Supplementary Data for:
False Positive Rates in Surface-based Anatomical Analysis

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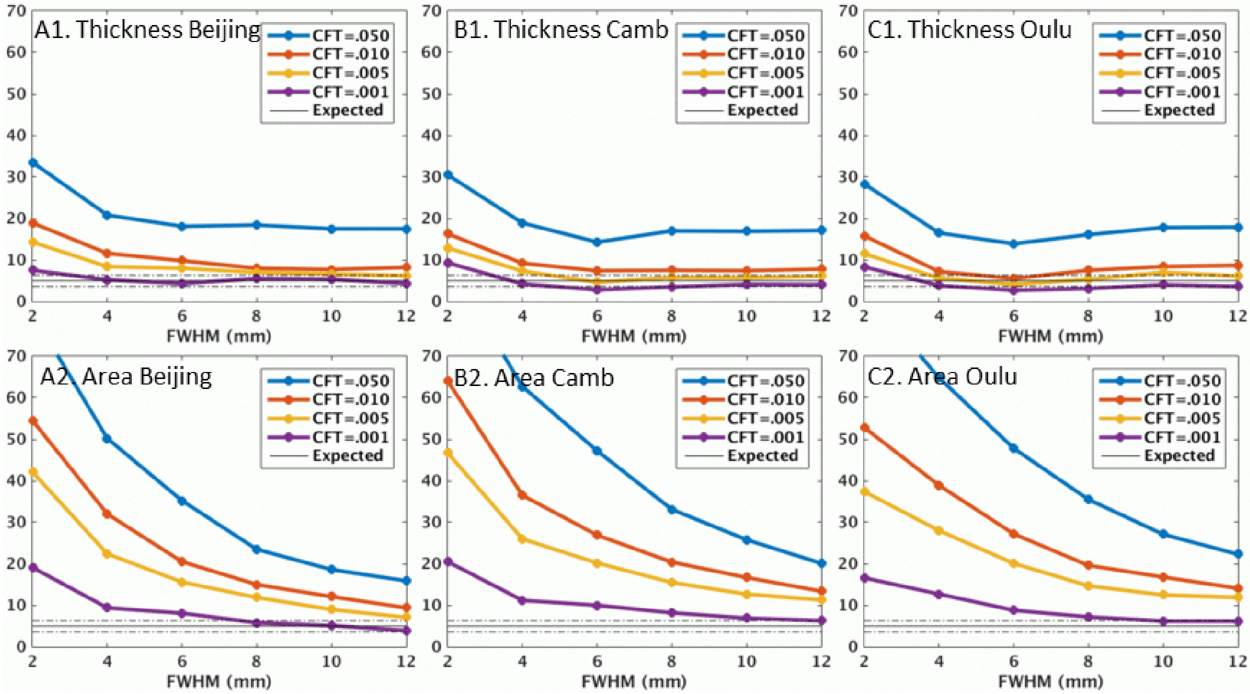

Figure S1. Comparison of MCZ FPRs (%) across site (Camb=Cambridge) for thickness and surface area. FWHM is the full-width/half-maximum of the applied smoothing kernel. CFT is the cluster forming threshold. This figure shows the similarity of the results across scanning site. Dashed lines are the 95% confidence interval around the ideal 5% value.

