Strategic Promotion of Ageing Research Capacity

Cognitive Ageing

Brain imaging | Machine learning | Visual perception | Learning

In Search of Biomarkers: Multimodal Imaging

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The Investigation

Objectives

A core challenge in human cognitive ageing is to understand the mechanisms that lead to rapid cognitive decline in some older adults while others maintain high levels of cognitive performance. We propose to identify biomarkers of cognitive ageing by developing sensitive tools for the measurement and analysis of age-related changes in behaviour, brain structure and neural function. In particular we will investigate the links between brain structure and function that mediate the ability of the ageing brain to interpret and make categorical decisions about novel sensory experiences. How does the human brain adapt to unfamiliar situations and decide on the interpretation and classification of novel perceptual experiences that have not been honed by evolution and development? How are these cognitive processes affected by ageing?

Plan

We aim to develop new tools for cognitive ageing research by combining advanced mathematical approaches (i.e. machine learning) for the analysis of biological data (behavioural performance, functional brain activations) with multimodal brain imaging techniques (structural MR, functional MRI, EEG) and behavioural methods. This integration of advanced measurement and analysis methods will allow us to develop new sensitive tools for studying the variability of cognitive ageing across individuals from rapid decline to sustained high levels of performance.

Resources

Birmingham University Imaging Centre (BUIC):
3T Philips scanner, MR-compatible EEG
Collaborators & Partners at University of Birmingham:
Professor Reinhard Heun, School of Psychiatry
Dr. Peter Praamstra, School of Psychology

References

Kourtzi Z, DiCarlo JJ (2006) Learning and neural plasticity in visual object recognition. *Current Opinion in Neurobiology,* 16, 152-8.

Lu Y, Bagshaw AP, Grova C et al (2006) Using voxel-specific hemodynamic response functions in EEG-fMRI data analysis. *Neuroimage* 32, 238 – 247.

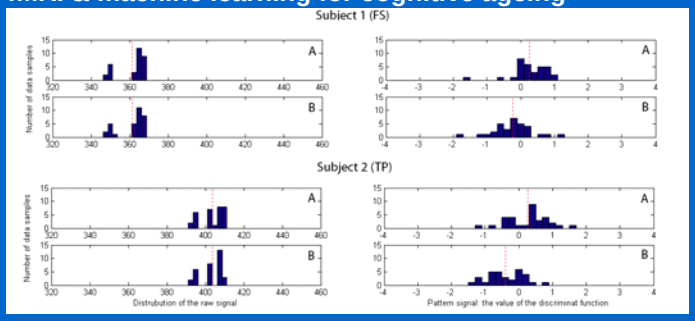
Potential Benefits

For older people and society

Our methods and findings will provide new insights in understanding life-long learning and cortical plasticity and will be potentially useful for early diagnosis and intervention in normal and pathological ageing (e.g. mild cognitive impairment, dementia, Alzheimer's).

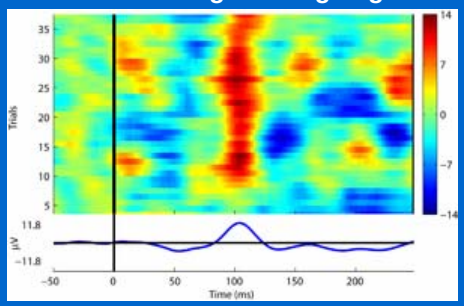
Feasibility and Current Developments

fMRI & machine learning for cognitive ageing



Distributions of average fMRI vs. pattern signals for classification of two stimulus categories (A, B).

EEG tools for cognitive ageing



EEG data (electrode O2) recorded during continuous fMRI scanning at 3T (BUIC). The upper panel shows colour coded single trial data and the lower the mean evoked potential to a full field flickering (2Hz) checkerboard.

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