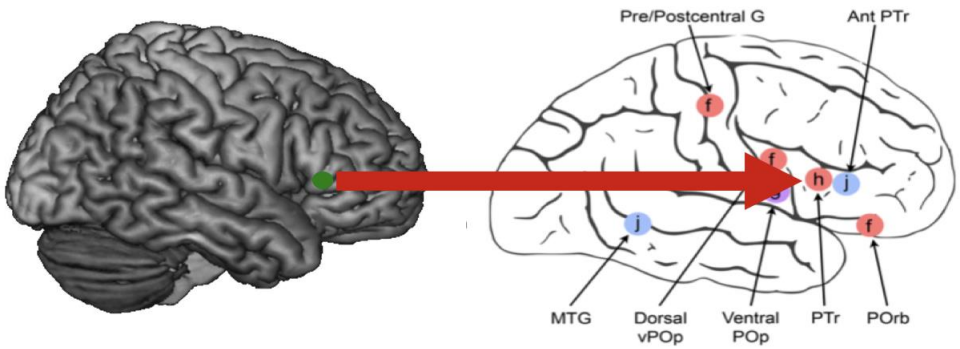


Normal Systems

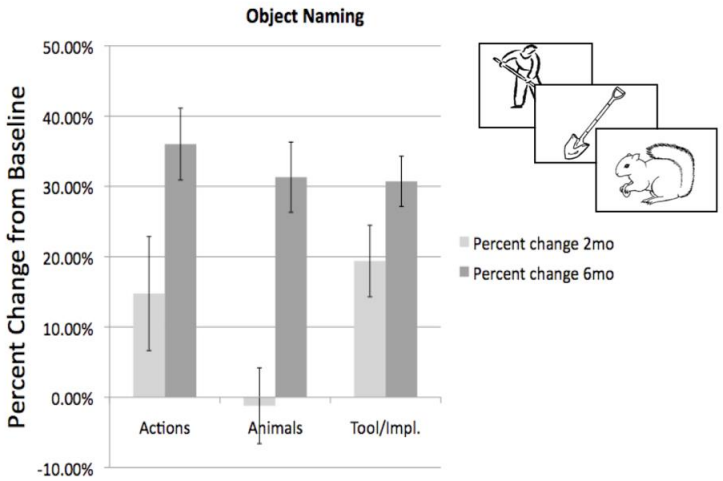
Reorganized Systems



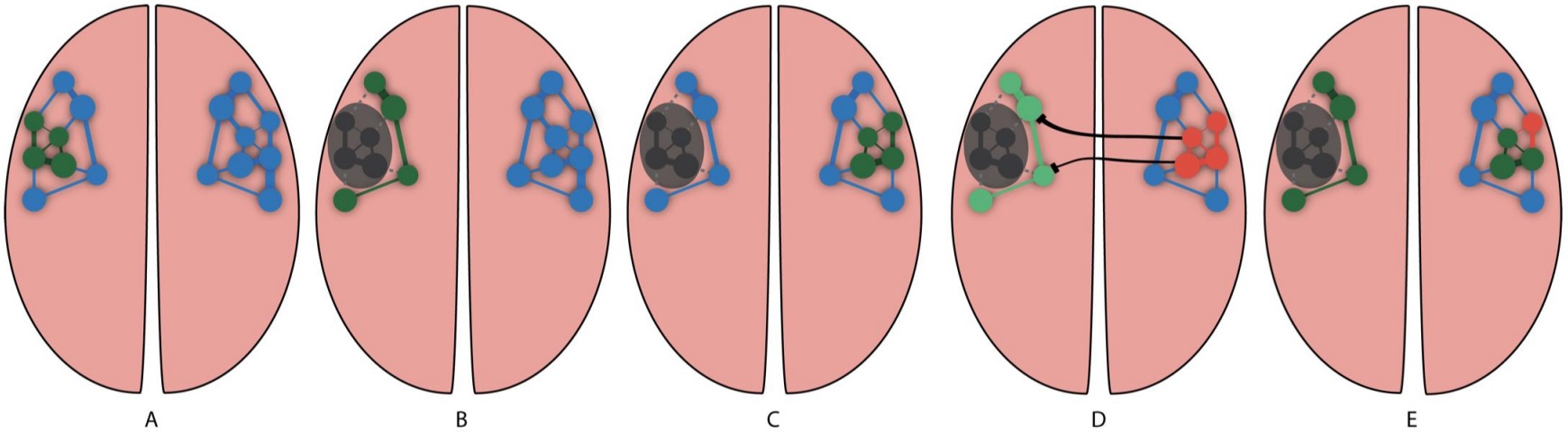
Cognitive Outcomes



Hypothesis-guided Neuromodulation



Multiple mechanisms of aphasia recovery



Left hemisphere perisylvian recruitment (B)

