A Descriptive Atlas of the Common Marmoset Cortex Based on Anatomical MRI

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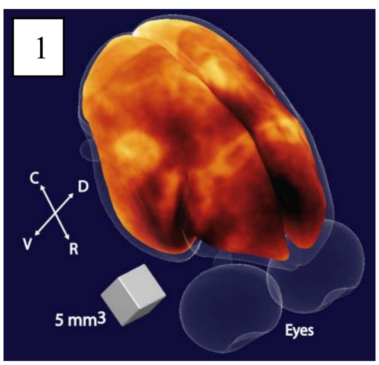
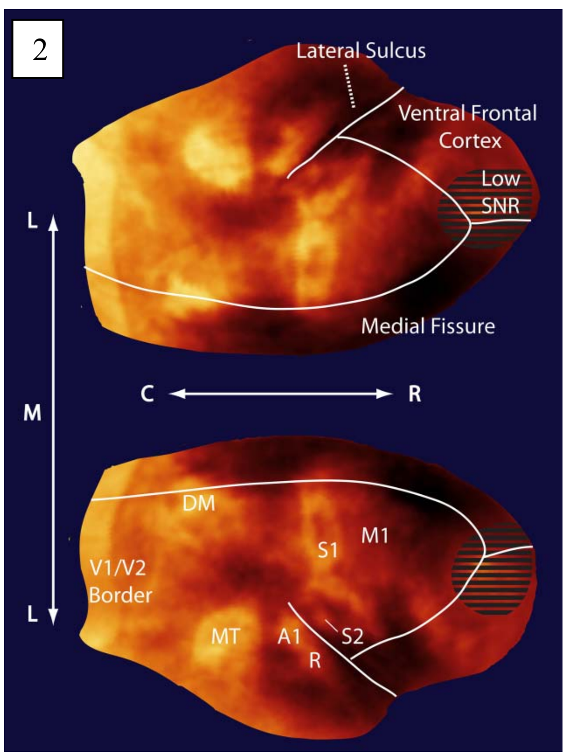
With advances in image quality and resolution, MRI can increasingly visualize the rich anatomical detail of the cortex to make brain atlases. One feature that is often used in histology to identify specific cortical regions is the pattern of myelination over the cortex[1,2,3,4]. We have previously shown an optimized 3D T_1-weighted pulse sequence which produces image enhancement correlated with areas of high cortical myelin density[5]. Here, we use images made with this sequence to create a descriptive atlas of the cortex in common marmoset monkeys (Callithrix jacchus).

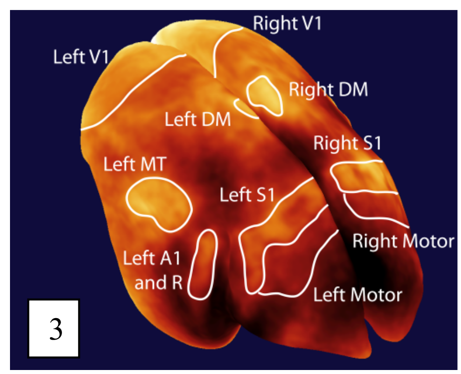
For our atlas, we imaged two 3-year old and two 8 year-old live female marmosets using a heavily T_1-weighted 3D MP-RAGE sequence on a 7 Tesla MRI scanner. We imaged the entire brain in 3D at an isotropic resolution of 150 µm. To visualize the data, we defined a digital surface through a middle depth of the cortex where the degree of myelination is greatest and displayed the MRI data at that depth on the surface using an orange colourmap to highlight contrast (**Figure 1**). To better appreciate the spatial relationships between regions, we flattened the cortical surface for display (**Figure 2**). Finally, we returned to the 3D dimensional surface to make distortion-free measurements of surface areas of given regions (**Figure 3** and **Table**).

Using MRI, we have produced an atlas which shows the entire cortical surface in the marmoset monkey and describes important regions based on their location and surface area. The atlas highlights the large percent of the marmoset cortex dedicated to primary visual tasks (22%) versus somatosensory (3%) and auditory (1%). It also serves as an important reference for marmoset and comparative neuroanatomy studies. In the future, our method can be used to produce cortical atlases in other species and in humans.





Cortical anatomy key: V1 = primary visual, S1 = primary somatosensory, A1 = primary auditory, R = rostral auditory, S2 = secondary somatosensory, M1 = primary motor cortex, MT = middle temporal, DM = dorsomedial



Region	Surface Area (mm)
Left Cortex	1005 ± 21
Left V1	219 ± 12
Left Motor	36 ± 2
Left S1	28 ± 4
Left MT	17 ± 3
Left A1 and R	11 ± 3
Left DM	8 ± 1
Right Cortex	1007 ± 34
Right V1	222 ± 3
Right Motor	37 ± 3
Right S1	30 ± 4
Right MT	19 ± 2
Right A1 and R	11 ± 3
Right DM	7 ± 1

n = 4

References:

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