The relationship between radial optic flow perception and neurodegeneration in Parkinson's Disease: A volumetric MRI analysis

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Clinical

Introduction

- Parkinson's Disease (PD) is a disorder that affects one million people in the U.S.
- Symptomatic navigational veering in PD is related to abnormal processing of Radial Optic Flow (ROF), which are the motion patterns perceived during forward self-movement.
- Areas V6 of the parieto-occipital sulcus and V5/middle temporal (MT+) are important for the analysis of visual motion patterns during self-motion/ response to visual motion stimuli, and therefore navigation.
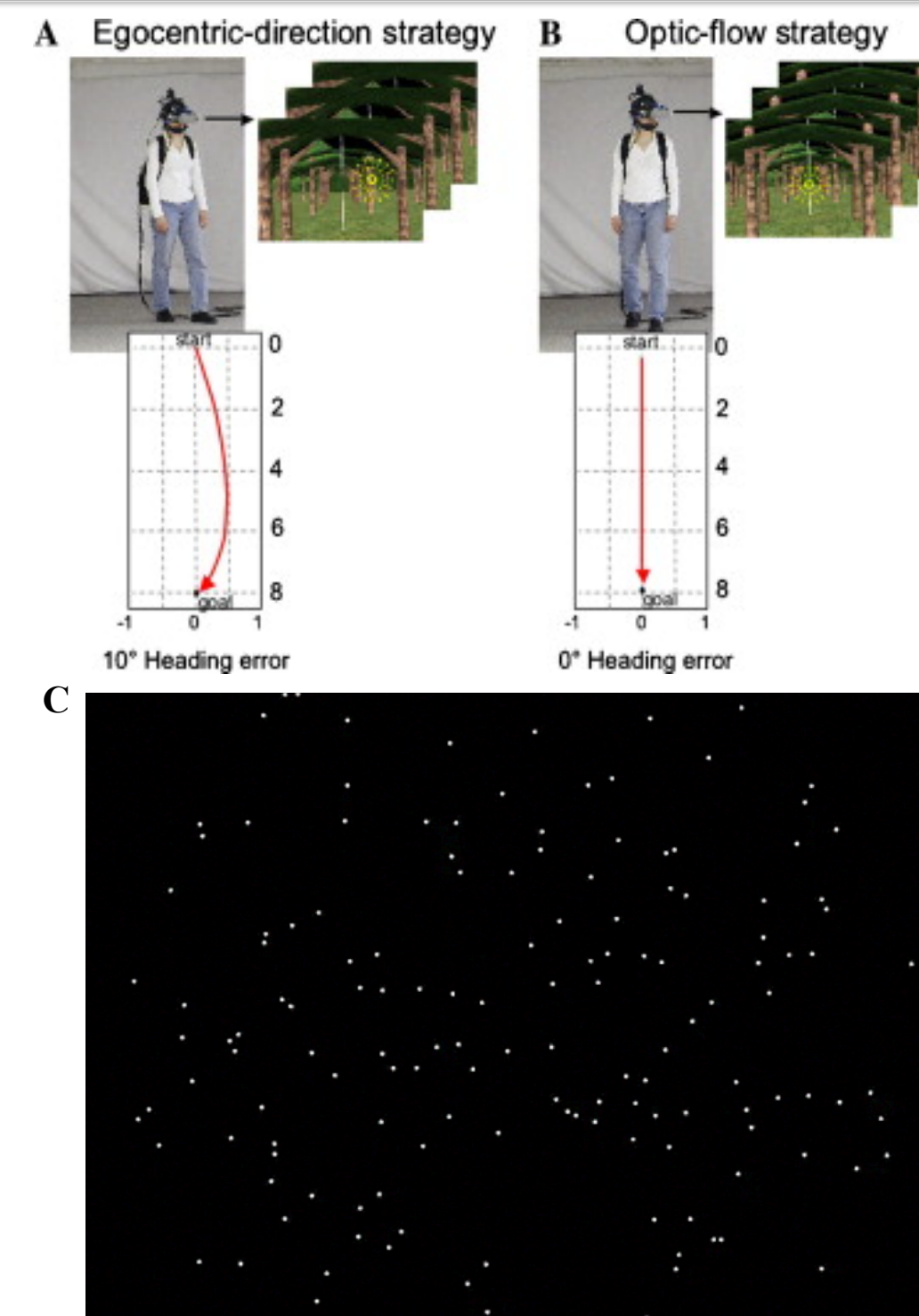- Information regarding the effects of ROF on particular neuroanatomical structures is currently limited.

Figure 1: A) Correction strategy and B) Normal Radial Optic Flow pattern. C) 3D Radial Optic Flow stimulus.

