

# #1169 TEST-RETEST RELIABILITY OF CORTICAL THICKNESS AND STRUCTURE VOLUME IN VOLUMETRIC NAVIGATOR SEQUENCES



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## INTRODUCTION

- An important issue for magnetic resonance imaging studies is subject motion, which may be detrimental to the utility of the scan and may impact volumetric and morphological estimates.<sup>1</sup>
- A prospective technique to correct for subject motion that has become increasingly common in large-scale initiatives involves embedding volumetric navigators (vNavs) (i.e. fast-acquisition low-resolution 3D EPI images) within the “dead-times” of longer acquisition sequences.<sup>1</sup>
- vNavs undergo rapid rigid registration to estimate changes in head position, tracking and updating subject motion during an acquisition, at a negligible cost of time, contrast, and intensity.<sup>1</sup>
- The current work examined the reliability and similarity of volumetric and morphometric structural imaging measures in a sequence with vNavs alongside a standard T1-weighted (T1w) acquisition sequence.

## METHODS

### Study Design:

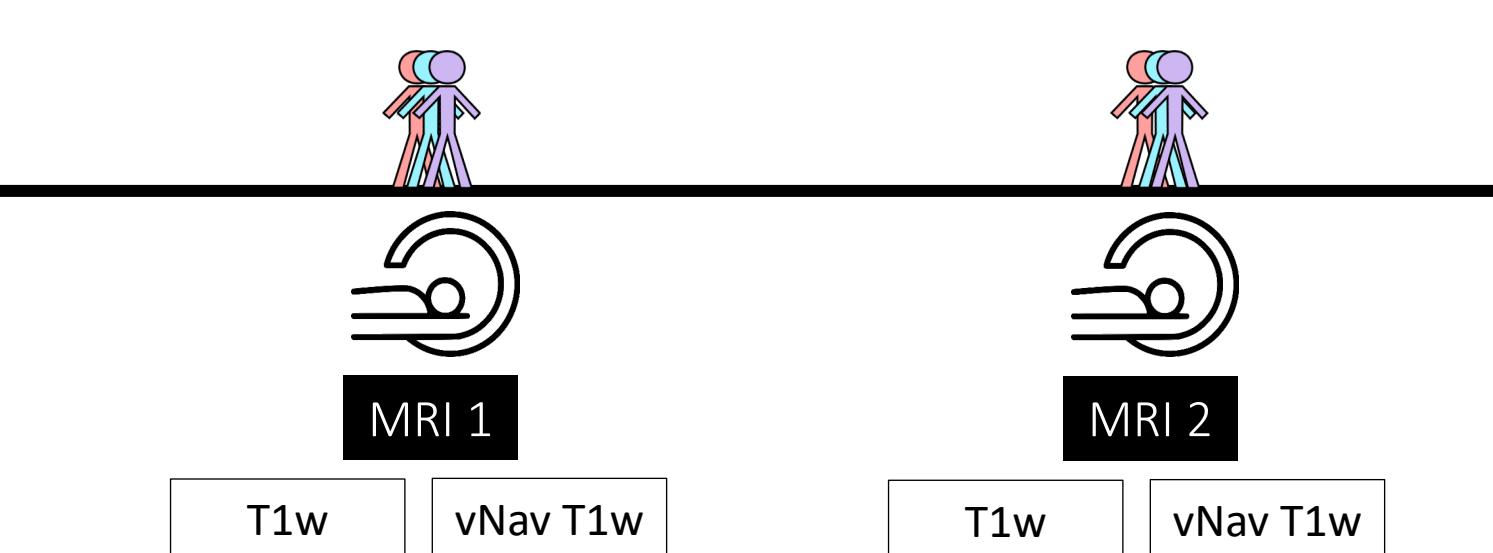


Figure 1. Study design. 13 individuals (7F, 6M; mean age:  $27.31 \pm 6.64$  years) underwent 2 MRI sessions (Siemens Prisma scanner).