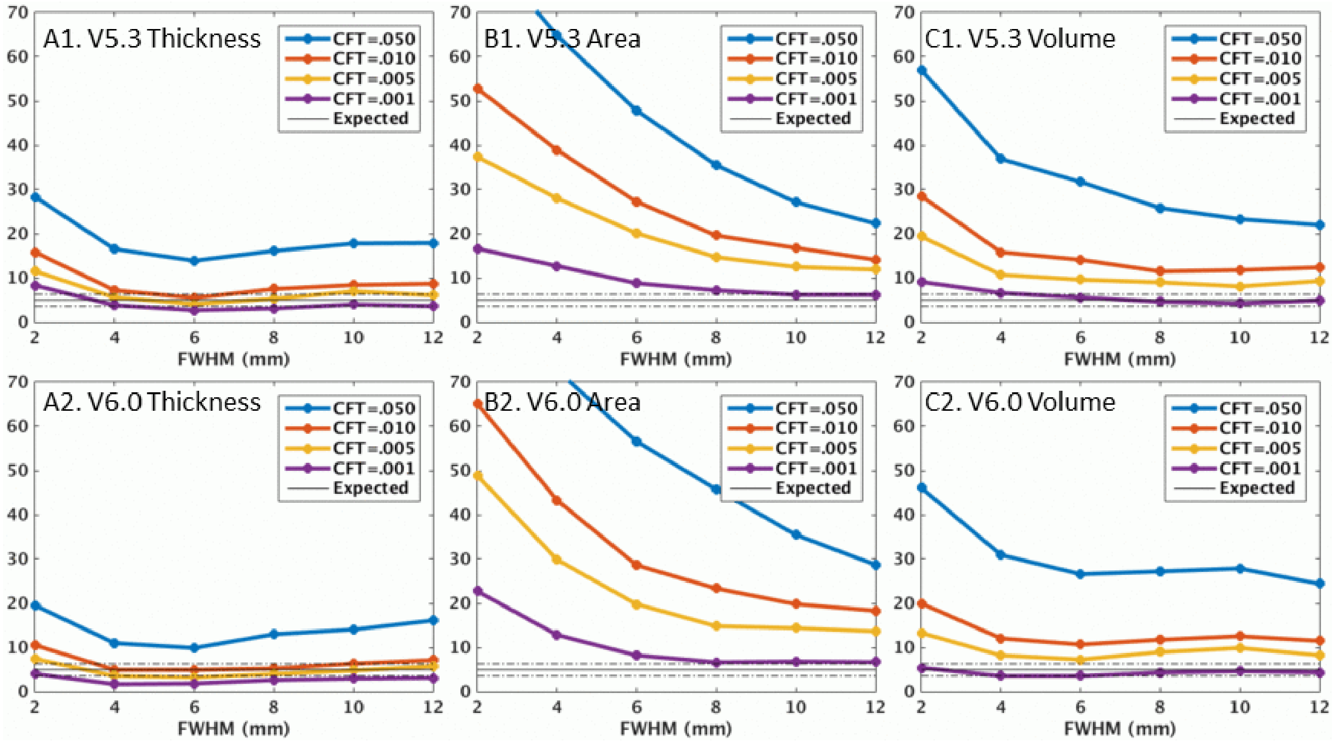

Figure S2. Comparison of MCZ FPRs (%) across FreeSurfer version (5.3 vs 6.0) for thickness, surface area, and volume for the Oulu data set. FWHM is the full-width/half-maximum of the applied smoothing kernel. CFT is the cluster forming threshold. This figure shows that the two versions give very consistent results. Dashed lines are the 95% confidence interval around the ideal 5% value.

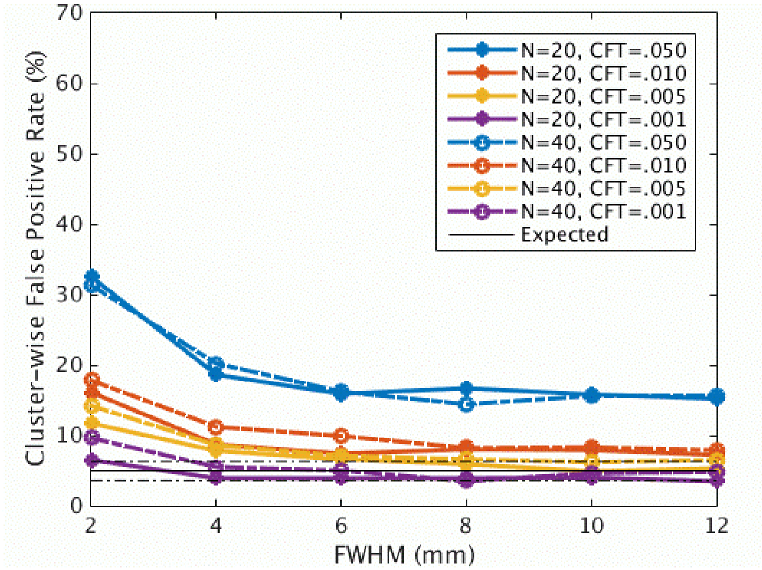

Figure S3. Comparison of MCZ thickness FPRs (%) for different number of subjects in the group (20 or 40) using the Beijing data set. FWHM is the full-width/half-maximum of the applied smoothing kernel. CFT is the cluster forming threshold. This figure shows that the FPRs change very little when the number of subjects is doubled. Dashed lines are the 95% confidence interval around the ideal 5% value.

