

Validating Removal of Facial Features in Adults with Down Syndrome using *mri_reface*

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Background

- Modern face recognition algorithms have increased the risk that study participants may be re-identified through neuroimaging.
- Face de-identification (“de-facing”) algorithms can de-identify neuroimages.
- No de-facing algorithms have been validated in individuals with Down syndrome (DS), a population at high risk of AD due to trisomy 21 resulting in an additional copy of the APP gene.

Methods

- T1-weighted MRIs from 37 adults with DS from the Trial Ready Cohort-Down Syndrome (TRC-DS) study were parcellated using FreeSurfer 7.4.1 both before and after de-identification with *mri_reface* 0.3.5.
- A control group of 78 neurotypically developed (TD) participants from the Mayo Clinic Study of Aging (MCSA) were ~2:1 matched according to age, sex, and MRI manufacturer (Table 1).
- For each regional measurement, we computed direct differences (subtraction) and compared these with linear model F-tests, then we measured discriminability (AUROC) between DS vs TD and compared these paired AUROCs with DeLong's test, adjusting all for multiple comparisons with permutation testing.
- If participants failed visual quality control these were not included in the analysis.

Table 1. Participant Demographics

	Adults with Down Syndrome	Age-matched TD controls	p-value
N	37	78	N/A
Age (years) (Range)	39.9 (30-55)	40.8 (31-55)	0.525
Sex (%)			0.982
Female	16 (43.2%)	32 (41.0%)	
Male	21 (56.8%)	46 (59.0%)	
ID (%)			NA
Mild	20 (54.1%)	NA	
Moderate	14 (37.8%)	NA	
Severe	3 (8.1%)	NA	
mCRT TRS (SD)	34.2 (4.2)	NA	NA
DSMSE (SD)	80.8 (12.7)	NA	NA
MRI manufacturer			0.938
Siemens	20 (54.1%)	40 (51.3%)	
GE	17 (45.9%)	38 (48.7%)	

Results

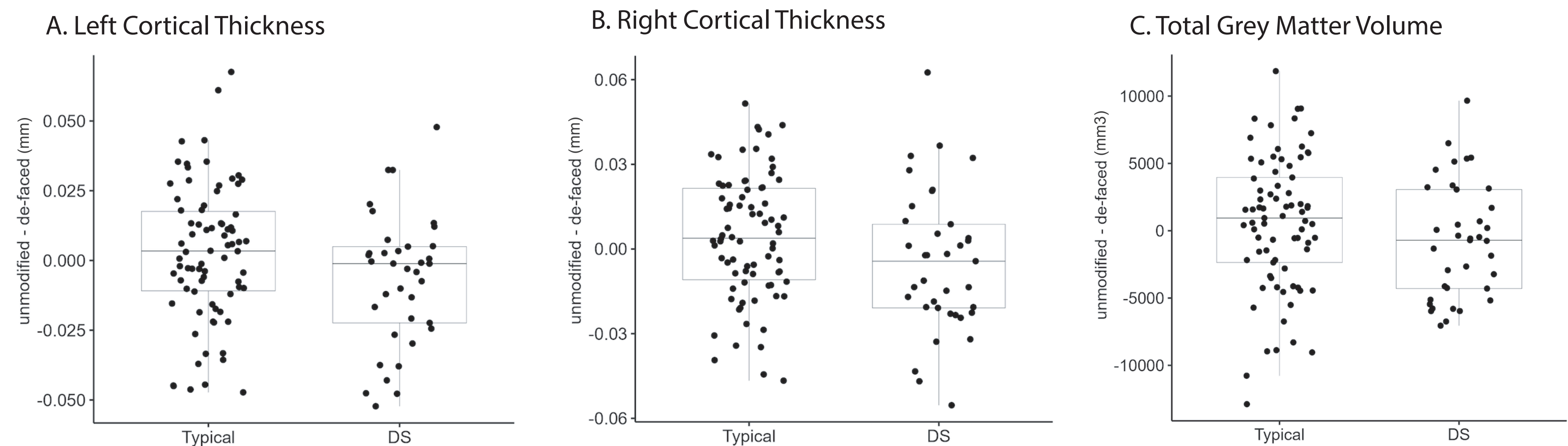


Figure 2. No significant direct differences following de-facing with *mri_reface*