### Magnetic Resonance Imaging Data:

Acquisition:  
T1w and vNav T1w structural images  
T1w: MPRAGE, TR=2300ms, TE=2.01ms, TI=900ms, flip angle=9°, bandwidth=240Hz/Px, voxel size=1.0 x 1.0 x 1.0mm, 192x240x256 matrix. vNav T1w: vNav-MPRAGE (Massachusetts General Hospital), TR=2300ms, TE=2.90ms, TI=1070ms, flip angle=9°, bandwidth=240Hz/Px, voxel size=1.0 x 1.0mm, 176x240x256 matrix

Processing:  
bpPipe pipeline<sup>2</sup>  
FreeSurfer<sup>3</sup>, CIVET<sup>4</sup>, MAGeT-Brain<sup>5</sup>  
CIVET and FreeSurfer: Desikan-Kiliany-Tourville (DKT)<sup>6</sup> atlas regions of interest (ROIs). MAGeT-Brain and FreeSurfer: Striatum, thalamus, globus pallidus, hippocampus, and amygdala volumes<sup>7,9</sup>

Statistical analysis: Intraclass correlation coefficients (ICCs) (3,1) for pairs across sessions and similarity analyses (i.e. T1w and vNav T1w pair). Linear mixed-effects models to test differences between acquisitions (acquisition as fixed effect, subject as random effect).

## RESULTS

Table 1. Intraclass Correlation Coefficients of Structure Volumes

ROI	MAGeT-Brain						FreeSurfer					
	Left Hemisphere			Right Hemisphere			Left Hemisphere			Right Hemisphere		
	M-M	V-V	M-V	M-M	V-V	M-V	M-M	V-V	M-V	M-M	V-V	M-V
Amygdala	0.98	0.93	0.98	0.98	0.94	0.98	0.90	0.88	0.91	0.85	0.94	0.84
Hippocampus	1.00	0.99	0.97	0.97	1.00	0.98	0.92	0.92	0.99	0.97	0.97	0.97
Globus Pallidus	0.98	0.98	0.98	0.98	0.94	0.97	0.91	0.82	0.82	0.87	0.73	0.78
Striatum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	0.98	0.90	0.93
Thalamus	0.99	0.99	0.98	0.99	0.99	0.99	0.90	0.92	0.86	0.90	0.93	0.94

M-M, MPRAGE-MPRAGE pair; V-V, vNav-MPRAGE-vNav-MPRAGE pair; M-V, MPRAGE-vNav-MPRAGE pair