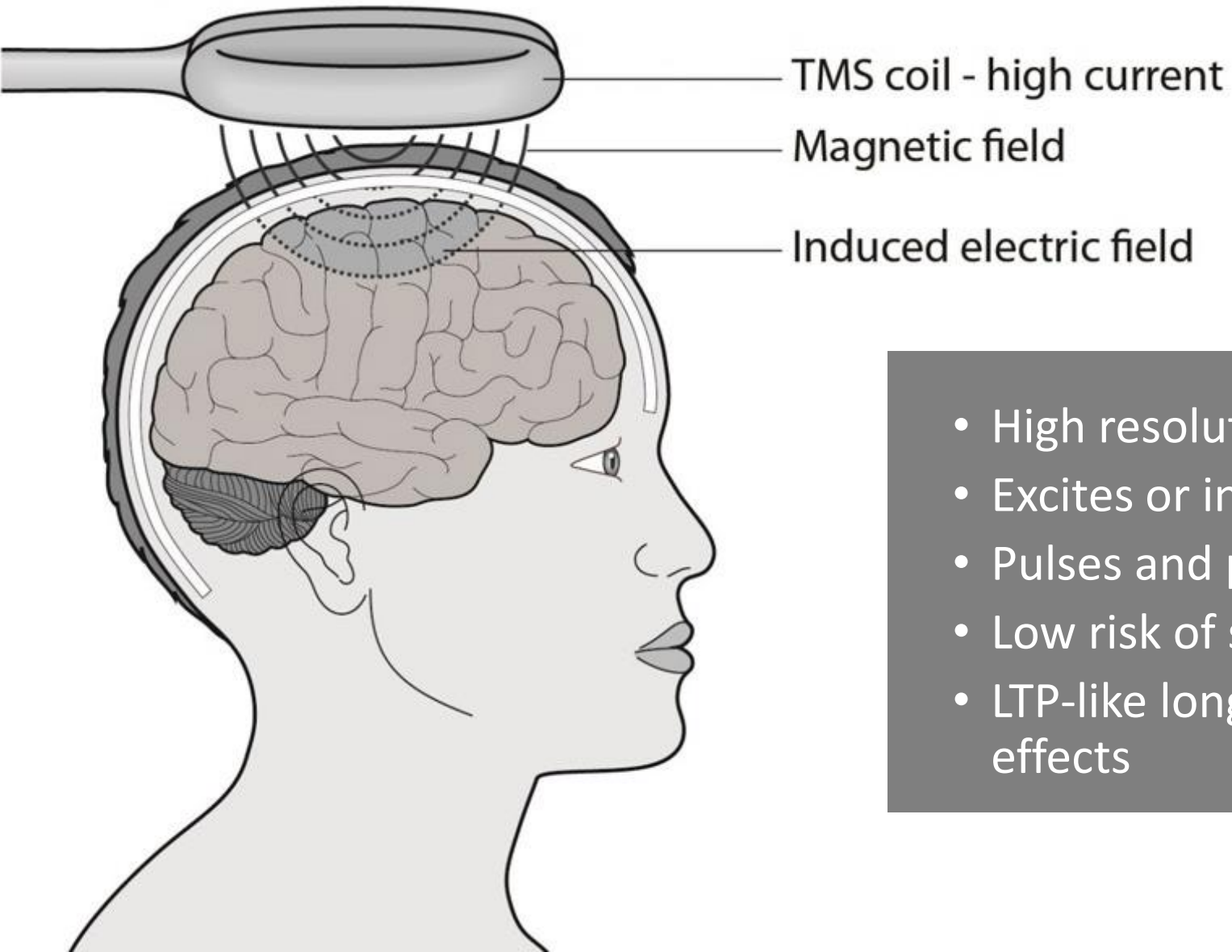
Right hemisphere homolog recruitment (C)

Interhemispheric inhibition (D)

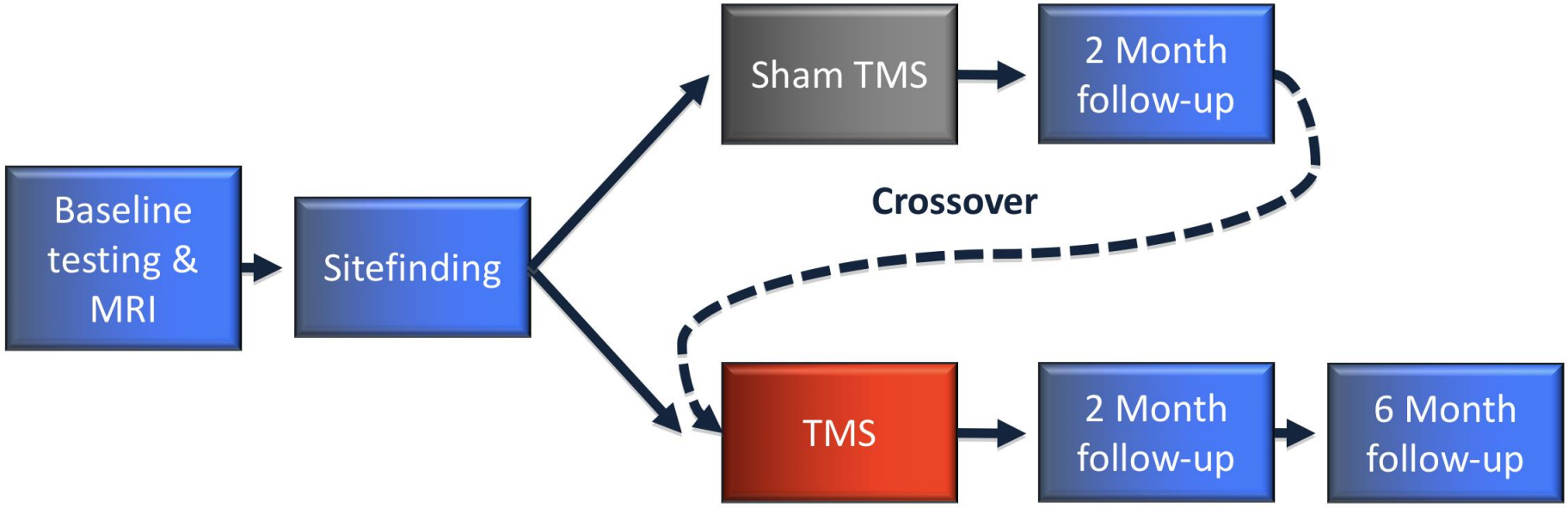
Inefficient bilateral compensatory reorganization (E)