Hypothesis

- We hypothesized that there is degeneration in the V6 of the parieto-occipital sulcus and V5/middle temporal (MT+) that correlates with radial optic flow measures in PD patients.

Methods

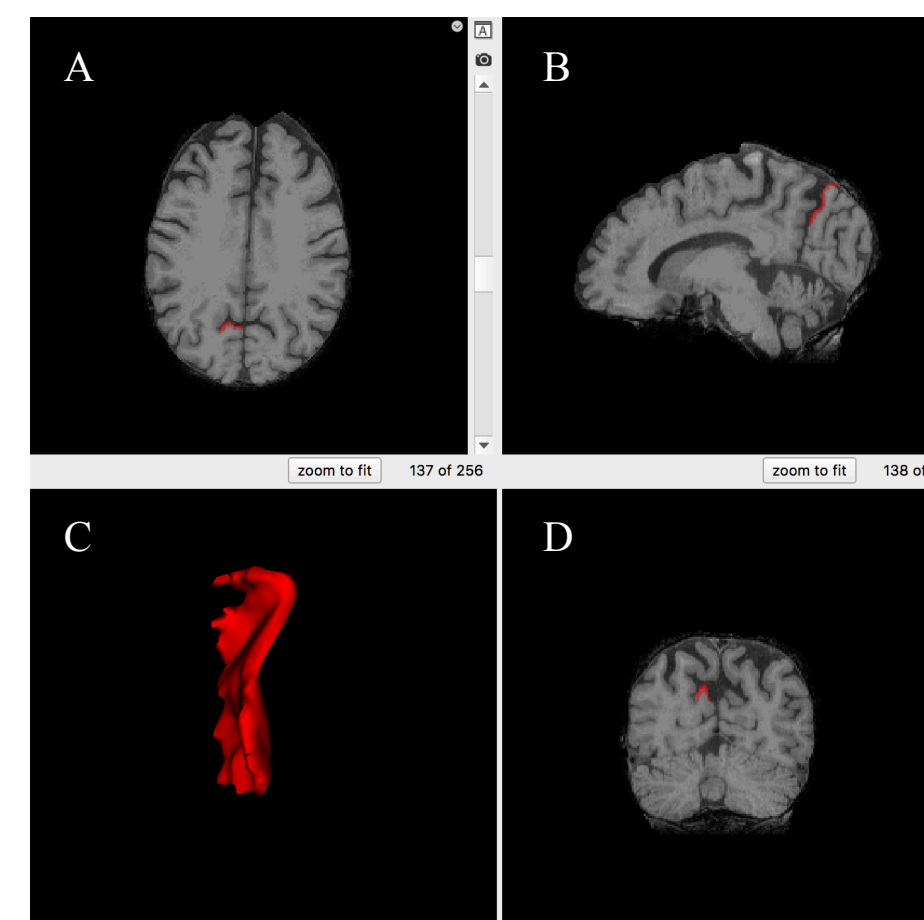**SPM (Matlab): Conversion of T1 MRI data from DICOM**

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FreeSurfer: Processing and Analyses of MRI images

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ITK-SNAP: Segmentation of Grey and White Matter Structures →

- **Align ROI in all views (Axial, Sagittal, Coronal)**
- **Manual demarcation of ROI using Sagittal View**
- **Adjustments of ROI using Axial and Coronal Views**
- **ROI observed in 3D view**

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Volumetric Analysis : Association analyses of focal differences in brain anatomy

