

Causal evidence for hierarchical predictive coding among cingulo-opercular and frontoparietal networks supporting cognitive control

"T-A-B-L-E-T"

Start "L" Follows "B"

or dim

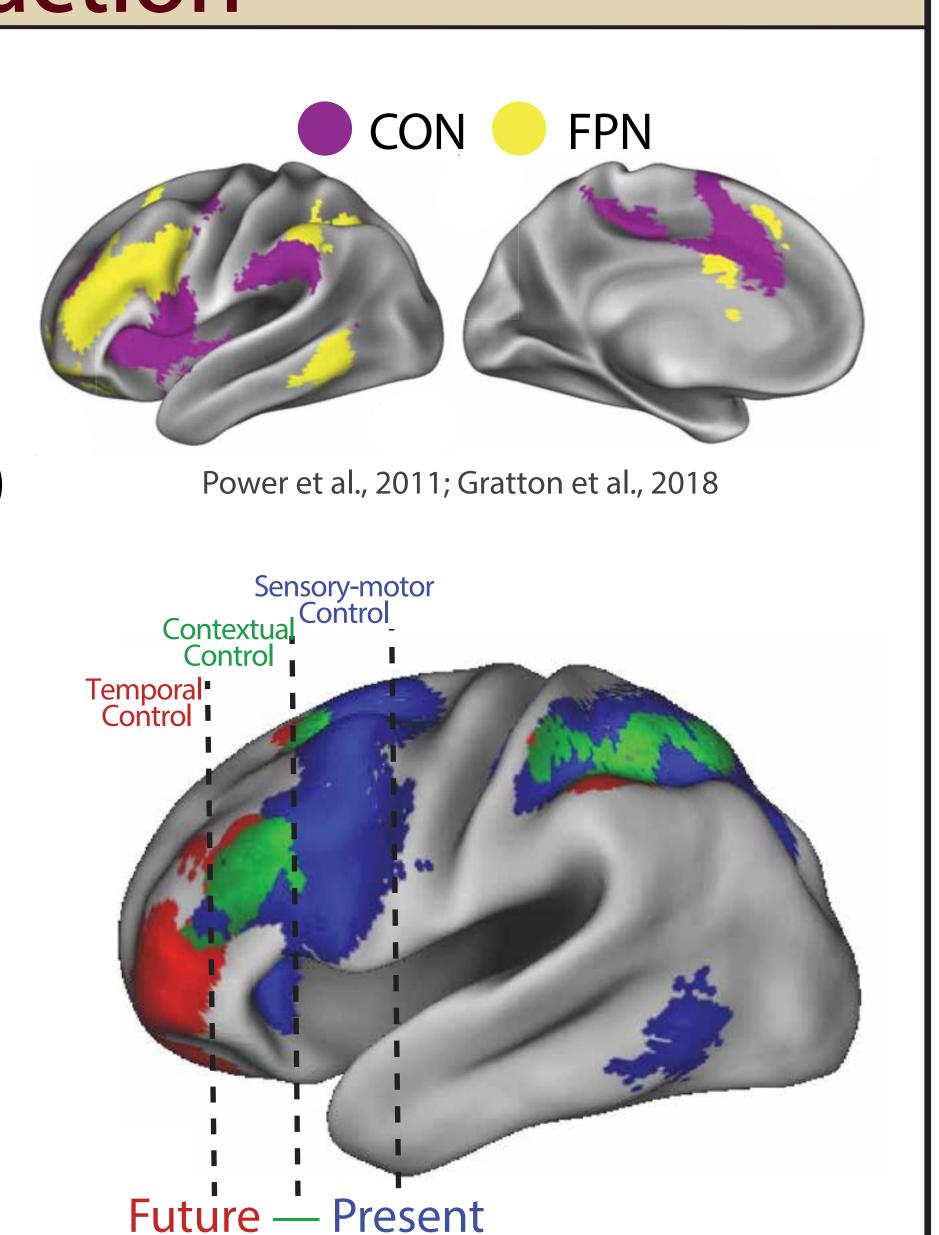


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Introduction

- Cognitive control is the ability to align behaviors with goals when habit will not suffice
- Cognitive Control Networks: cingulo-opercular network (CON) frontoparietal network (FPN)
- Networks are organized along a present/external to future/ internal axis
- How these networks and subsystems interact to support this temporal organization remains unclear



