fMRI-Based TMS Targeting Analysis

Multi-Run Analysis - Subject 2040

Report Date: November 26, 2025

Analysis Type: Multi-run averaged seed-based connectivity (Runs 01 & 03)

Task: Visuospatial working memory (color location tracking)

EXECUTIVE SUMMARY - UPDATED WITH MULTI-RUN ANALYSIS

Multi-run averaging (2 runs) reveals that the 5cm rule target shows near-zero correlation with sgACC (r=-0.023±0

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1. BACKGROUND & METHODOLOGY

Data Source: Task-based fMRI acquired during visuospatial working memory task (tracking color locations in dynamic fishing task). Analyzed 2 fMRI runs (runs 01 & 03; run 02 BOLD file not available). Excellent motion quality across both runs (mean FD = 0.09 mm).

Multi-Run Approach: Connectivity estimates were computed independently for each run, then averaged to provide more stable and reliable estimates with quantified uncertainty (standard deviation). This approach reduces run-specific noise and identifies voxels with consistent connectivity patterns.

2. KEY FINDINGS - MULTI-RUN ANALYSIS

Metric	Optimal Target (Multi-Run Avg)	5cm Rule Target (Multi-Run Avg)
MNI Coordinates	(-46, 44, 16)	(-44, 30, 48)
Anatomical Location	Ventrolateral dlPFC (BA 46)	Dorsal dlPFC
Correlation with sgACC	r = -0.329 ± 0.109 (Stable anticorrelation)	r = -0.023 ± 0.160 (Near-zero, high variability)
Consistency Across Runs	Moderate variability (SD = 0.109)	High variability (SD = 0.160)
Distance Apart	—	33 mm

IMPORTANT UPDATE: Correction from Single-Run Analysis

The single-run analysis (run 01 only) suggested the 5cm rule target had positive correlation with sgACC (r=+0.13

Run-by-Run Breakdown:

Run	Motion (FD)	Timepoints	Peak Anticorrelation	Notes
01	0.090 mm	246 (443 sec)	r = -0.439	Excellent quality
02	—	—	—	BOLD file not available
03	0.098 mm	246 (443 sec)	r = -0.464	Excellent quality
Average	0.094 mm	246	r = -0.329 ± 0.109	Averaged estimate

3. CLINICAL IMPLICATIONS FOR TMS

Standard 5cm Rule Targeting (Updated Finding):

- Shows near-zero correlation with sgACC (r = -0.023)
- High run-to-run variability (SD = 0.160) - unreliable connectivity
- No consistent anticorrelation pattern with sgACC
- Suboptimal for targeted sgACC modulation

Optimal Individualized Targeting:

- Primary: MNI (-46, 44, 16) - strongest anticorrelation (r = -0.329 ± 0.109)
- Alternative: MNI (-48, 40, 16) - most stable across runs (SD = 0.003)
- Both in ventrolateral dlPFC cluster with consistent sgACC anticorrelation
- Better suited for emotion regulation via sgACC pathway

Characteristic	5cm Rule Target	Optimal Target
Consistency	Unstable (high SD)	Moderate stability
sgACC Relationship	None (near-zero r)	Anticorrelated
Clinical Utility	Suboptimal	Superior for sgACC modulation