Torres et al., 2013

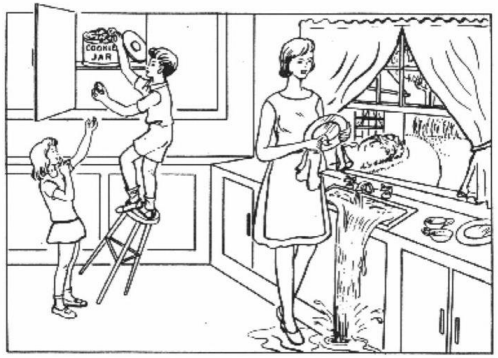
Transcranial Magnetic Stimulation (TMS)



- High resolution
- Excites or inhibits
- Pulses and patterns
- Low risk of seizure
- LTP-like long-term effects



1 Hz = *Inhibitory* Stimulation



Number of Items

25
20
15
10
5
0

*
*

Unique Nouns
Total Nouns
Total Verbs
Unique Words
Unique Verbs

200
160
120
80
40
0

Narrative length (seconds)

40
32
24
16
8
0

*
*

CCW
CIU
OCW
Speech rate (wpm)

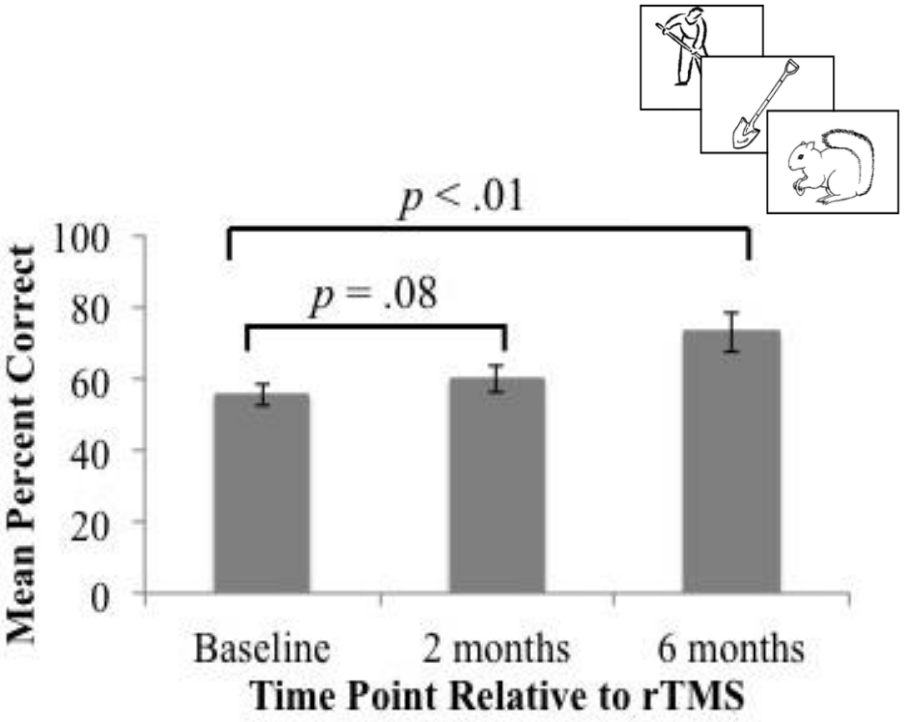
75
60
45
30
15
0

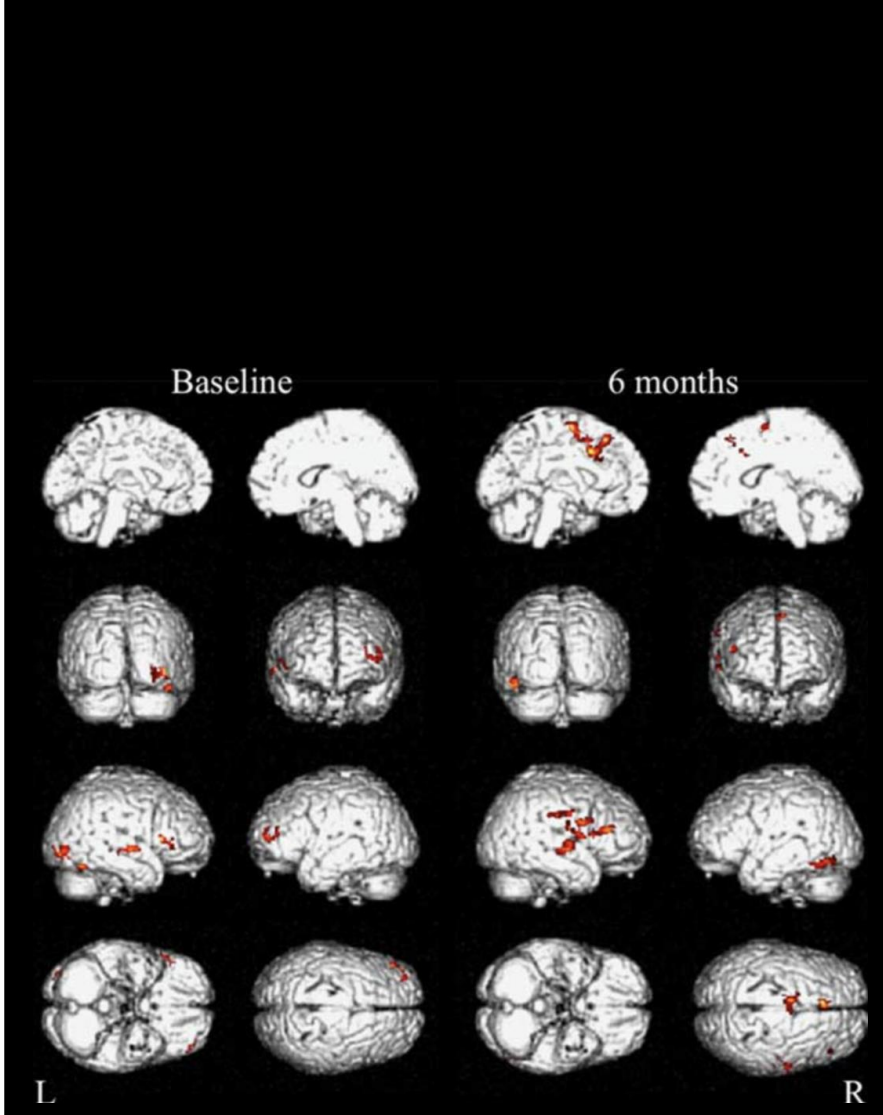
*

Narrative Words

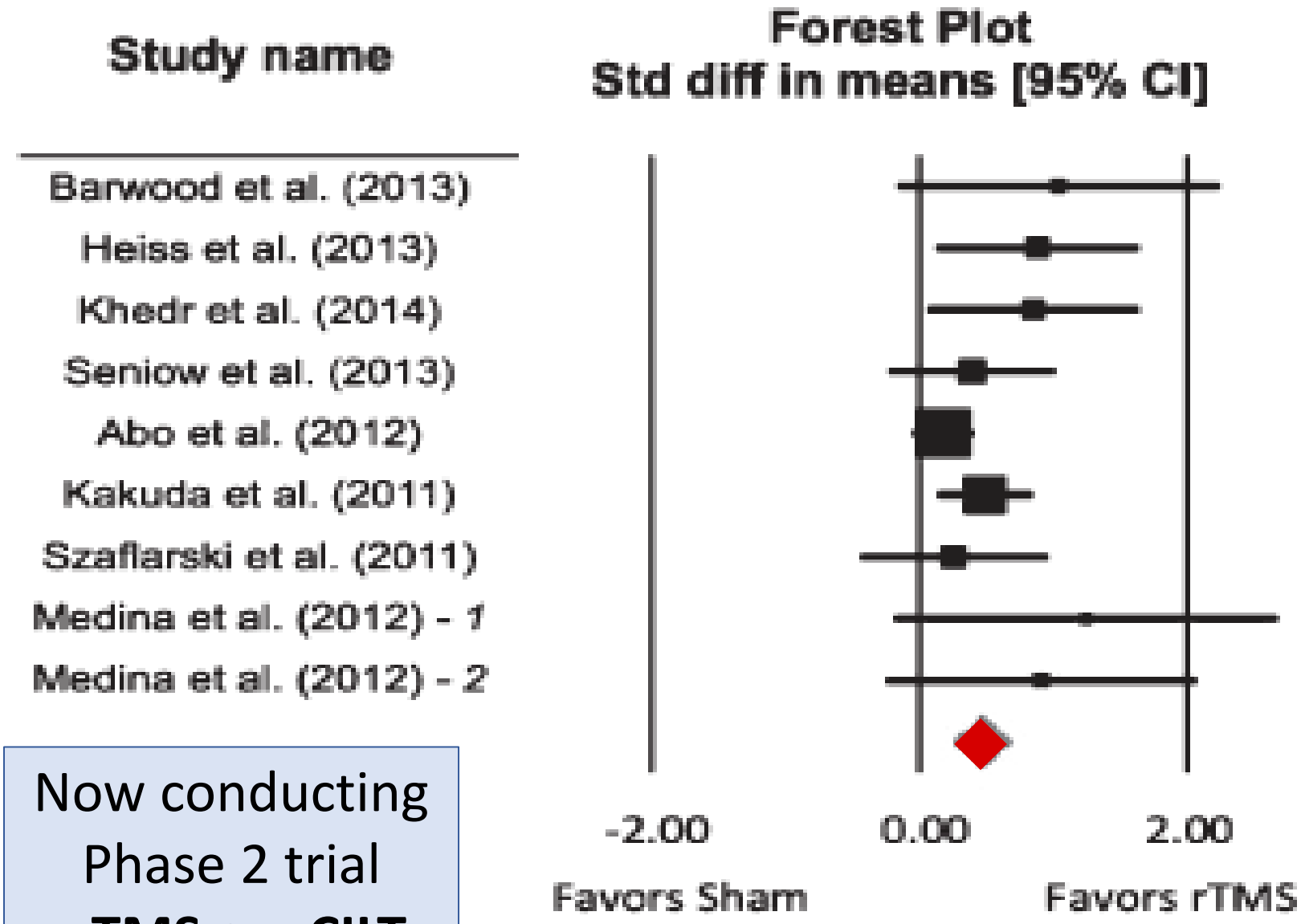
Pre TMS
Post TMS

Medina et al., *Brain Stimulation*, 2013





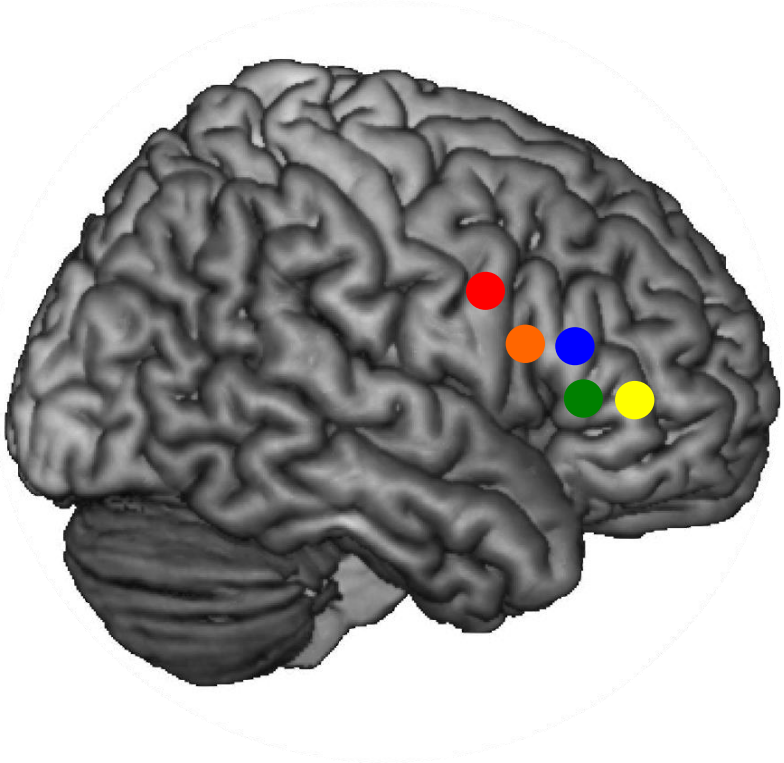
Harvey et al., 2017

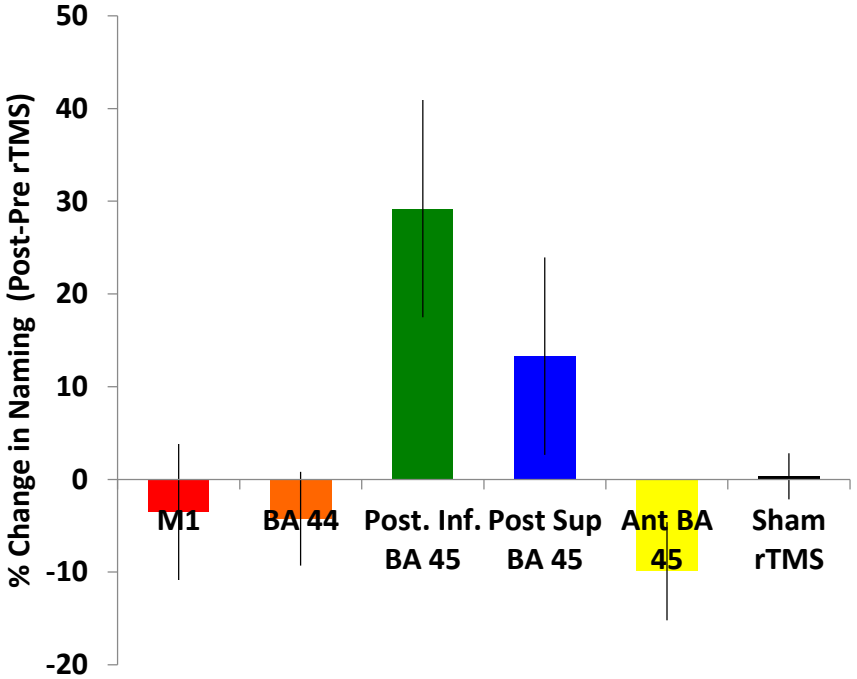


Now conducting
Phase 2 trial
rTMS + mCILT
(target *N*=70)