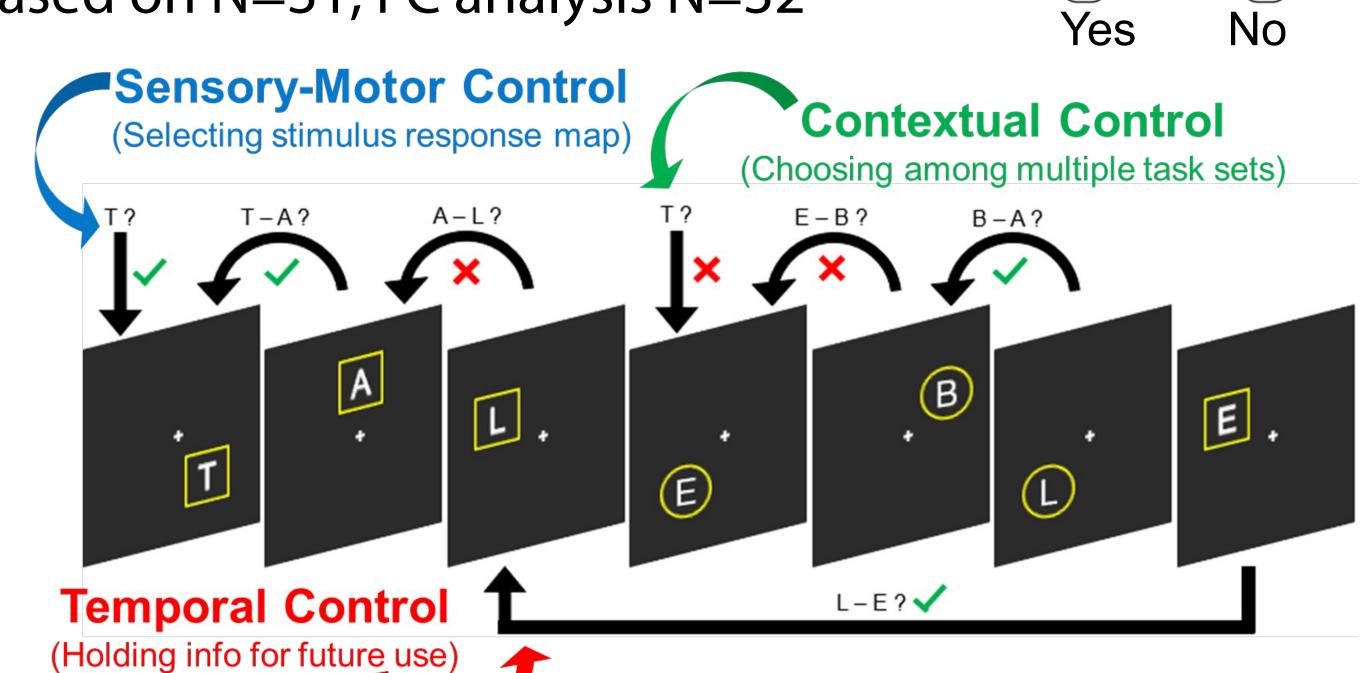
Adapted from Nee & D'Esposito, 2016;

Badre & Nee, 2018

Methods Verbal sequence Within-subjects design:

Individualized cTBS sites: mid-dIPFC, lateral frontal pole (FPI), and a control site (S1)

 N=34 completed study; Task activations based on N=31, FC analysis N=32



Visit Five Visit One Visit Two Visit Three **Visit Four** cTBS to Target cTBS to Target Baseline fMRI Consenting and Initial Screening Behaviora fMRI Scan fMRI Scan fMRI Scan Thresholding Training