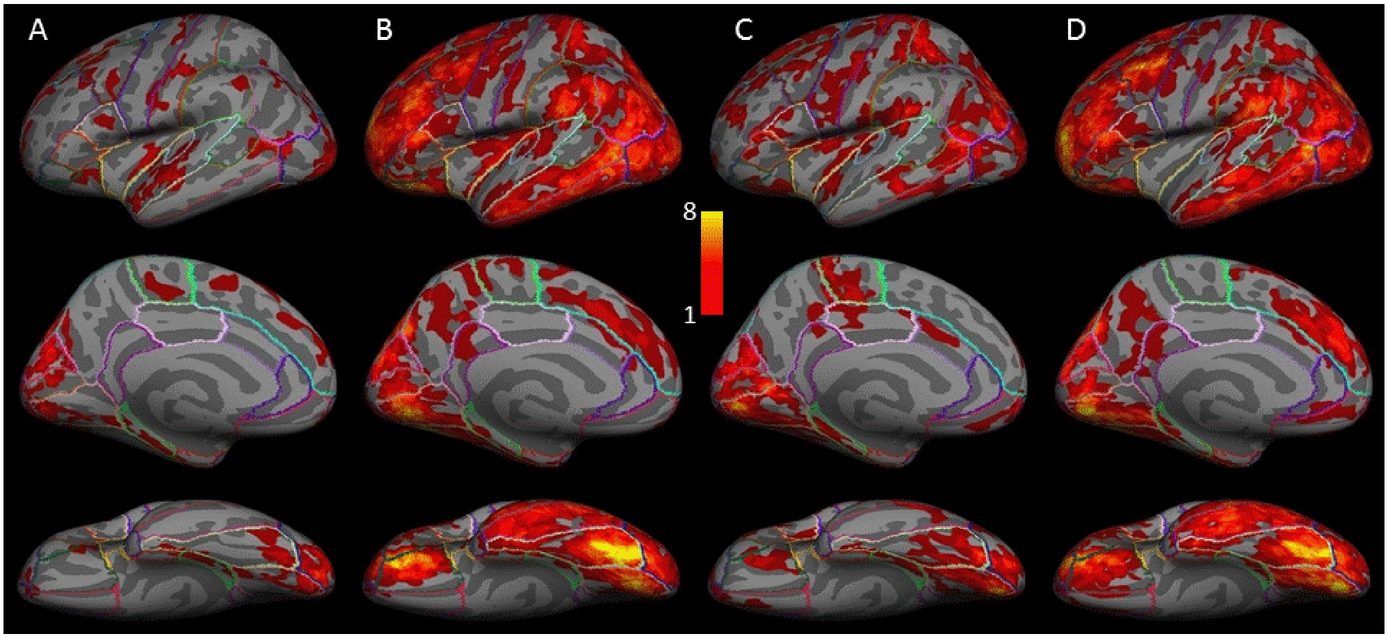

Figure S4. MCZ Cluster frequency map for Beijing, N=20, FWHM=6mm, CFT=.01 displayed on the inflated average surface (fsaverage). A. Thickness, B. Surface Area, C. Volume, D. JAC. The value indicates the number of clusters at that point out of 1000.