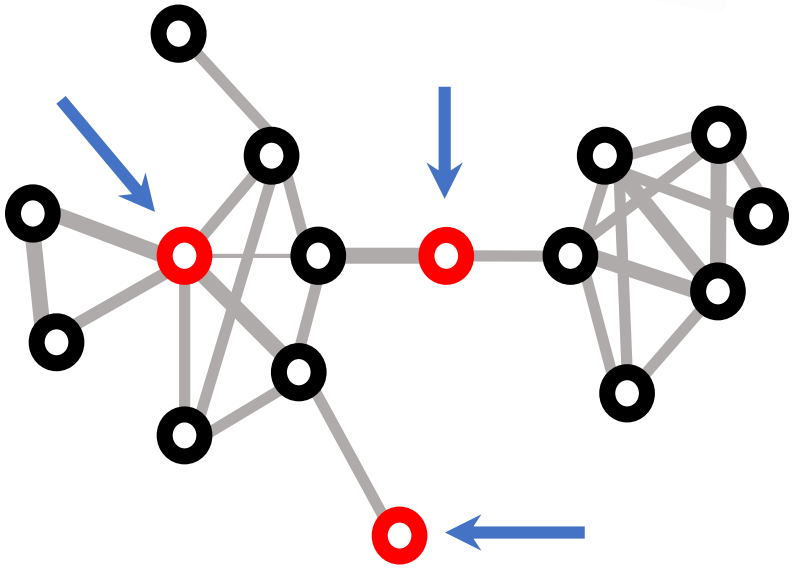
Shah-Basak, Wurzman, et al., 2016

Location matters…



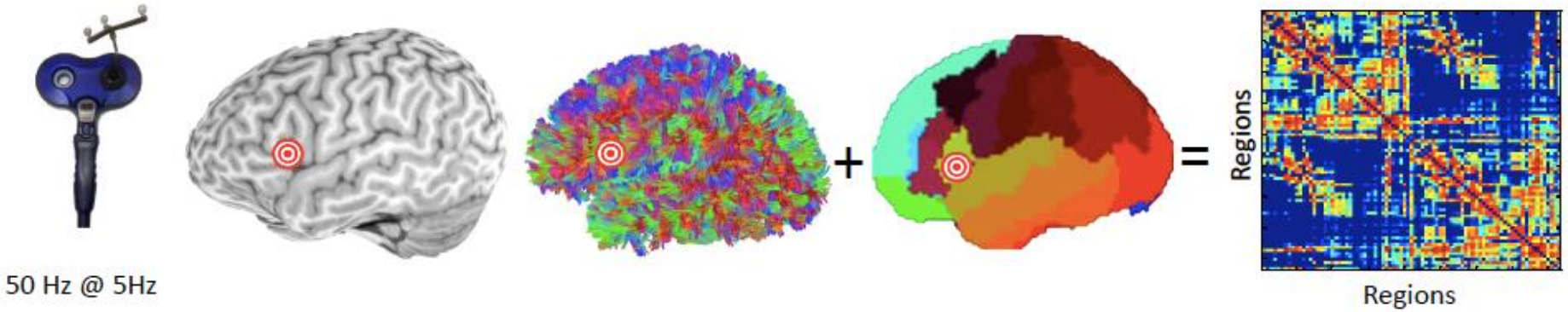


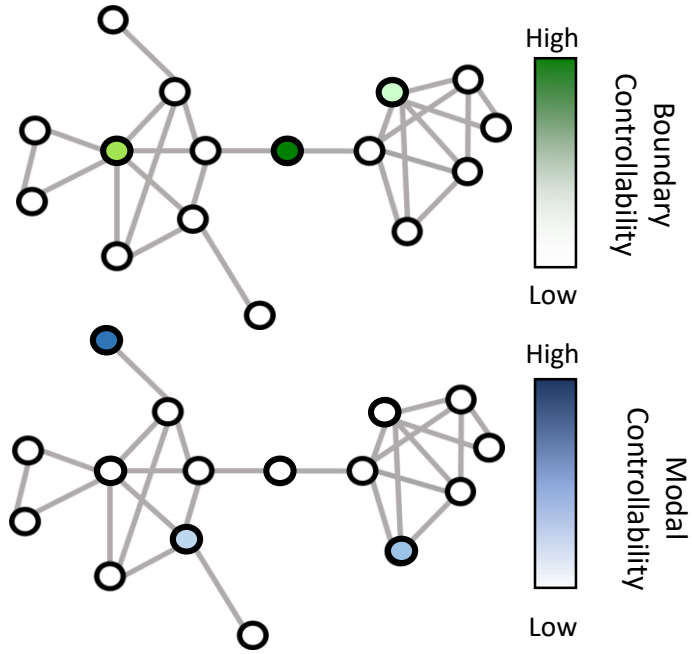
Garcia et al., *JoVE*, 2013



Cognitive localization in the brain is a function of local and global connectivity.

Network control theory allows inferences about the operational utility of brain centers based on *anatomic* connections.