Figure 2: ITK SNAP segmentation view of V6 A) Axial B) Sagittal C) 3D D) Coronal.
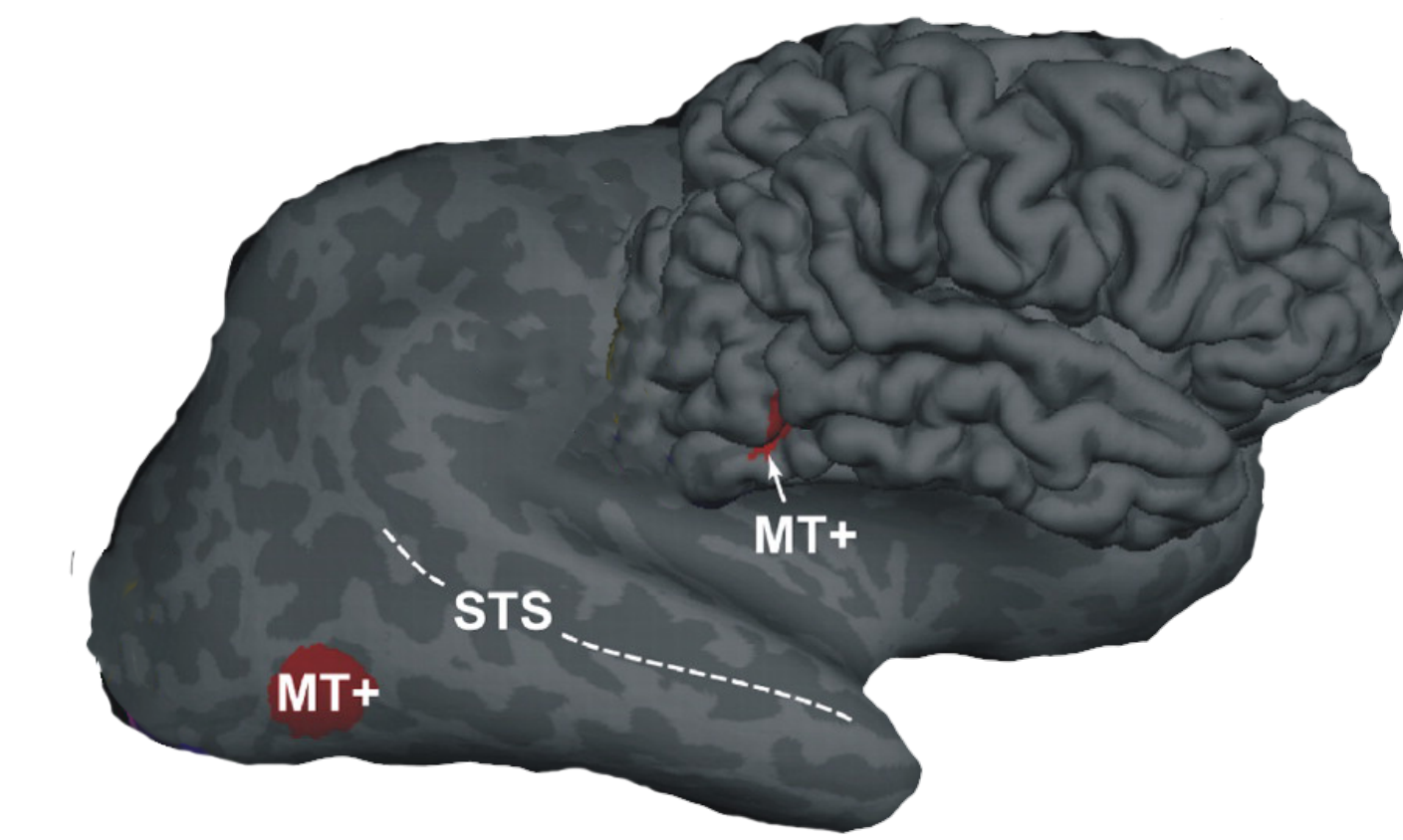
ROF Performance and Visual Field Volume

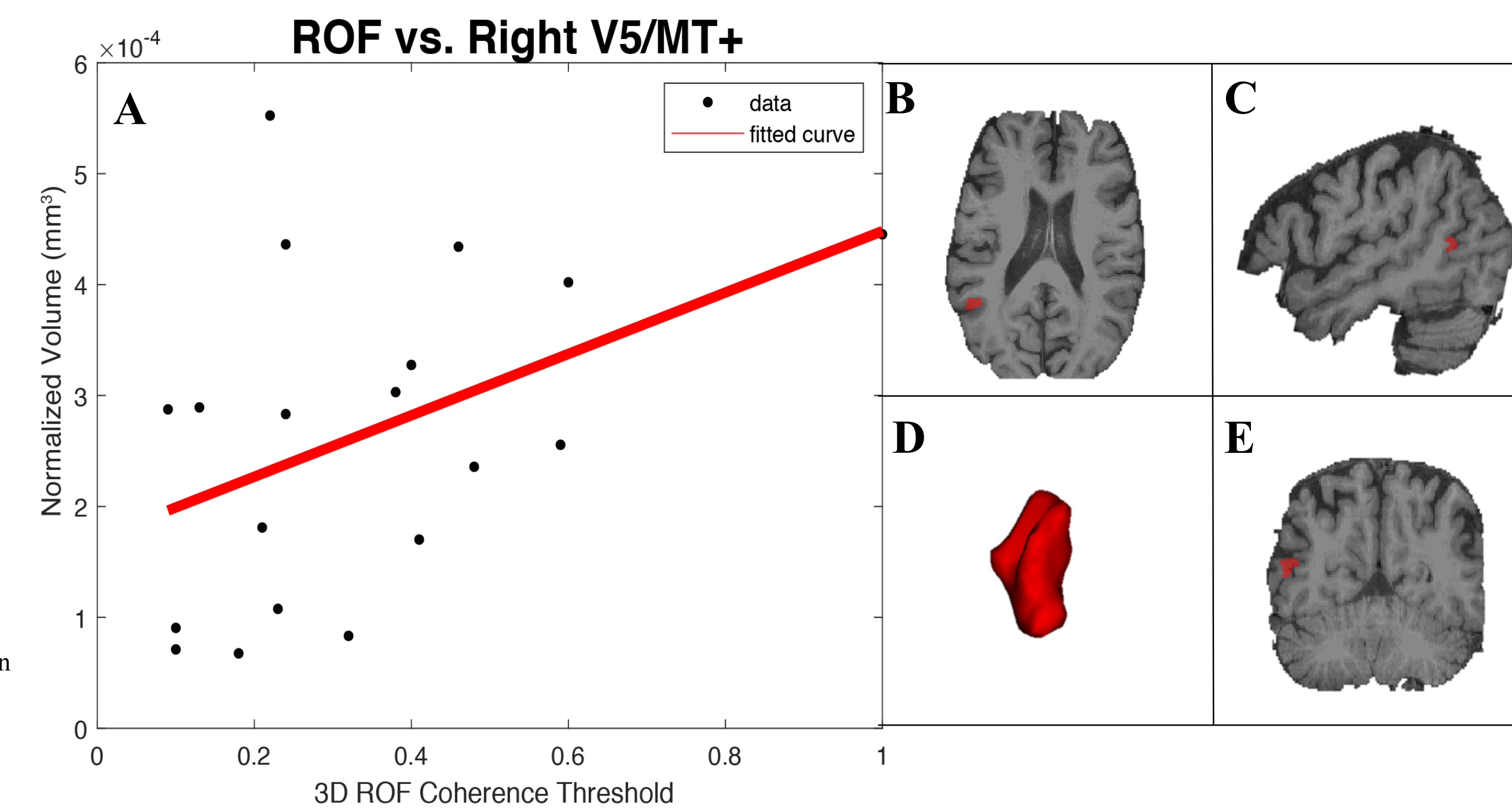**Figure 3:** Reference image used to establish boundaries for segmentation of V5/MT+.