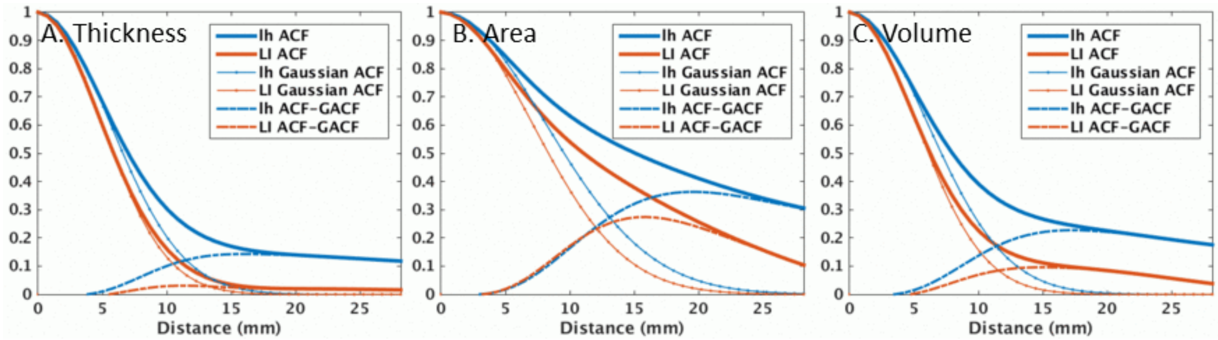

Figure S5. ACFs of the Beijing set 806 with 6mm of applied smoothing for ipsilateral (lh) or cross-hemispheric (LI) analysis. A: Thickness, B: Surface Area, and C: Volume. The Gaussian ACFs are based on the estimated FWHMs. The dashed lines are the difference between the measured ACF and the ideal Gaussian ACF and are a measure of non-Gaussianity (heavy-tailedness). For thickness, the non-Gaussianity of the LI analysis is much less than that of the lh analysis at radii of 5mm and beyond. For surface area, LI does not become less heavy-tailed until about 12mm. For volume, the two diverge at around 5mm, but the tail of the LI analysis is still heavier than that of the thickness analysis. So, in all cases the LI analysis makes the ACF less heavy-tailed, but it is much more effective for thickness than for area which is why the thickness MCZ FPRs get better with LI and they do not for surface area. Distance is the distance along the surface.

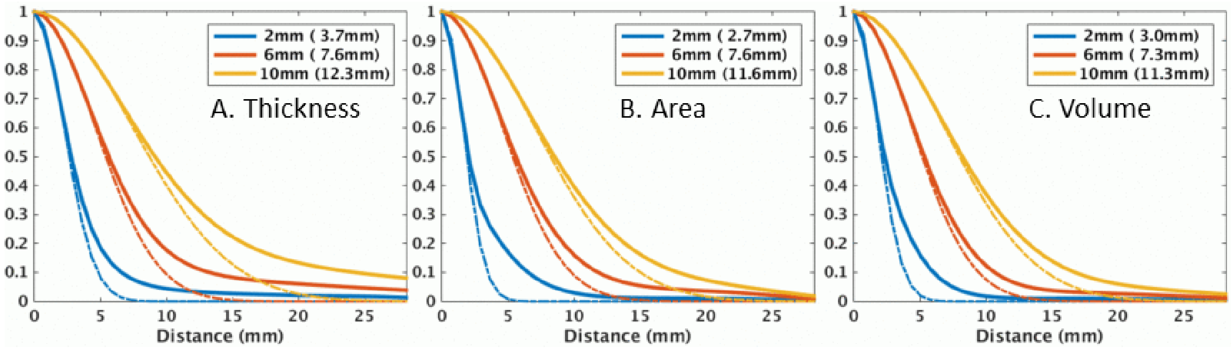

Figure S6. ACFs for simulation subject sub08816 for applied smoothness levels of 2, 6, and 10mm. A: Thickness, B: Surface area, C: Volume. Estimated FWHMs are in parentheses. The dashed lines are the ideal Gaussian ACFs based on the estimated FWHMs. This data was generated from 20 data sets where each data set was the T1 MRI from sub08816 with white Gaussian noise added. Each data set was anayzed in FreeSurfer and mapped into the common surface space where it was analyzed with a one-sample group mean GLM. Residuals were extracted and used to compute the ACFs shown. This analysis is meant to measure the smoothness induced by smoothness constraints in the surface placement. The heavy-tailedness and overall smoothness are much less than when different subjects are used (cf. Figures 4A, 4B, and 4C in the main text) indicating that the smoothness constraints are not to blaime for heavy-tailedness in the group analysis. Also note that area and volume do not differ much from thickness. This is because the effects of Jacobian correction will be subtracted out since all the underlying data will have about the same Jacobian correction. Distance is the distance along the surface.