Shown are the subtractive differences in left cortical thickness (A), right cortical thickness (B) and total grey matter volume (C) in neurotypically developed individuals and in individuals with Down syndrome. Adjusted *p*-values 0.997, 1.0 and 1.0 respectively. No differences were observed in any FreeSurfer-defined regions.

Conclusion

- FreeSurfer-derived volumetric and cortical thickness measures were changed minimally following de-facing with *mri_reface* 0.3.5 in adults over 30 years of age with DS.
- The average magnitude of cortical thickness change was 0.0095 mm (left hemisphere) and 0.0092 mm (right hemisphere, which is far smaller than previously reported scan-rescan effects (0.018 mm and 0.022 mm).
- De-facing did not alter how well different regions discriminated between individuals with DS and TD participants. AUROCs of different regions were unaffected by de-facing, and those that displayed the largest numerical change following de-facing were areas with low AUROCs.
- De-facing should be strongly considered prior to brain image data sharing, including in studies of DS.
- The present data demonstrates *mri_reface* performs suitably for de-facing MRIs of individuals with DS 30 years and older.

Funding

National institutes on aging: R01 NIA AG068206, R33 AG066543-05 (NIH INCLUDE Project), U01 AG006786, P50 AG016574, R01 AG034676, R37 AG011378, R01 AG041851, R01 AG056366.

National Institute of Neurological Disorders and Stroke: R01 NS097495, U01 NS100620.

The GHR Foundation; The Elsie and Marvin Dekelboum Family Foundation; The Alexander Family Alzheimer's Disease Research Professorship of the Mayo Clinic; The Liston Award; The Schuler Foundation; and The Mayo Foundation for Medical Education and Research.

Downloads

mri_reface is publicly available and used for de-facing major consortia including ADNI, SCAN, A4, MCSA, CLARITI, ALLFTD.

https://www.nitrc.org/projects/mri_reface

Full manuscript recently published:
Russell JK, Rafii MS, Kremers WK, et al. Facial feature removal in magnetic resonance imaging scans of adults with Down syndrome: A de-facing methodological study. *Alzheimer's Dement.* 2026;22:e71614.