Figure 4: A) Relationship between Normalized Volume (mm³) and ROF Coherence Threshold of segmented Right V5/MT+. Segmentation of Right V5/MT+ in B) Axial C) Sagittal D) 3D E) Coronal views. P-value = 0.96, R-value = 0.43
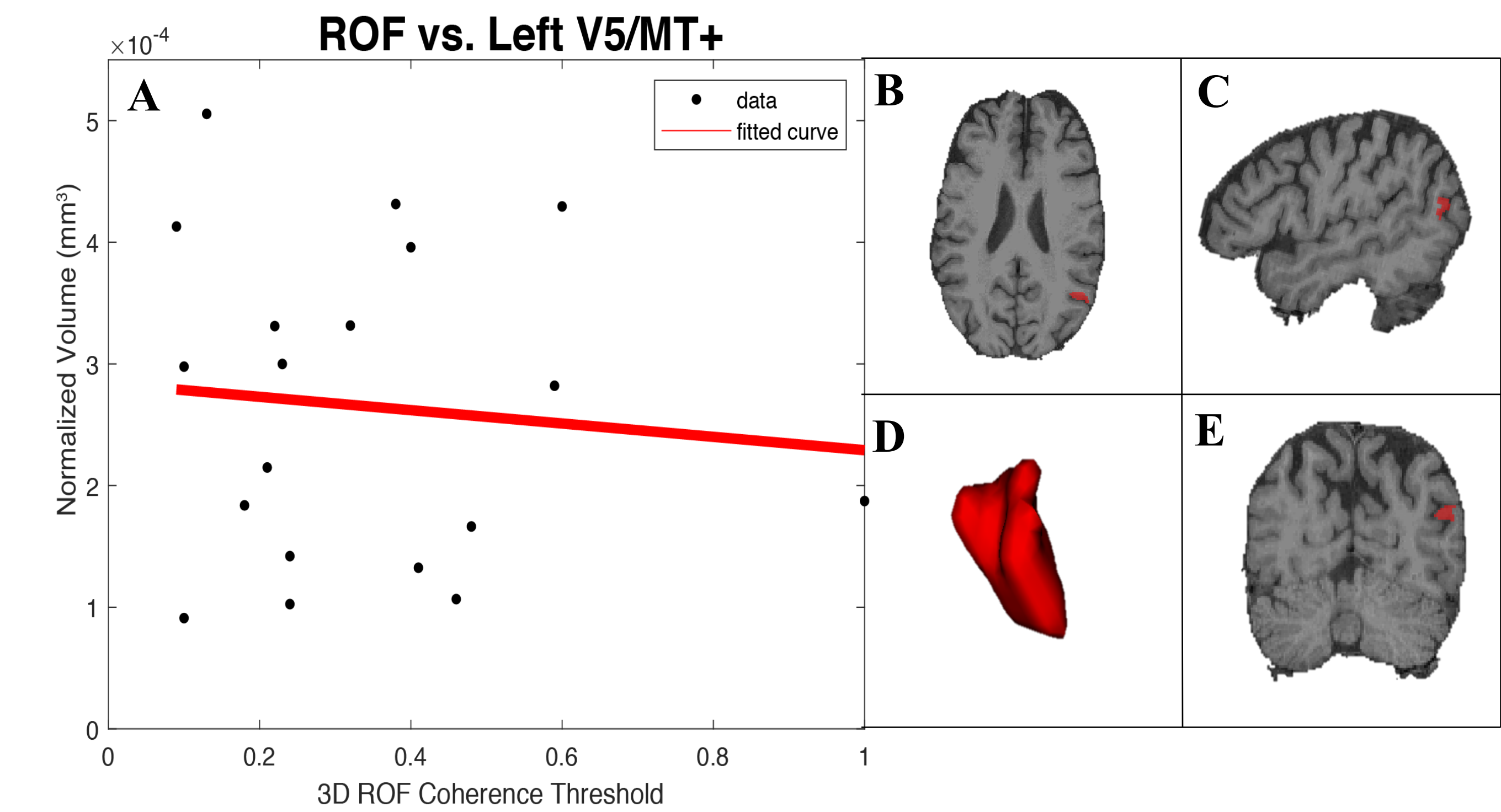

