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Experiment name:

Brain Imaging of Normal Subjects (BRAINS) age-specific MRI atlases from young adults to the very elderly (v1.1)

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Description:

Atlas subjects and methods

We have developed seven age-specific atlases of T1 brain MRI from 25 to 92 years. The number of subjects and age band of each atlas are summarised in the table below. The classification of these subjects as “normal” is supported by a large battery of medical and cognitive tests^{1, 2, 6}.

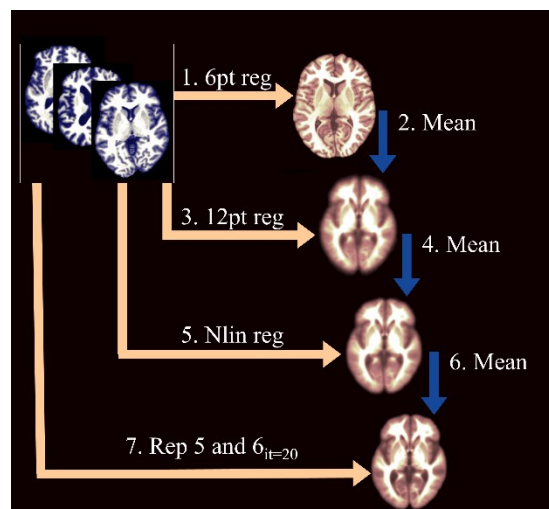
Group Name	Age (years)	N
Group00001	25-34	20
Group00002	35-44	24
Group00003	45-54	23
Group00004	55-64	13
Group00005	71-74	47
Group00006	75-78	50
Group00007	91-93	48

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The mean T1 intensity atlases for each age band were created by following a validated and widely used protocol³. Briefly, within each age band,

1. All subjects were 6pt (rigid body) registered to a randomly selected subject
2. A T1 intensity average of the results from step 1 was taken
3. All subjects were 12pt registered to the average T1 image from step 2
4. A T1 intensity average of the results from step 3 was taken
5. All subjects were nonlinearly registered to the average T1 image from step 4
6. A T1 intensity average of the results from step 5 was taken
7. Steps 5 and 6 were repeated for a total of 20 further iterations (it).

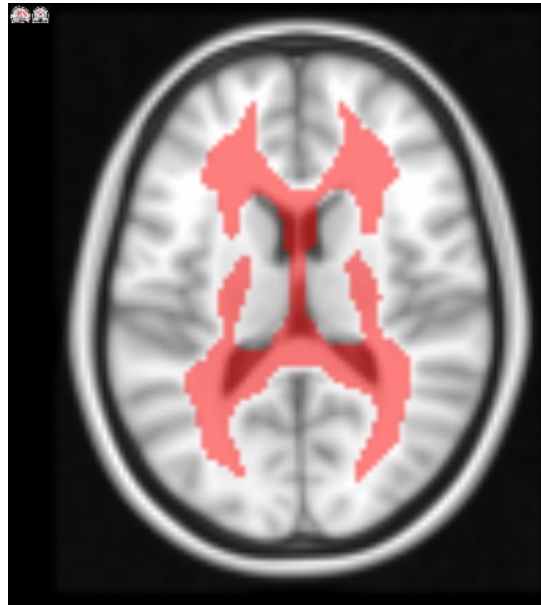
This process is illustrated in the figure below.



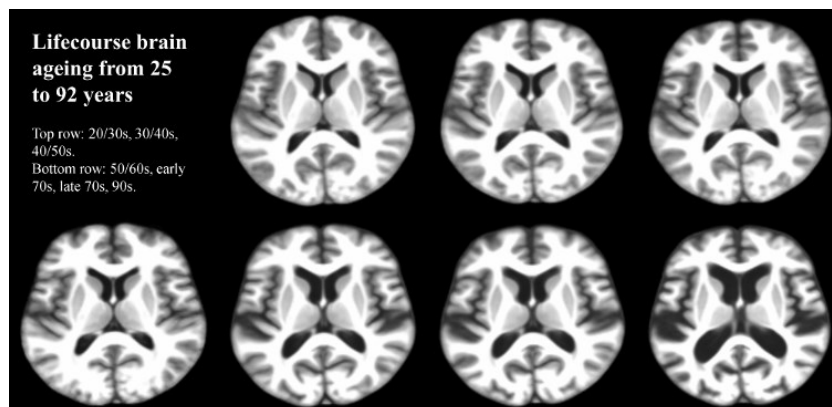
Grey matter (GM), normal appearing white matter (WM), and cerebrospinal fluid (CSF) tissue maps were estimated in the native space of each subject using T1 voxel neighbourhood information and atlas based correction which may assist in successful segmentation of elderly brains^{4,5}. T1 hypointensities in the white matter incorrectly classified as GM were removed by defining a standard space region mask where GM almost universally does not occur, e.g., in the occipital caps of the lateral ventricles. This mask, shown in the figure below, was then nonlinearly warped to each subject and applied to their GM mask. Probability maps for each tissue within each age band were estimated by 12pt registering each individual tissue mask to

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the finally derived average T1 image within their age band and calculating the mean tissue probability in each voxel.



The finally derived average T1 images from each age band are summarised in the figure below.



Funding & Data sources

The 25-64 year data⁶ were acquired through NIH grant R01 EB004155-03 (PI: Dr Mark E. Bastin), the 71-93 year data were acquired as part of the Lothian Birth Cohort^{1,2,7} (PIs: Prof Ian J. Deary, Dr Mark E. Bastin, Prof John M. Starr, Prof Joanna M. Wardlaw) funded by a Research into Ageing program grant, the Age UK funded Disconnected Mind project, and the UK Medical Research Council. Brain Research Imaging Centre (BRIC), The University of Edinburgh funded the creation of the templates.

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Citation guidelines

Use of these atlases in conference proceedings and journal publications should be cited as,

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