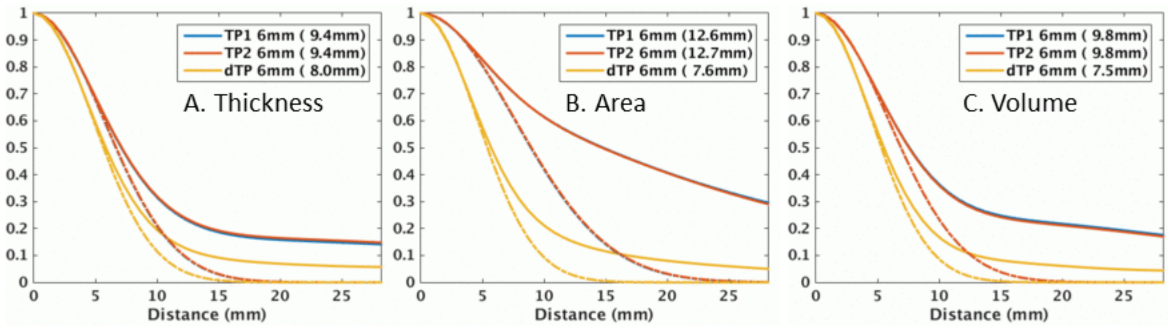

Figure S7. ACFs of longitudinal MIRIAD data (N=20) with 6mm of applied smoothing. A: Thickness, B: Surface Area, and C: Volume. TP1: Time Point 1. TP2: Time Point 2. dTP: TP1-TP2. Estimated FWHMs are in parentheses. The dashed lines are the ideal Gaussian ACFs based on the estimated FWHMs. In some cases, TP1 is hard to see because it overlaps so closely with TP2. TP1 and TP2 were analyzed independently in FreeSurfer. TP1 and TP2 are two volumes from the same scanning session, so there will be no true anatomical differences between them. The similarity between TP1 and TP2 attest to the repeatability. The ACFs for TP1 and TP2 are very similar to that of the Beijing 806 data set in Figure 4 of the main text showing heavy, non-Gaussian tails for all three measurements, but especially for surface area. However, when the difference between the two time points is analyzed, the ACFs become much more Gaussian, and area and volume become quite similar to thickness. This is consistent with the idea that the heavy-tails are caused by anatomical features that are unique to each individual which then get subracted out during the longitudinal analysis. Distance is the distance along the surface.

FWHM(mm)	CFT=.050	CFT=.010	CFT=.005	CFT=.001
2	0.00040	0.00480	0.00700	0.02900
4	0.00200	0.01440	0.01840	0.04500
6	0.00320	0.01880	0.02120	0.05920
8	0.00160	0.02140	0.02980	0.03940
10	0.00120	0.02200	0.03360	0.04440
12	0.00040	0.01700	0.03120	0.05880

Table S1. Table of maximum nominal MCZ cluster p-value that allows for the actual cluster p-value to be .05 or better for thickness analysis. This is a table version of the plots in Figure 2A in the main paper.

FWHM (mm)	CFT=.050	CFT=.010	CFT=.005	CFT=.001
2	0.00020	0.00020	0.00020	0.00060
4	0.00020	0.00020	0.00020	0.00880
6	0.00020	0.00040	0.00160	0.02080
8	0.00020	0.00300	0.00700	0.03860
10	0.00020	0.00600	0.01720	0.04960
12	0.00020	0.00920	0.02520	0.05880

Table S2. Table of maximum nominal MCZ cluster p-value that allows for the actual cluster p-value to be .05 or better for surface area analysis. This is a table version of the plots in Figure 2B in the main paper.

FWHM(mm)	CFT=.050	CFT=.010	CFT=.005	CFT=.001
2	0.00020	0.00020	0.00140	0.00880
4	0.00020	0.00320	0.01380	0.05080
6	0.00020	0.00500	0.01320	0.04560
8	0.00020	0.00760	0.01860	0.05000
10	0.00020	0.00940	0.02100	0.06200
12	0.00020	0.01380	0.02340	0.06660

Table S3. Table of maximum nominal MCZ cluster p-value that allows for the actual cluster p-value to be .05 or better for volume analysis. This is a table version of the plots in Figure 2C in the main paper.