Figure 5: A) Relationship between Normalized Volume (mm³) and ROF Coherence Threshold of segmented Left V5/MT+. Segmentation of Left V5/MT+ in B) Axial C) Sagittal D) 3D E) Coronal views P-value = 0.34, R-value = 0.09
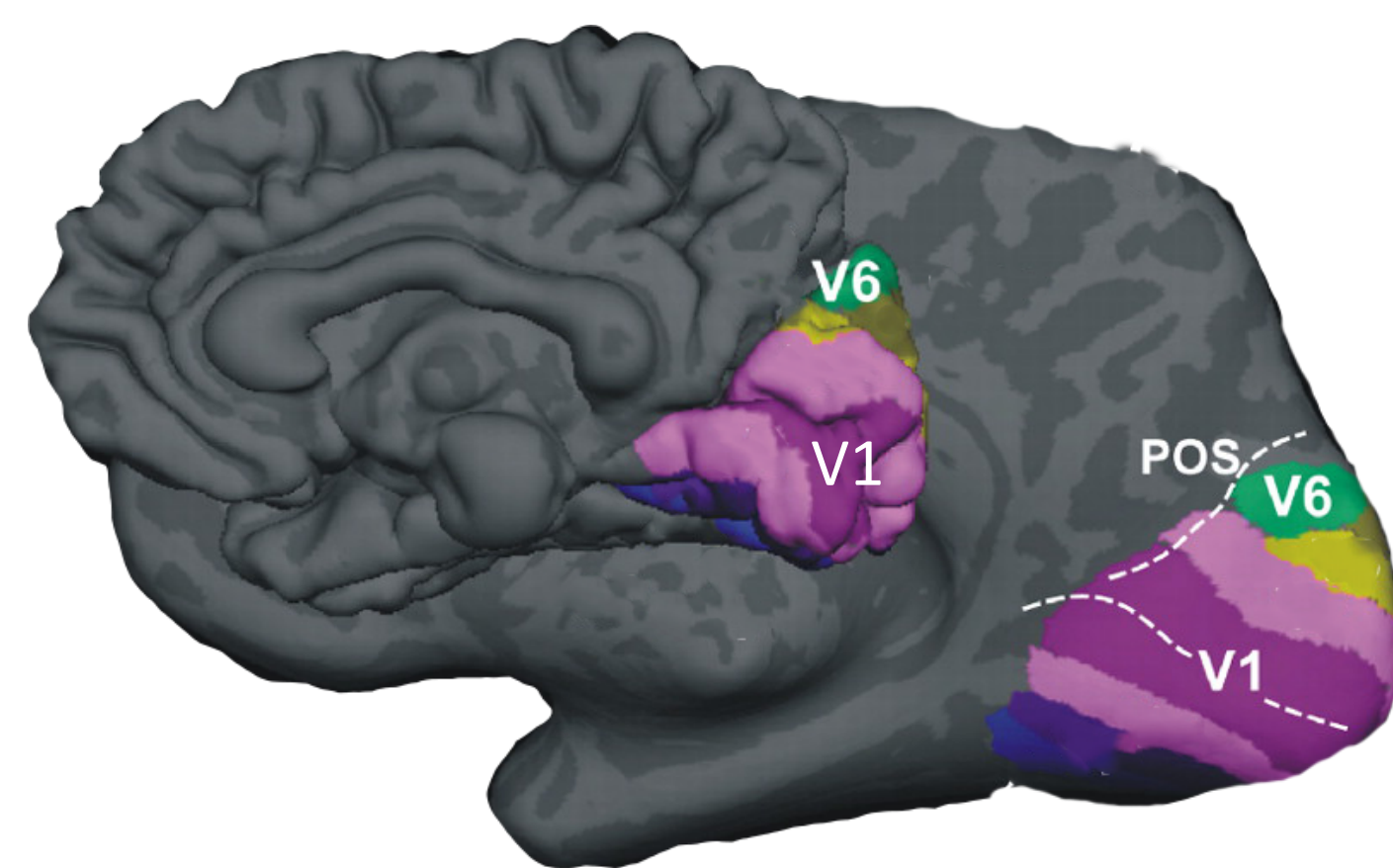