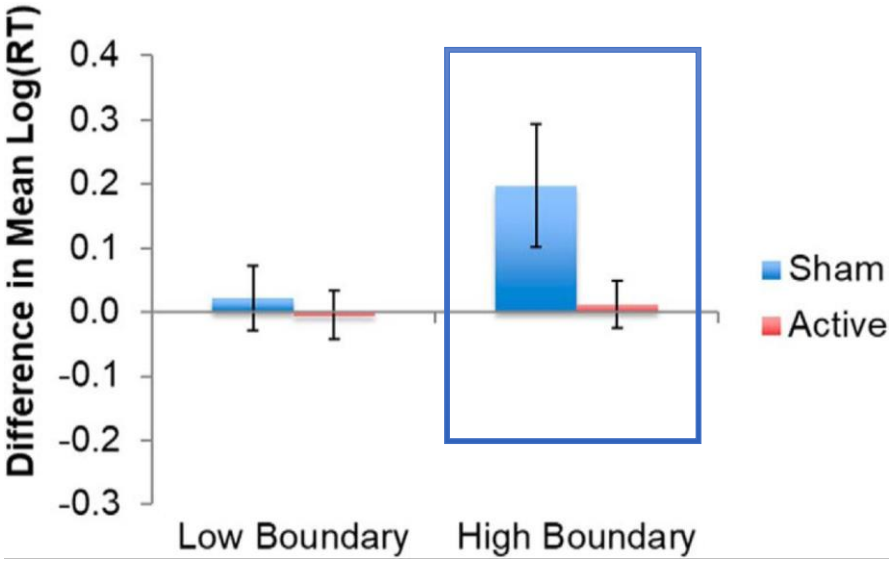


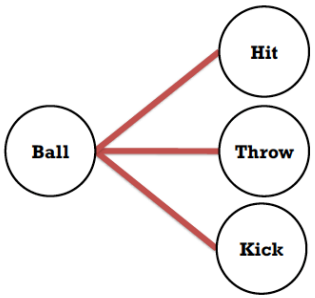


Medaglia et al., *J. Neurosci*, 2018

Boundary Control

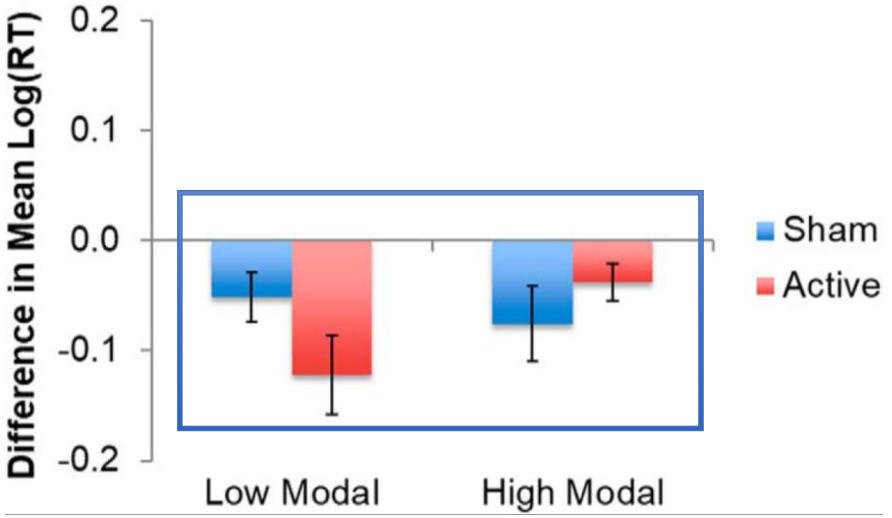