7 days

mid-dIPFC **TMS Targets** Future > Present

3 – 7 days

1 – 7 days

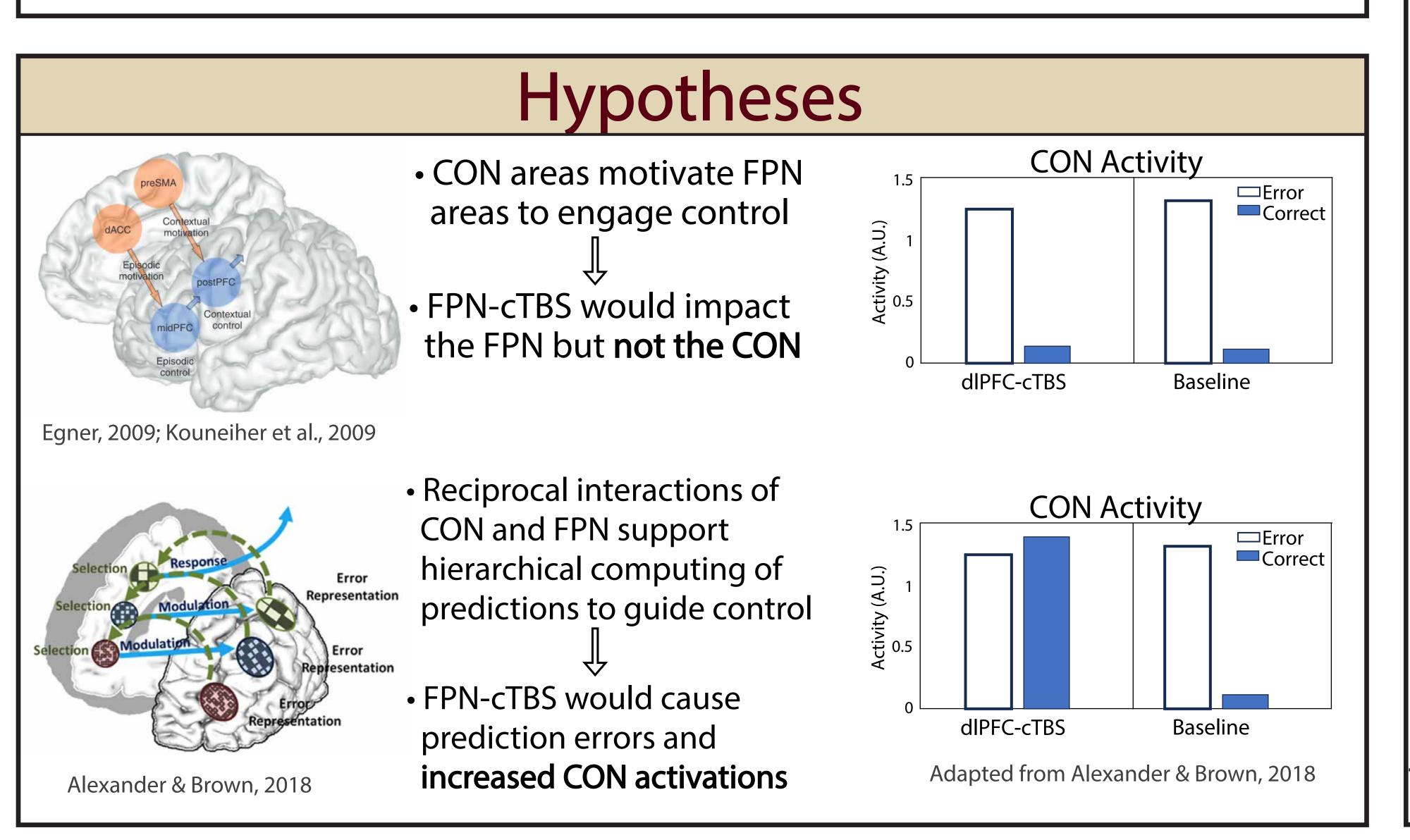
Anatomically & Functionally Individualized cTBS Targets