<https://doi.org/10.1002/alz.71614>

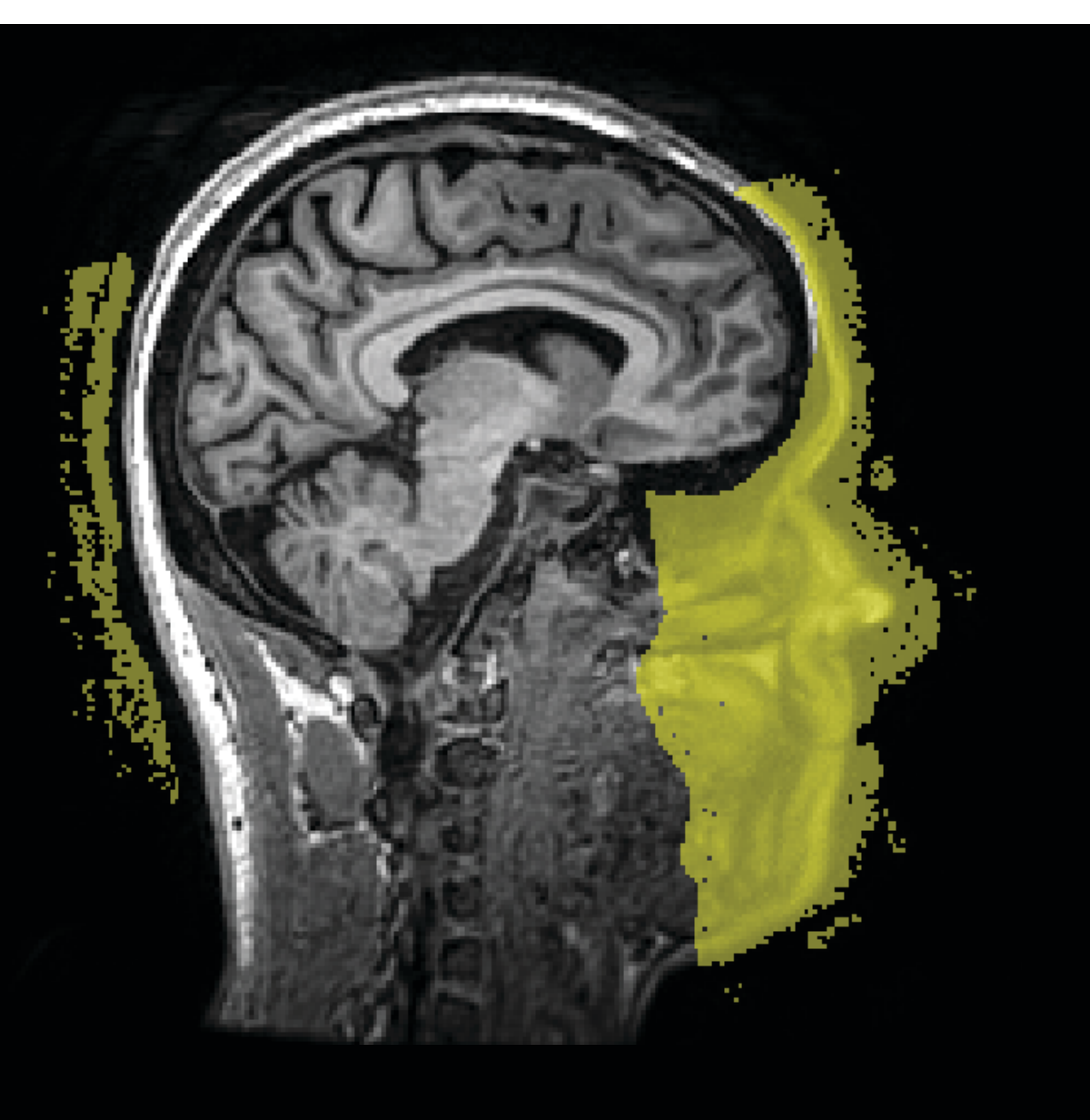


Figure 1. *mri_reface* method

Shown are the voxels that are altered by *mri_reface* (in yellow) following refacing with *mri_reface*