Open tasks





Modal Control

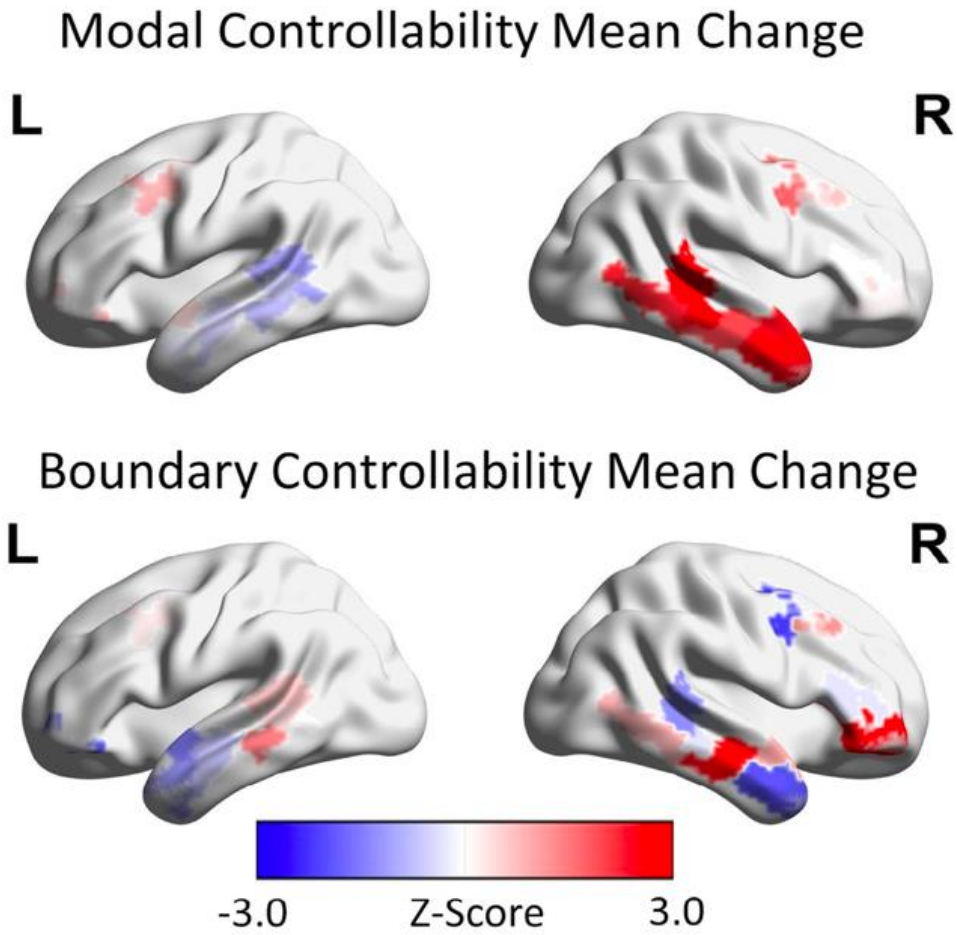
Closed tasks



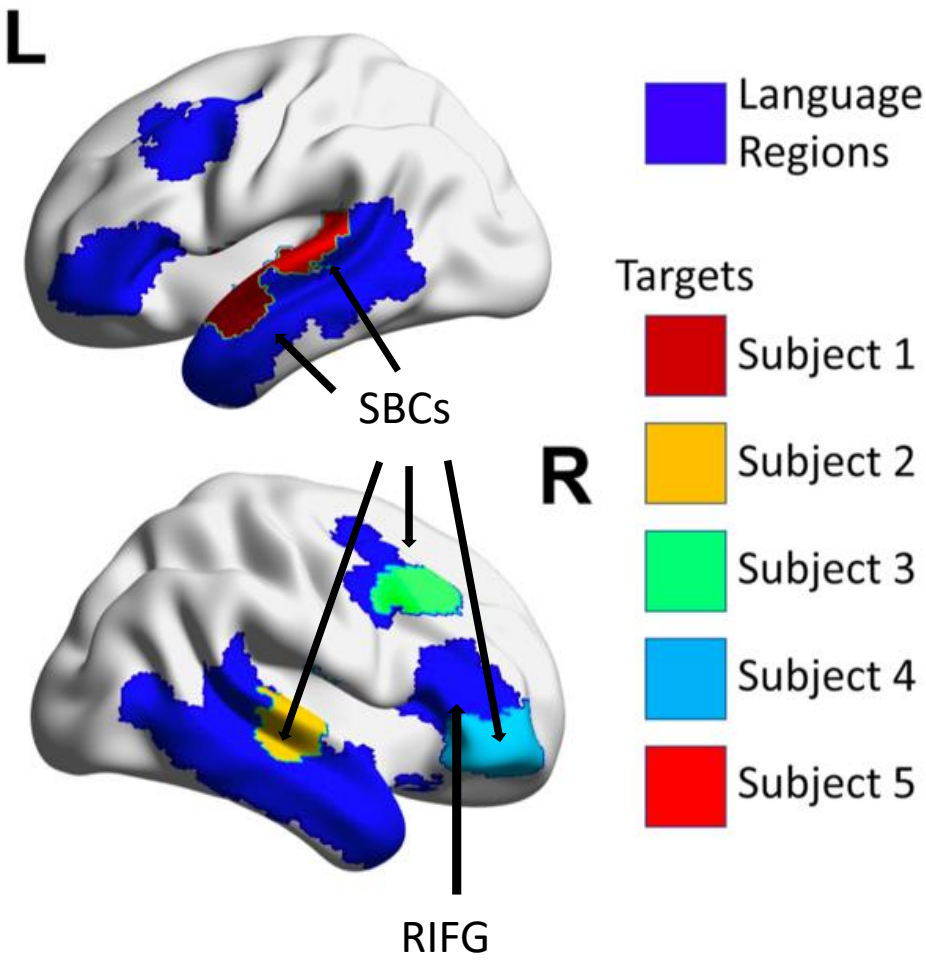
Medaglia et al., *J. Neuroscience. 2018*

