

## The Allen Institute mouse brain gene expression data co-aligned with a mouse MRI atlas

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### Introduction

The Allen Institute for Brain Science recently created a digital atlas containing the expression patterns of ~ 20,000 genes in the adult mouse brain[1]. These gene expression maps provide a powerful data source for studies in brain structure and function. There has also been a concomitant increase in the use of MRI to phenotype novel mouse models. The goal of the project described herein was thus to co-register the Allen Institute reference atlas with an existing MRI atlas in order to enable the MR research community to use gene expression maps to aid in the interpretation of MRI mouse brain imaging results.

### Methods

We chose a model-independent atlas of 20 male and 20 female 12 week old C57Bl/6 mice as the target MR for the registration. This dataset was acquired using fixed brains in their skulls with T2 FSE scans at 32 $\mu$ m isotropic voxels, has previously been segmented into 62 anatomical structures[2] and is publicly available at [www.mouseimaging.ca](http://www.mouseimaging.ca). The Allen Institute reference atlas consists of a stacked set of coronal Nissl stained histology slices linearly aligned to minimize movement between neighbouring slices.

The alignment proceeded as follows. An outline of the brain was created for each of the two datasets and brought into correspondence using a linear transform. To cope with the contrast differences between Nissl stained slices and T2 weighted MRIs the pre-existing segmentations for each dataset were employed to create a novel map of corresponding structures (i.e. cortex given a label of 1, striatum of 10, etc.), which was then blurred with a 0.5mm Gaussian kernel. An elastic non-linear transform[3] was then used for a more detailed alignment of the two atlases. The resulting alignment is shown in Fig 1 along with one sample gene expression map of the dopamine D2 receptor.

The final step was the creation of a file-converter for the Allen Institute sparse volume file format. Gene expression maps are available through the Allen Brain Atlas website (i.e. [http://www.brain-map.org/aba/api/expression/\[ImageSeriesID\].sva](http://www.brain-map.org/aba/api/expression/[ImageSeriesID].sva)).

### Discussion

Any MR study wishing to use the Allen Institute gene expression maps can thus use the following procedure: (1) Bring the MRIs of their study into alignment with the C57Bl/6 MRI atlas available at [www.mouseimaging.ca](http://www.mouseimaging.ca). (2) Chose the desired gene expression maps at [www.brain-map.org](http://www.brain-map.org) and download their sparse volume files. (3) Convert the sparse volume files to full 3D volumes and apply the transform described above to bring them into alignment with the C57Bl/6 atlas. The file converter and transform to align gene expression maps with the C57Bl/6 MRI atlas will all be made freely available at [www.mouseimaging.ca](http://www.mouseimaging.ca). We hope that this will prove to be a valuable resource for the community.

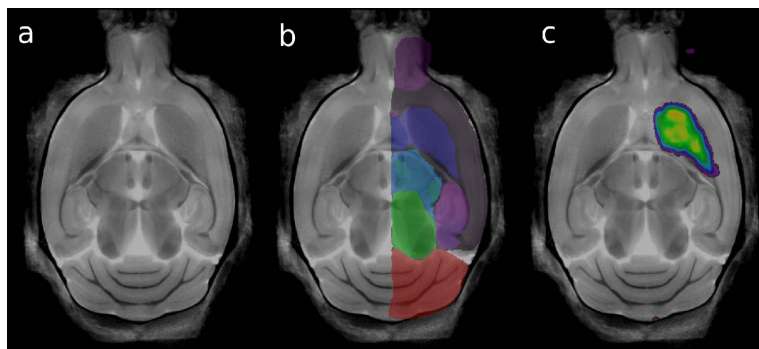


Figure 1: (a) the C57Bl/6 MRI atlas; (b) Allen Institute brain structure segmentation after alignment to the MRI atlas; (c) the dopamine D2 receptor gene expression map after alignment to the MRI atlas.

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