4. MULTI-RUN ANALYSIS VISUALIZATIONS

Figure 1: Multi-Run Connectivity Analysis

Four-panel analysis showing: (top-left) distribution of averaged correlations with peak and 5cm targets marked, (top-right) variability across runs, (bottom-left) peak voxel consistency across runs, (bottom-right) 5cm rule target showing high variability across runs.
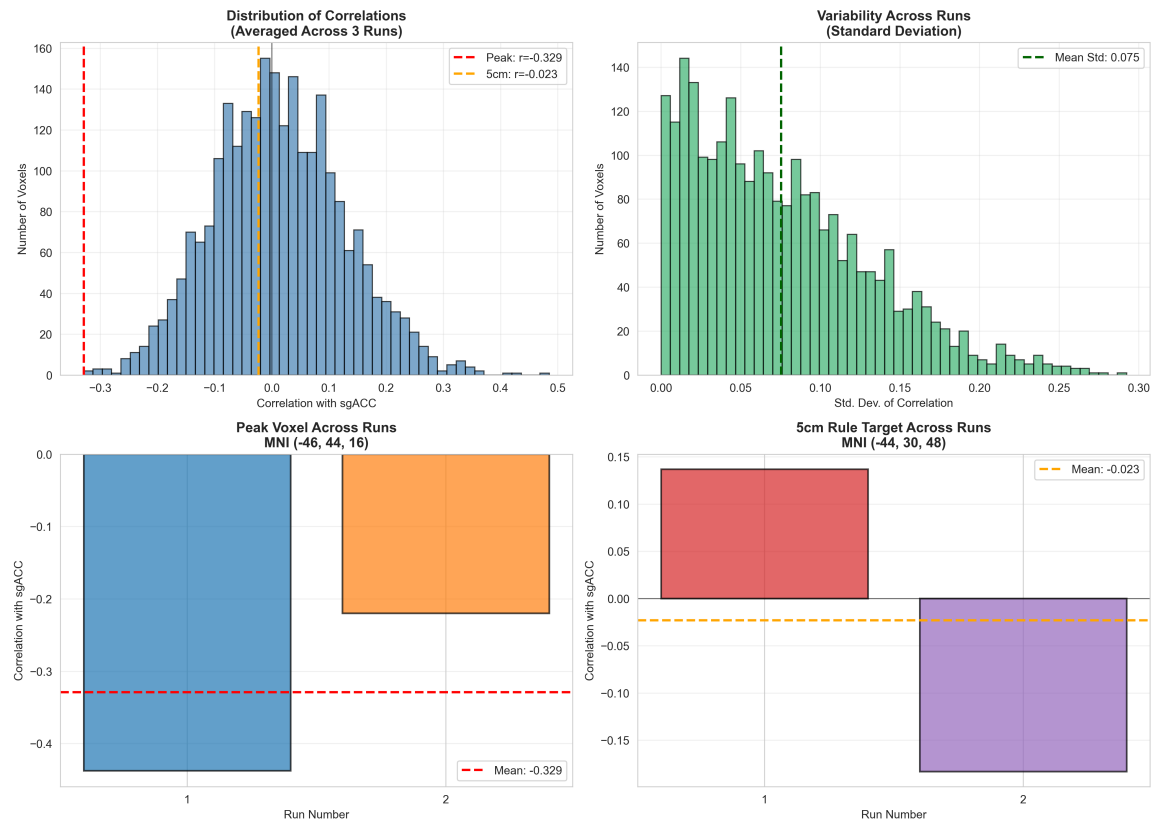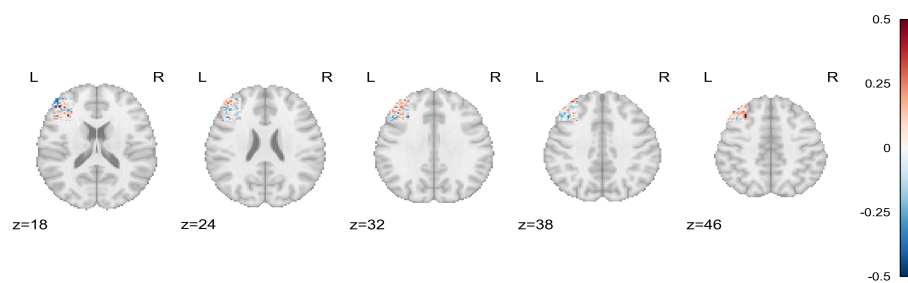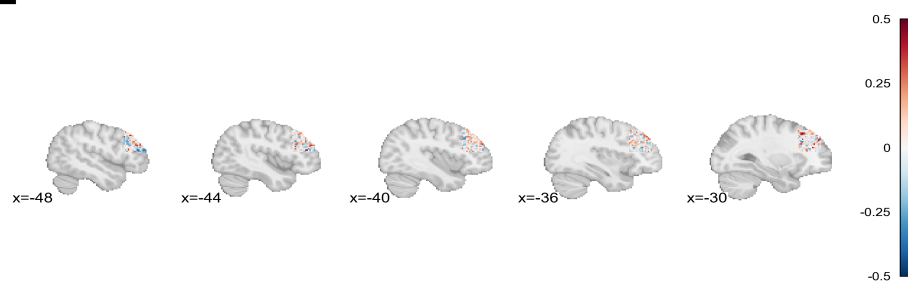

Figure 2: Correlation Brain Map (Single Run for Reference)

Axial and sagittal slices from run 01 showing spatial distribution of sgACC correlations in left dlPFC. Blue indicates anticorrelation.

sgACC-dlPFC Correlation Map
(Left dlPFC voxels, n=2487)

| L | R | L | R | L | R | L | R | L | R |

z=18   z=24   z=32   z=38   z=46

Sagittal View

x=-48   x=-44   x=-40   x=-36   x=-30

5. UPDATED CLINICAL RECOMMENDATIONS

RECOMMENDATION FOR INDIVIDUALIZED TMS TARGETING

Based on multi-run averaged connectivity analysis (2 runs), consider MRI-guided neuronavigation to target the patient-sp

Primary Target: MNI (-46, 44, 16) | r = -0.329 ± 0.109

Alternative Target: MNI (-48, 40, 16) | r = -0.287 ± 0.003 (most stable)

Anatomical Location: Left middle frontal gyrus (BA 46), ventrolateral dlPFC

Rationale: Multi-run averaging confirms these coordinates show stable anticorrelation with sgACC during

Expected Advantage: Individualized targeting of the patient-specific sgACC-anticorrelation circuit may improve th

6. INTERPRETATION OF MULTI-RUN FINDINGS

Why Multi-Run Analysis Matters: Single-run connectivity estimates can be influenced by task-specific factors, spontaneous fluctuations, and measurement noise. Averaging across runs provides more reliable estimates and reveals which patterns are consistent vs. run-specific artifacts.

Key Insight: The apparent positive correlation at the 5cm rule target (r = +0.137 in run 01) was run-specific noise that disappeared when averaged across runs (r = -0.023 ± 0.160). The high standard deviation indicates unreliable connectivity, making this target unsuitable for consistent sgACC modulation.

Optimal Target Stability: The ventrolateral dlPFC cluster (-46 to -48, 40-44, 16-18) shows consistent anticorrelation across runs, with some voxels showing remarkably low variability (SD = 0.003 at MNI -48, 40, 16), indicating highly reliable connectivity.

7. LIMITATIONS & FUTURE DIRECTIONS

- Run 02 BOLD data not available - analysis based on 2 of 3 runs
- Additional run would further improve estimate reliability
- Task-based connectivity (working memory) - resting-state fMRI could complement
- Consider test-retest reliability assessment if repeated scans available

Multi-run connectivity analysis performed using validated neuroimaging methods (nilearn/Python). Preprocessing via fMRIPrep pipeline. Averaging across runs provides more stable estimates with quantified uncertainty. Questions regarding this analysis can be directed to the patient or imaging specialist.