Conclusions

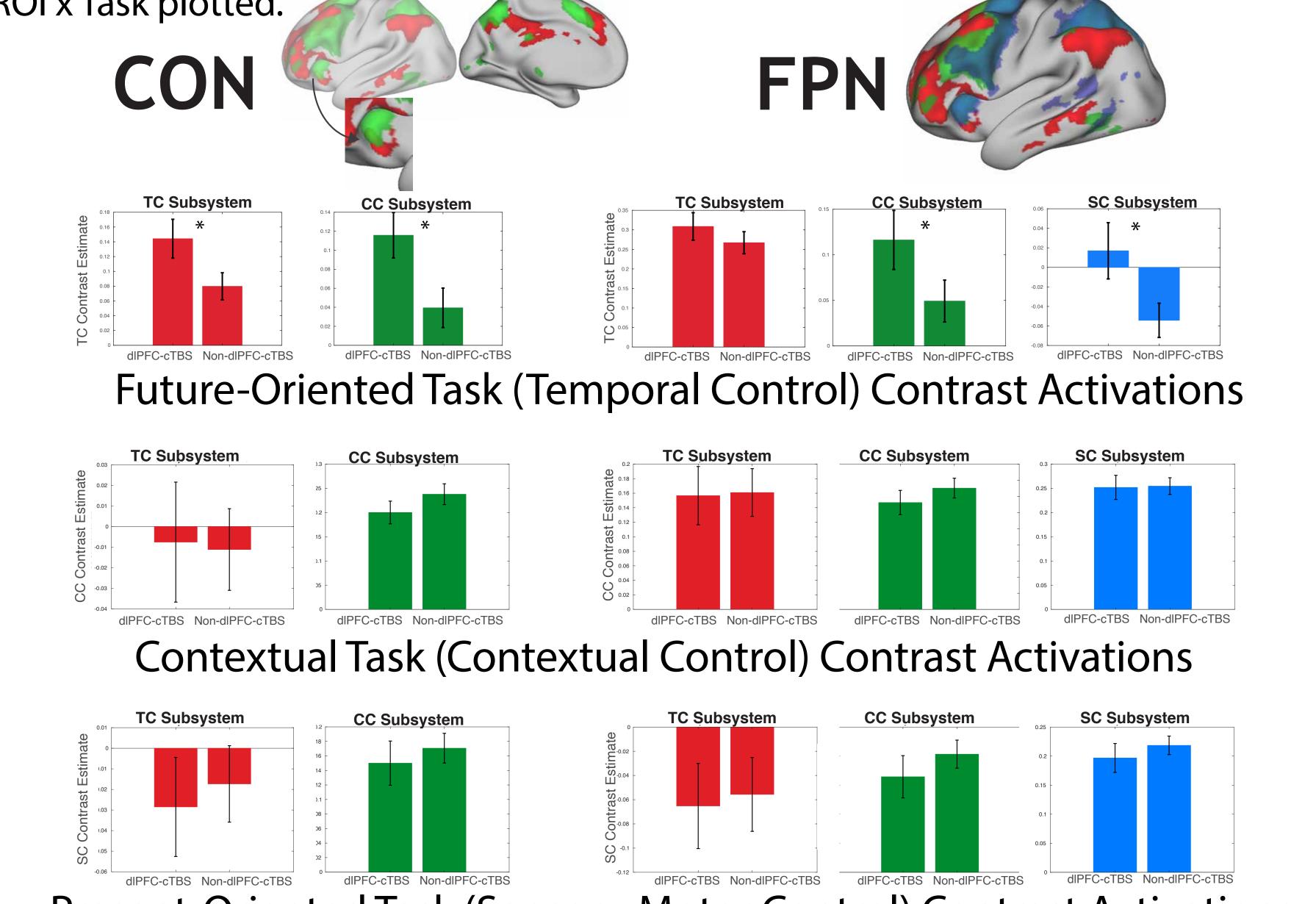
- cTBS to the mid-dIPFC increased both CON and FPN future-oriented control activation
- cTBS to the FPN did not change functional connectivity
- Results suggest cTBS to the mid-dIPFC does not affect the amount of communication, rather it leads to prediction errors which propagate across networks and sub-systems
- These results suggest temporally organized cognitive control aligns with a framework of hierarchical predictive coding

Purpose

Use causal methods to test hypotheses regarding how CON and FPN interact to support cognitive control



Results - BOLD Task Activations ANOVAs of control contrast activations for the CON and FPN: Interactions of Visit x ROI x Task plotted.



