THE UNIVERSITY of EDINBURGH

BRAINS
IMAGEBANK

Facilitating the reuse of brain imaging and clinical data from completed studies across the life course: the Brain Images of Normal Subjects (BRAINS) Imagebank.

Dealing with Data Conference

31st August 2015

Samuel Danso, Dominic E. Job, David Alexander Dickie, David Rodriguez, Andrew Robson, Cyril Pernet, Susan D. Shenkin, Joanna M. Wardlaw

SINAPSE Edinburgh Imaging
www.ed.ac.uk/edinburgh-imaging

The following Universities are charitable bodies, registered in Scotland, with registration numbers as below.

BRAIN RESEARCH IMAGING CENTRE Edinburgh

Scottish Funding Council
Promoting further and higher education

UNIVERSITY OF ABERDEEN SCO13683

UNIVERSITY OF DUNDEE SCO15096

THE UNIVERSITY OF EDINBURGH SC005336

University of Glasgow SC021474

University of St Andrews SC013532

UNIVERSITY OF STIRLING SC011159

CHIEF SCIENTIST OFFICE

Edinburgh & Lothians Health Foundation

BBSRC bioscience for the future

SPARKING IMPACT

Background:

❑ There is a global drive to increase value and reduce waste in research by archiving and sharing of research data.

❑ This is critical in imaging research and therefore a great demand in the use of imagebanks.

❑ Currently, nine repositories exist for brain images with 944 normal subjects aged ≥60 years in total, but only 98 subjects are openly accessible.

❑ The Brain Images of Normal Subjects (BRAINS) Imagebank:

   ✓ an integrated repository project being developed by a team based in the Edinburgh University.

   ✓ provides detailed brain imaging data across the normal human life-course from completed research projects : MRI sequences linked with related phenotypical, demographic and cognitive measures, without diagnosed disease.

Framework:

Original Data Area

Original images

Original textual data

Staging Area

Light de-identified DICOM

Database with de-identified textual data and DICOM headers

Pre-processing: cleaning, mapping and harmonisation of textual data

Public Area

Strongly de-identified DICOM and textual data hosted in XNAT

Access-controlled web interface via REST data load

Ethics & Governance:

❑ **Ethical approval was obtained from Caldicott Guardian which was described as "an exemplar for data sharing".**

❑ **User account registration and validation.**

❑ **Data access request and usage agreement.**

❑ **Data contribution agreement.**

❑ **Steering Committee:**

- **principal investigators of the original studies;**

- **experts in ethics, governance and law;**

- **two lay representatives or other relevant persons and/or bodies.**

BRAINS Imagebank

This is an early beta/ test release of BRAINS imagebank. This means

- We are not currently accepting requests for data. The data request process is for illustrative purposes only
- Availability of the website during the beta is not guaranteed.

For further information see the Contact Us page

The BRAINS imagebank is collating anonymised images and associated clinical data from 'normal' individuals at all ages (from prenatal to old age). These have been collected from participants in several healthy volunteer studies. BRAINS only includes information that the original study team have provided: additional data may have been collected (see Data Provenance for full details of the primary studies). The BRAINS team based in the University of Edinburgh hosts the data, on behalf of, and under the governance of, a steering committee which comprises: principal investigators of the original studies (including experts in obstetrics, paediatrics, geriatrics, neuroimaging, psychology); experts in ethics, governance and law, and two lay representatives (the "BRAINS Steering Committee"). All applications for data use will be reviewed and approved (or not) by the BRAINS Steering Committee. BRAINS provides a resource that offers numerous opportunities to reuse already collected data for studies across the life span with no additional data acquisition cost required. Examples of potential studies include:

- As a reference atlas, for interpretation of brain images in clinical diagnosis, such as having access to healthy subject reference images and linked data closely matched to a patient's scan, to improve diagnostic accuracy (Farrell, C. et al., 2009)

- For the biomedical research community to develop and test new methods, e.g. machine learning, to detect brain pathology and associated clinical manifestations such as early markers of neurodevelopmental impairment or dementia; and precise estimates of disease risk and developmental ranked atlases across the life-course (Dickie, D.A., et al., 2013).

BRAINS atlases are based on calculated distributions of brain structure rather than parametric estimates. These will be used to support image analysis research and clinical reporting of brain images.
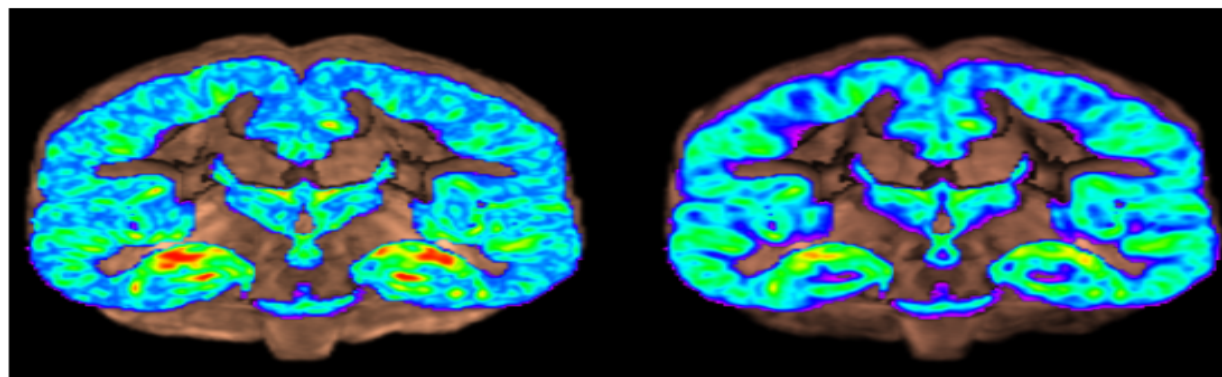
TODO- provenance of this image needs to be cited or the image should be replaced