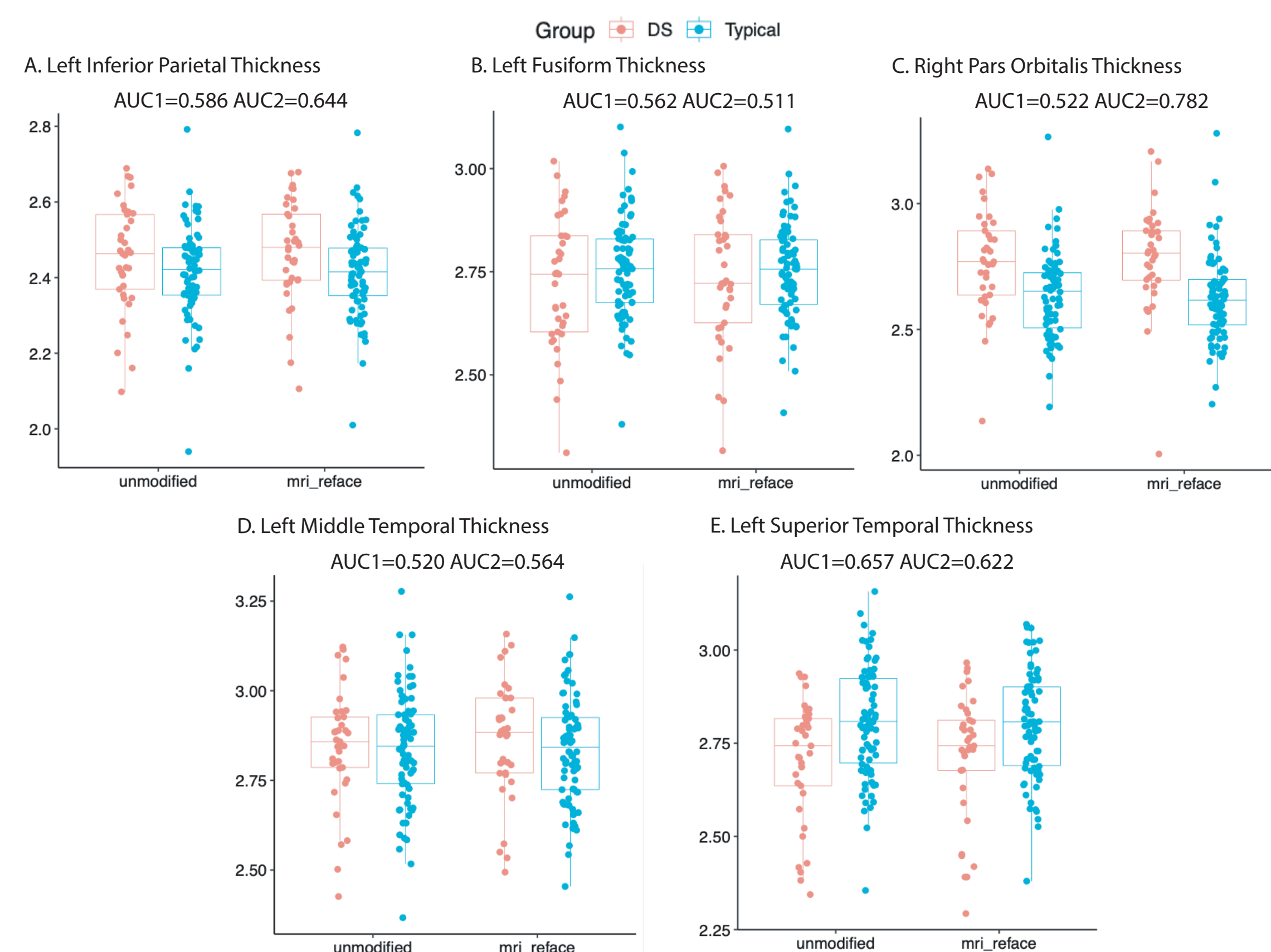


Figure 3. Regions with largest AUROC differences following de-facing are regions with low AUROCs

Shown are the regions with the largest differences in AUROC following de-facing: Left inferior parietal thickness ($p = 0.022$, $p.adj = 0.0763$) (A), left fusiform thickness ($p = 0.027$, $p.adj = 0.0973$) (B) right pars orbitalis thickness ($p = 0.027$, $p.adj = 0.0973$) (C), left middle temporal thickness ($p = 0.026$, $p.adj = 0.861$) (D) and left superior temporal thickness ($p = 0.029$, $p.adj = 0.889$) (E)

Figure 4. Regions with the largest discriminability between DS and TD participants were unaffected by de-facing

Shown are the regions with the largest AUROCs discriminating DS and TD participants pre- and post-de-facing: Right rostral anterior cingulate grey matter volume (A), left rostral anterior cingulate grey matter volume (B) left medial orbitofrontal thickness (C), left lateral orbitofrontal thickness (D) left parahippocampal grey matter volume (E), and right parahippocampal grey matter volume (F). Effect of de-facing: all $p.adj = 1.0$