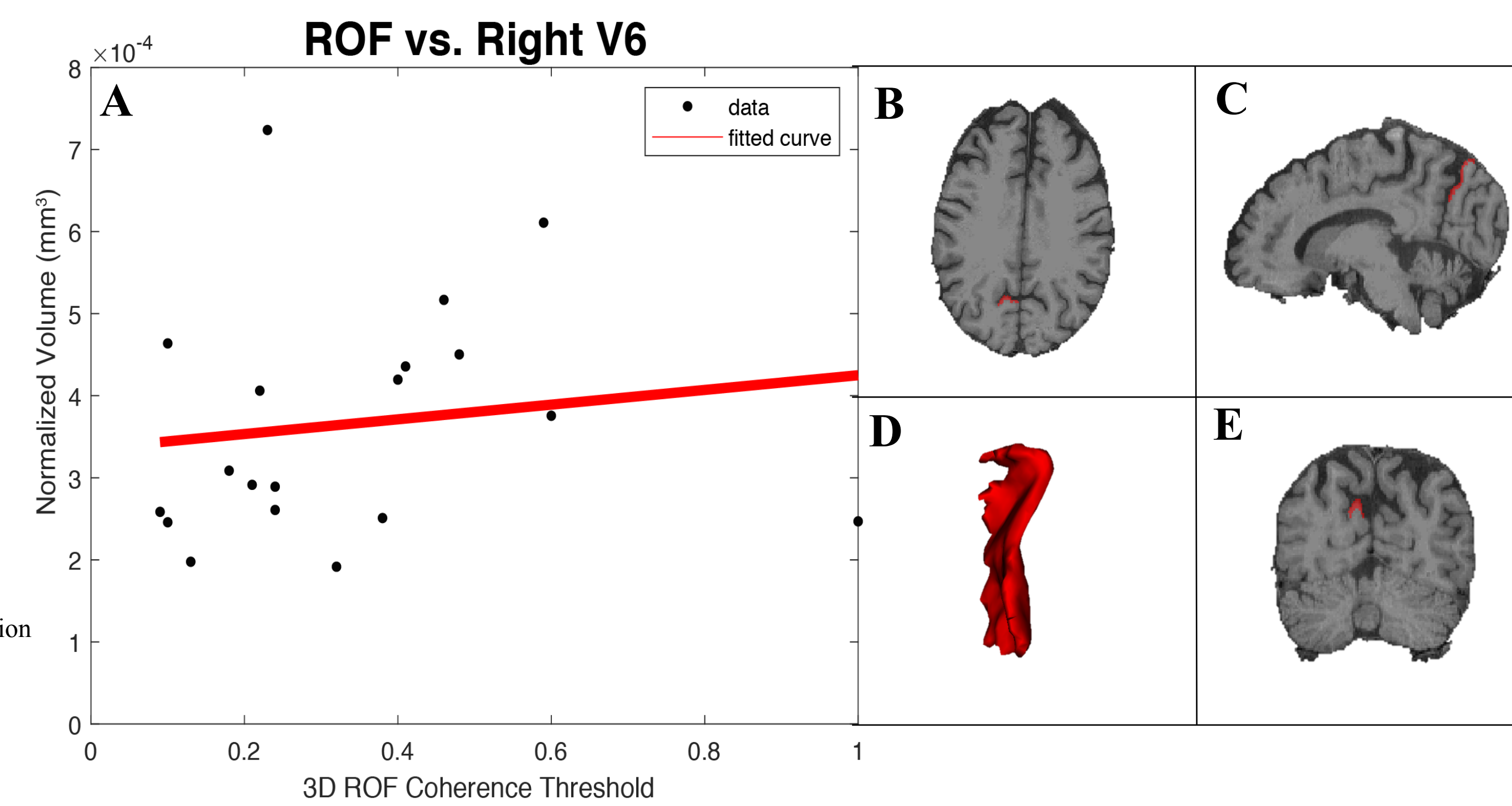**Figure 6:** Reference image used to establish boundaries for segmentation of V6.