Network Control & Post-Stroke Language Representation

- N=28
- Removed connections associated with LIFG
- Recomputed controllability across brain
- Computed controllability change
- Simulated damage to anatomic networks ***predicts locations functionally recruited in post-stroke aphasia***



Medaglia & Turkeltaub (unpublished)



If the RIFG is a ***strong boundary controller***:

Inhibiting the RIFG increases word selection cost

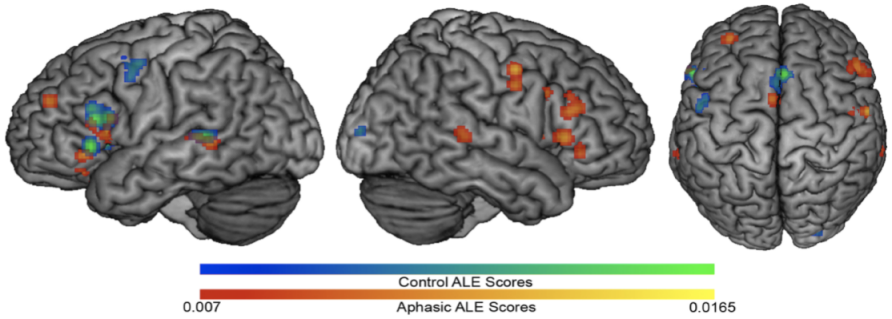
If the RIFG is a ***weak boundary controller***:

Inhibition of *SBCs* increases word selection cost

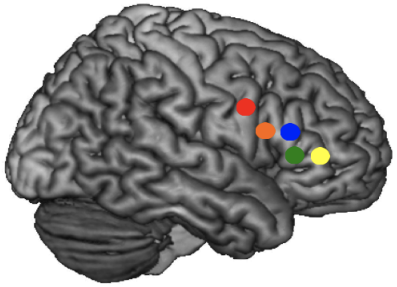
Network Control Predicts TMS Response in Post-Stroke Aphasia

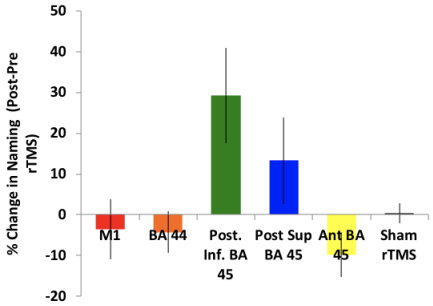
- Strongest boundary controllers (SBC) vary anatomically
- Continuous theta burst stimulation (cTBS) of SBCs:
  - Influences performance on language selection-retrieval tasks

Unpublished data

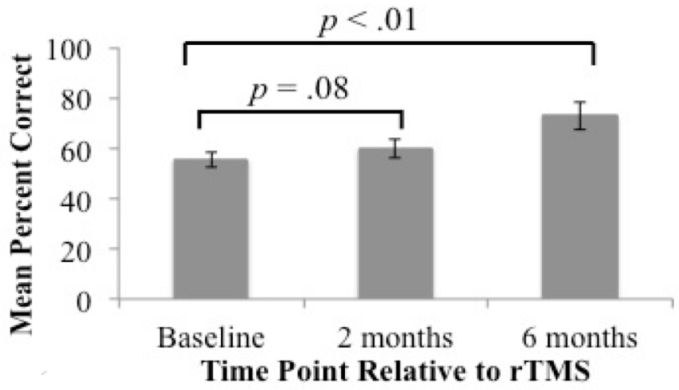


Bihemispheric Network

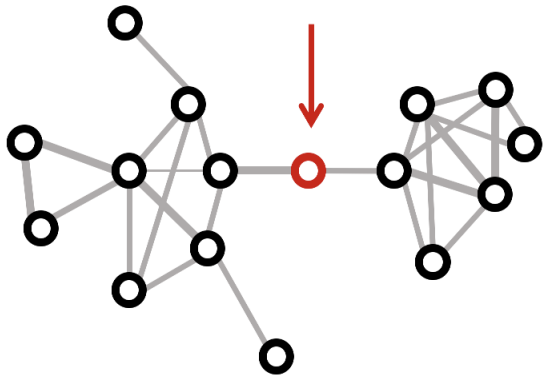




Focal Modulation



Behavioral Benefit



Network Neuroscience

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