## RESULTS CONT.

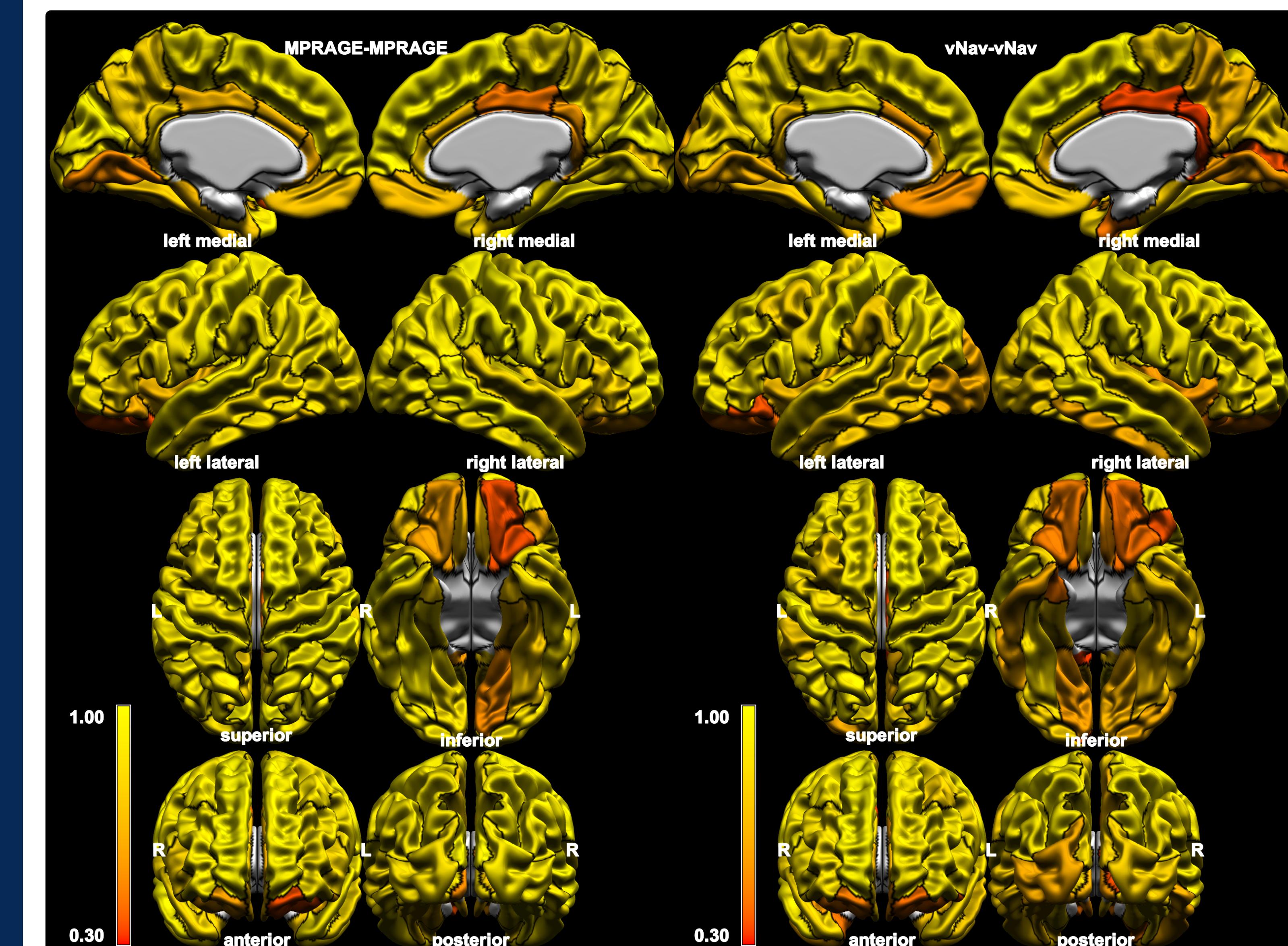


Figure 2. ICCs of CIVET-acquired CT Estimates (Reliability). ICCs calculated and displayed within ROIs delineated by DKT atlas. Left: MPRAGE pairs. Right: vNav-MPRAGE pairs.