Figure 7: A) Relationship between Normalized Volume (mm³) and ROF Coherence Threshold of segmented Right V6. Segmentation of Right V6 in B) Axial C) Sagittal D) 3D E) Coronal views P-value = 0.28, R-value = 0.14
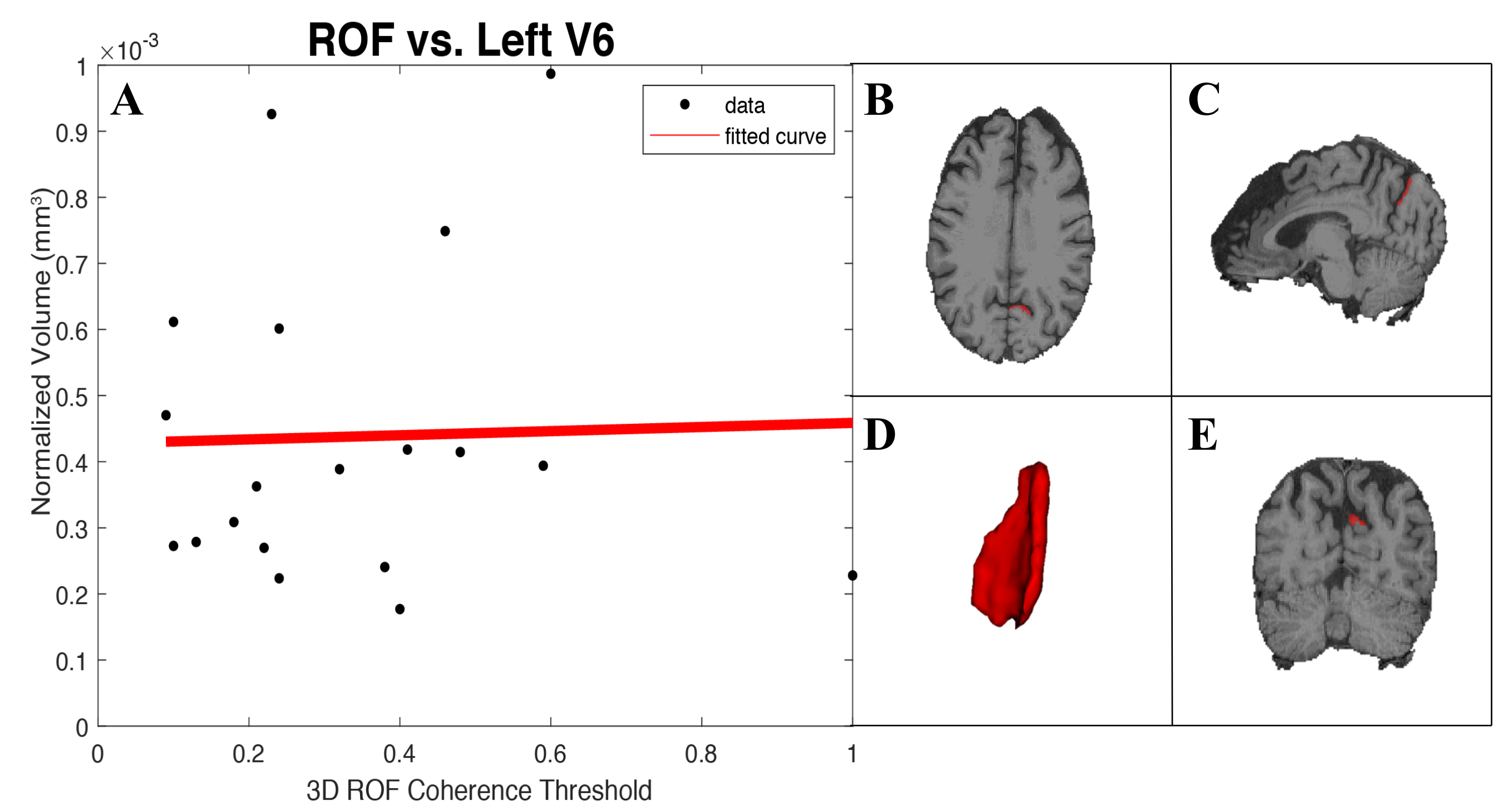

Figure 8: A) Relationship between Normalized Volume (mm³) and ROF Coherence Threshold of segmented Left V6. Segmentation of Left V6 in B) Axial C) Sagittal D) 3D E) Coronal views P-value = 0.54, R-value = 0.029