This image shows that the appearance of brain structure in a group of subjects diagnosed with Alzheimer's disease (AD) versus a normal control group changes based on the method used. The image on the left shows voxel-wise parametric effect size and the image on the right shows voxel-wise NONparametric effect size (red areas = higher effect sizes > 0.75). If the voxel-wise data were Normally distributed then the parametric effect size would equal the NONparametric effect size. However, these voxel distributions are not Normally distributed

1 Find subjects matching ...

Age at scan	from	[ ]	to [ ]	To limit by age (in years)
Sex		All ▼		Select sex or choose All
Systolic Blood Pressure	from	[ ]	to [ ]	To limit by Systolic BP
Diastolic Blood Pressure	from	[ ]	to [ ]	To limit by Diastolic BP
BMI		None selected ▼		To limit search by BMI select one or more ranges

2 Only include subjects with following data...

☑ T1 ☑ T2 ☑ T2* ☑ T1 GRE ☑ FLAIR   **Any** of the selected sequence types

☐ Cognitive Screening
Only subjects with cognitive screening data e.g. MMSE

☐ Cognitive Domain
Only subjects with cognitive domain data e.g. Logical memory, Verbal fluency

☐ Mood
Only subjects with mood related data e.g. Hamilton Rating Scale, Hospital Anxiety and Depression Scale

☐ General Intelligence
Only subjects with general intelligence data e.g. NART, Moray House test

☐ Handedness
Only subjects with known handedness

☐ Occupation
Only subjects with known occupation

☐ Years of formal education
Only subjects with known number of years of formal education

☐ Smoking status
Only subjects with known smoking status

☐ Alcohol use
Only subjects with known alcohol use

3 Exclude subjects with...

☐ Prior Stroke ☐ Hypertension ☐ Diabetes   Select to **exclude** subjects known to have specified conditions

🔍 Search

Status:

❑ Currently, 584 subjects (average age: 61.3, SD: 15.7, range: 19 - 81) from projects in 3 centres.

Study Name	Centre	N	T	Age years	Sequences and (sequences to be added)
Simpsons study	Edinburgh	110	2.0	75-81	T2, T1, T2*, FLAIR
ABC 1936	Aberdeen	244	1.0/1.5	77-80	T2, T1, FLAIR
PSOBID	Glasgow	42	3.0	20-60	T2, T1
Amygdala 2	Edinburgh	55	1.5	19-60	T2, T1, (fMRI)
NIH-DTI	Edinburgh	88	1.5	25-65	T2, T1, T2*, FLAIR, (DTI)
Glasgow-HV45	Glasgow	45			
		584			

❑ A further 2119 existing sets of data planned for immediate inclusion.

Conclusion & ongoing work:

❑ BRAINS provides a resource that offers numerous opportunities to reuse already collected data for studies across the life span with no additional data acquisition cost required.

❑ It is the first imagebank that provides detailed brain imaging with associated clinical linked data across the normal human life-course.

❑ Continue to process and add more data from studies of different populations and geographical locations.

❑ To produce brain templates for clinical research.

❑ Acting as a Dementia Platform UK cohort node.

Contact:

- Please visit , use it and let us know:

Website: www.brainsimagebank.ac.uk

Email: brains@ed.ac.uk

References:

❑ Job, D. E., Dickie, D. A., Rodriguez, D. R., Robson, A., Pernet, C., Bastin, M., Boardman, J. P., Murray, A. D., Ahearn, T., Waiter, G. D., Staff, R.T., Deary, I. J., Shenkin, S. D. and Wardlaw, J.M. (2015). A brain imaging repository of normal images across the life course: Brain Images of Normal Subjects (BRAINS). *NeuroImage* (submitted)

❑ Dickie, D. A., Job, D. E., Gonzalez, D. R., Shenkin, S. D., & Wardlaw, J. M. (2015). Use of Brain MRI Atlases to Determine Boundaries of Age-Related Pathology: The Importance of Statistical Method. *PloS one*, *10*(5), e0127939.

❑ Dickie, D. A., Job, D. E., Poole, I., Ahearn, T. S., Staff, R. T., Murray, A. D., & Wardlaw, J. M. (2012). Do brain image databanks support understanding of normal ageing brain structure? A systematic review. *European radiology*, *22*(7), 1385-1394.