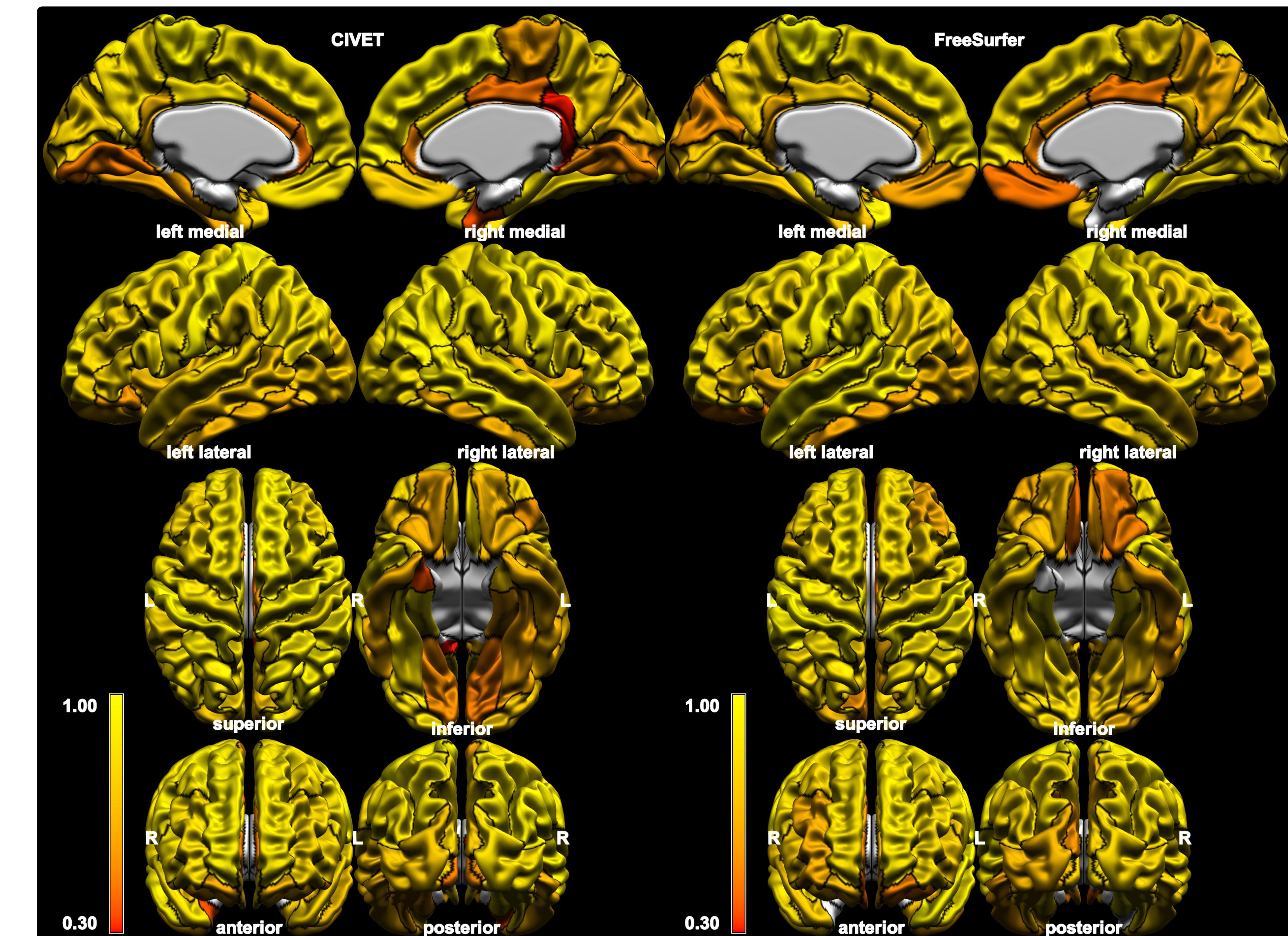


Figure 4. ICCs of CT Estimates Between MPRAGE and vNav-MPRAGE Pairs (Similarity). ICCs calculated and displayed within ROIs delineated by DKT atlas. Left: CIVET. Right: FreeSurfer. Note: right entorhinal cortex (FreeSurfer) not significant (ICC=0.28).