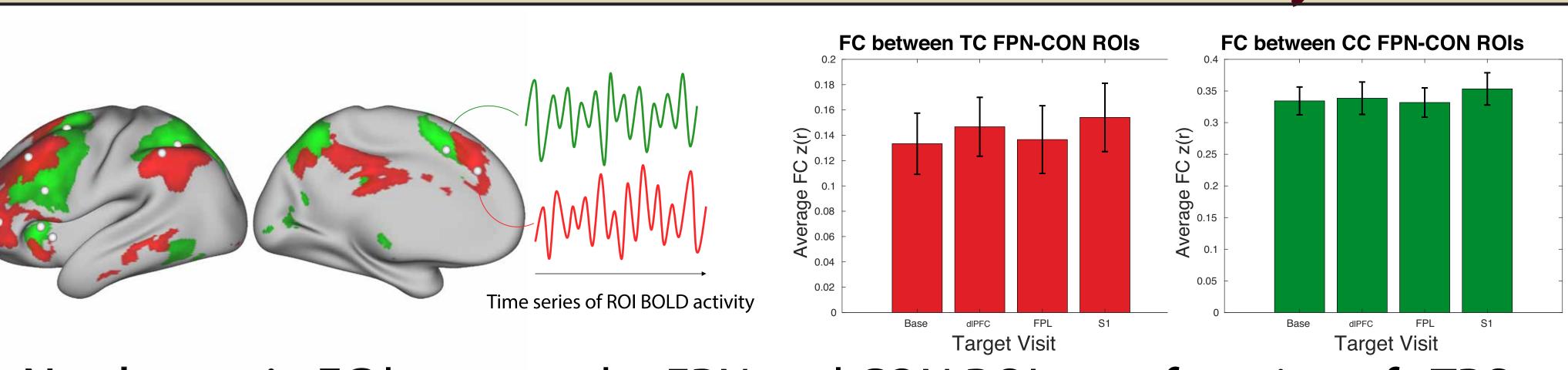
Present-Oriented Task (Sensory-Motor Control) Contrast Activations

dIPFC-cTBS increases both CON and FPN future-oriented control activation

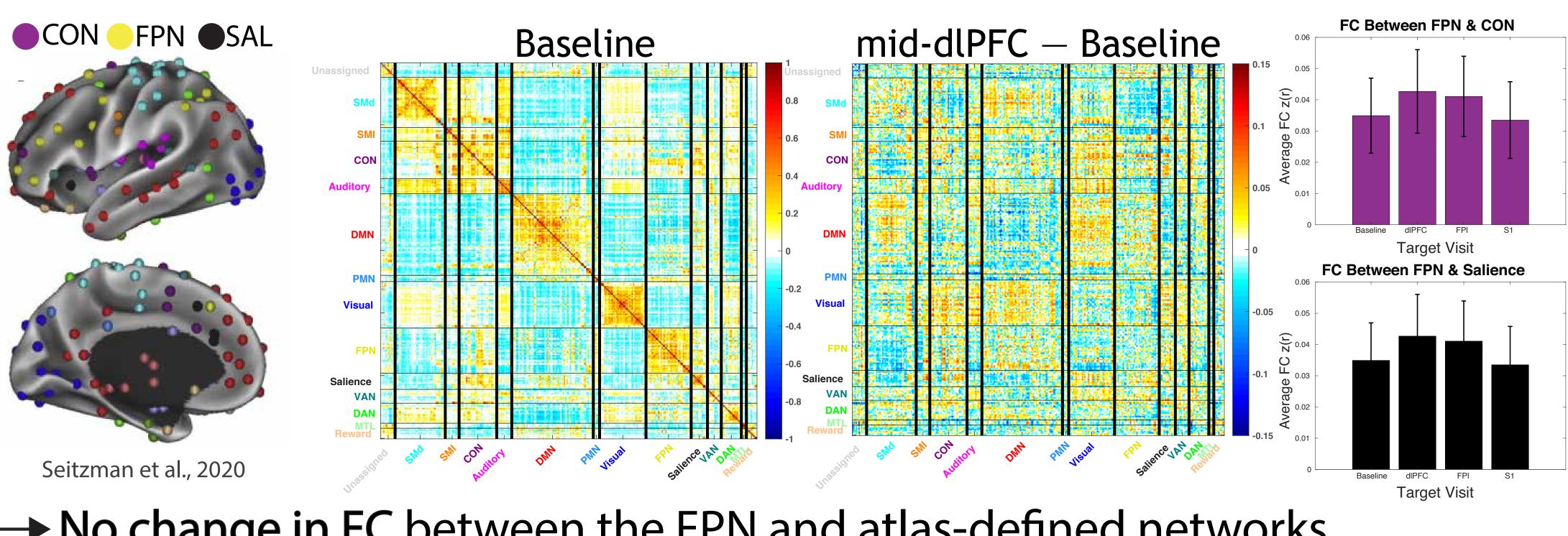
Results - Functional Connectivity

7 days

Control



→ No change in FC between the FPN and CON ROIs as a function of cTBS target



→ No change in FC between the FPN and atlas-defined networks

References & Acknowledgments

Funded by NIMH R01 MH121509. Power et al., 2011; Gratton et al., 2018; Nee & D'Esposito 2016; Badre & Nee 2018; Egner 2009; Kouneiher et al., 2009; Alexander & Brown 2018; Seitzman et al., 2020