ROF Performance and White Matter Volume

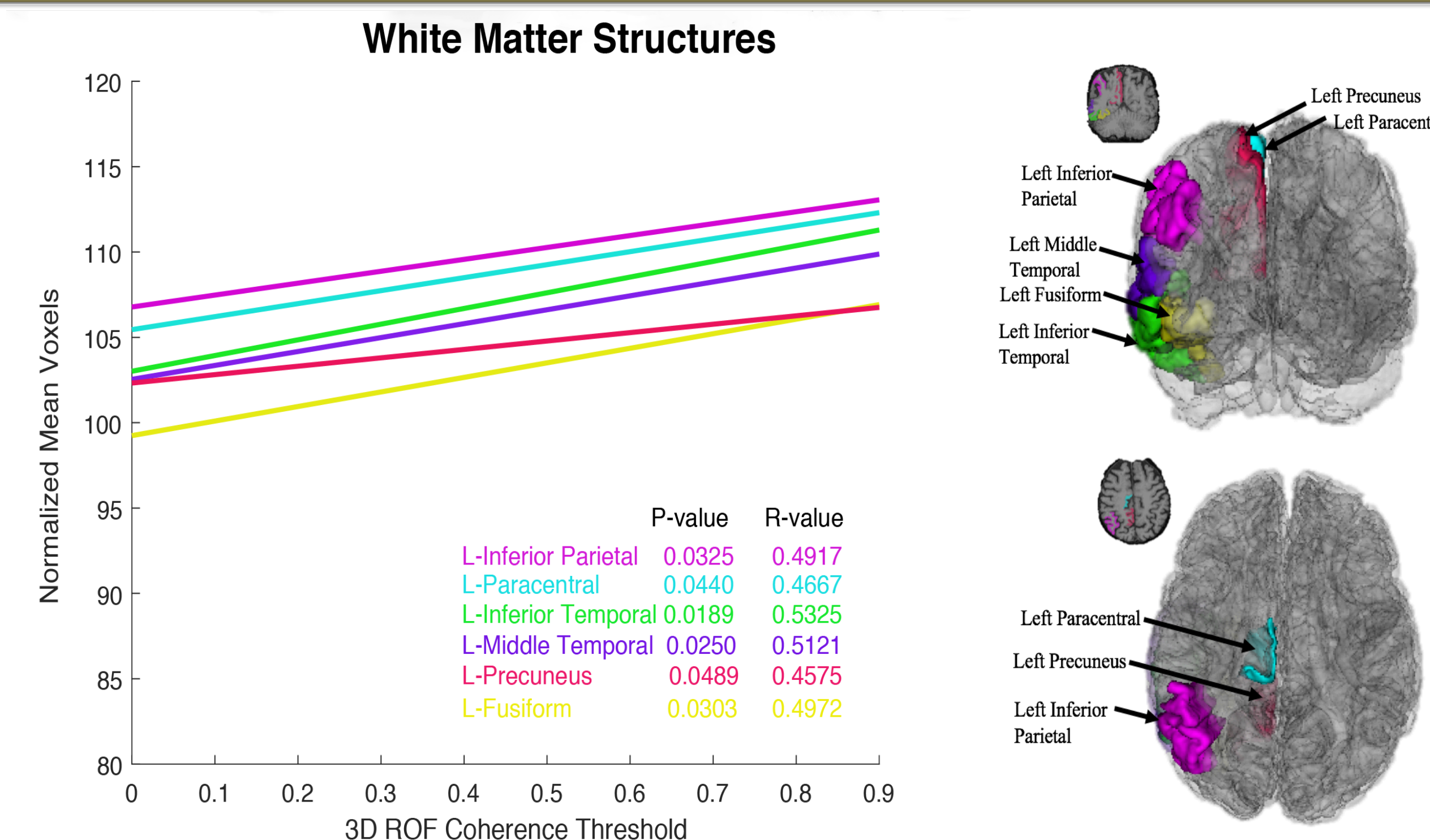|	P-value	R-value
L-Inferior Parietal	0.0325	0.4917
L-Paracentral	0.0440	0.4667
L-Inferior Temporal	0.0189	0.5325
L-Middle Temporal	0.0250	0.5121
L-Precuneus	0.0489	0.4575
L-Fusiform	0.0303	0.4972

Figure 9: A) Relationship between Normalized Mean Voxel Volume and ROF Coherence Threshold of Cortical Structures with P-values and R-values. ITK-SNAP representation of Cortical Structures in B) Frontal C) Ventral views.

Conclusions

- Results show that there is not a significant relationship between ROF Coherence Threshold and Normalized Volume of the Right and Left V5/MT+ and V6.
- FreeSurfer atlas analysis resulted in the identification of additional cortical structures that have a significant relationship with ROF.
- Further research should explore the relationship between identified cortical structure average volume and ROF.

Acknowledgements