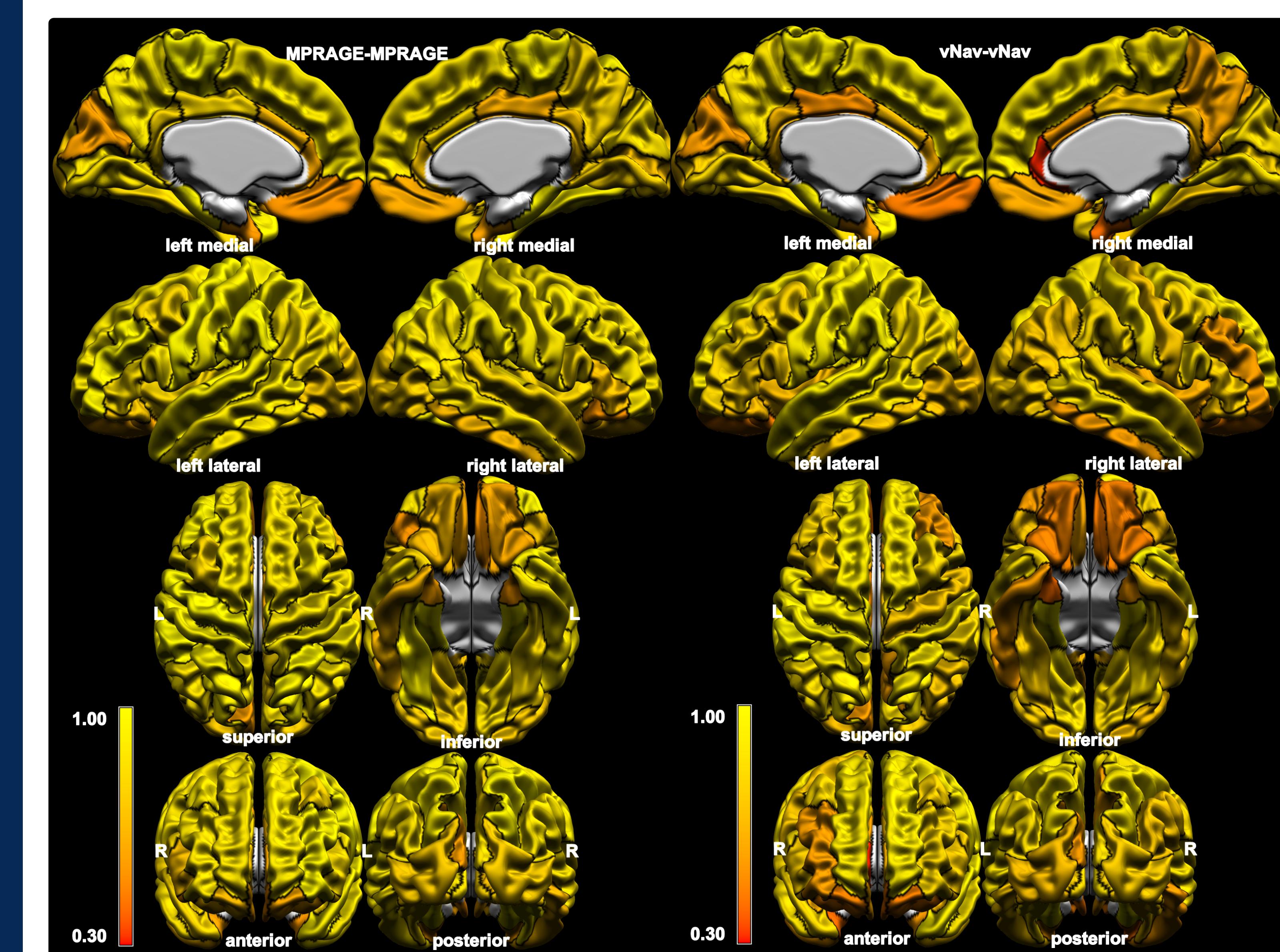


Figure 3. ICCs of FreeSurfer-acquired CT Estimates (Reliability). ICCs calculated and displayed within ROIs delineated by DKT atlas. Left: MPRAGE pairs. Right: vNav-MPRAGE pairs.

ROI	CIVET/MAGeT-Brain				FreeSurfer				
	Left Hemisphere		Right Hemisphere		Left Hemisphere		Right Hemisphere		
	t-value	p-value	t-value	p-value		t-value	p-value	t-value	p-value
Inferior Occipital Cortex	-0.97	0.351	-2.92	0.013	-1.14	0.276	-5.12	<0.001*	
Inferior Parietal	0.90	0.383	-8.39	<0.001*	4.58	<0.001*	-0.85	0.410	
Lateral Frontal Triangularis	-0.29	0.776	-0.51	0.621	3.21	0.008	6.91	<0.001*	
Lingual Gyrus	-2.21	0.047	-3.14	0.008	2.93	0.013	5.13	<0.001*	
Medial Orbitofrontal	4.51	<0.001*	3.80	0.003	3.56	0.004	3.61	0.004	
Middle Temporal	-1.34	0.206	-6.16	<0.001*	1.07	0.305	0.57	0.580	
Parahippocampal	-4.75	<0.001*	-10.09	<0.001*	-0.72	0.487	-0.31	0.765	
Percalcarine	1.26	0.231	-0.61	0.556	4.14	0.001	6.21	<0.001*	
Postcentral Gyrus	4.58	<0.001*	1.68	0.118	4.61	<0.001*	5.44	<0.001*	
Posterior Cingulate	-1.82	0.093	-4.42	<0.001	-0.13	0.897	-1.93	0.078	
Precentral Gyrus	-3.16	0.008	-6.56	<0.001*	-2.24	0.045	0.07	0.942	
Precuneus	-1.42	0.180	-6.93	<0.001*	2.54	0.026	0.34	0.738	
Rostral Middle Frontal	-0.97	0.351	2.42	0.032	3.85	0.002	7.79	<0.001*	
Superior Frontal Gyrus	0.83	0.422	3.38	0.005	2.03	0.066	5.17	<0.001*	
Superior Parietal	-0.30	0.768	-2.15	0.053	5.68	<0.001*	3.08	0.010	
Superior Temporal	-2.45	0.031	-5.32	<0.001*	-0.72	0.486	-1.37	0.194	
Transverse Temporal	-0.29	0.775	-0.70	0.499	10.65	<0.001*	2.14	0.054	
Hippocampus	1.24	0.238	1.45	0.172	-4.51	<0.001*	-2.33	0.038	
Thalamus	-0.59	0.568	-0.97	0.353	2.99	0.011	4.53	<0.001*	

Table 2. ROIs that significantly differed between MPRAGE and vNav-MPRAGE acquisitions. Note: positive t-values represent cortical thickness increases in vNav-MPRAGE. Asterisk indicates significance after Bonferroni correction (62 CT ROIs) (10 SV ROIs).

## DISCUSSION

- Using previously established criteria for interpretation,<sup>10</sup> ROIs with “fair” or “poor” (ICC: 0.59 to 0.00) reliability were found in cingulate, orbitofrontal, and medial temporal areas.
- Interestingly, CT estimates were larger in MPRAGE acquisitions mainly within temporal areas (CIVET), while the opposite was identified in parietal brain regions (FreeSurfer).
- This work is relevant to studies including certain clinical populations, and prospective motion correction investigations are warranted in cases of marked/forced head movement.

## REFERENCES

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