Large-scale, multimodal imaging: the CamCAN example

Rik Henson
MRC CBU
Cognestic Summer School, Sep 2022
• People are living longer, and the proportion of most world populations that are in “old age” is increasing

• Ageing brings cognitive problems, owing to brain changes, so understanding how ageing of the brain affects cognition might help us maintain cognitive abilities for longer, and so help people function independently for longer

• Brain structure and function can be measured in many ways (sMRI, fMRI, DTI, MEG…) and relating to individual differences requires large samples…

… a “large-scale, multi-modal” approach…
“Crystallised” Intelligence  
“Fluid” Intelligence  
“Episodic” Memory  

CamCAN
More than Brain Structure?

=> *functional* connectivity/reorganisation/compensation…?
• MRI has been used for many years to study brain ageing
• **Structural** MRI (sMRI) measures (static) brain anatomy
• **Functional** MRI (fMRI) measures dynamic activity / connectivity, eg related to specific cognitive functions
• However, fMRI response is a function of 1) **neural** and 2) **haemodynamic** characteristics (vasculature)…
• …and ageing likely to affect both
• Furthermore, haemodynamics are **slow** (seconds)…

• MEG (and EEG) provide direct measure of **neural** activity…
• … at millisecond resolution, revealing rich repertoire of oscillatory activity above 0.1Hz (fMRI)
• MEG has greater spatial degrees of freedom than EEG, ie., can resolve more nodes/states
- 2010: ~2700 recruited after ~9000 calls (opt-out), so population-derived 2-hour home interview (eg, lifestyle)

- 2011: 100 per decade 18-88, from 3000 ~7 hours of cognitive tests 1 hour MRI (T1, T2, DTI, MTR, fMRI) 0.5 hour of MEG

- 2016: data released – over 1500 downloads, over 100 publications:
  https://camcan-archive.mrc-cbu.cam.ac.uk/dataaccess/

http://www.cam-can.org/
Cambridge Centre for Ageing and Neuroscience

Cam-CAN Data Repository

The data repository for the Cambridge Centre for Ageing and Neuroscience (Cam-CAN) dataset can be found here

Data Access Portal

Worldwide Usage

The CamCAN dataset has been requested by over 1000 researchers worldwide (number last updated 26/01/2022; map last updated 11/05/2020).
CamCAN Data Use Agreement

I request access to data collected by the Cambridge Centre for Ageing Neuroscience (CamCAN) for the purpose of scientific investigation, teaching or the planning of clinical research studies and agree to the following terms:

1. I will receive access to de-identified data and will not attempt to establish the identity of, or attempt to contact, any of the CamCAN participants.
2. I will not further disclose data beyond the uses outlined in this agreement.
3. I will use the data only for the purposes of non-commercial, ethical research or teaching specified in this application and to seek the approval of CamCAN (via the CamCAN Administrator) for any other proposed use.
4. I will require anyone on my team who utilizes these data, or anyone with whom I share these data, to comply with this data use agreement. Note, for this reason, students should ask their supervisors to apply on their behalf.
5. I will not copy data to external storage locations (such as Dropbox, Google drive or external hard drives) and understand data must remain on my institution's server.
6. I will respond promptly and accurately to requests to update this information.
7. I will comply with any rules and regulations imposed by my institution and its institutional review board in requesting these data.
8. I understand that it is my responsibility to check data for errors, and that CamCAN is not responsible for the consequences of unreported errors in the data. I also agree to make any such errors known to CamCAN as soon as possible.
9. I understand that CamCAN cannot guarantee exclusive use of these data or police potential overlaps of interest with other researchers.
10. I agree to make any publications that arise from use of CamCAN data open-access. Any derived data and processing scripts used to produce those derived data will also be made available on a suitable open-access data repository.
11. I will acknowledge the CamCAN project as a source of data and include language similar to the following: “Data collection and sharing for this project was provided by the Cambridge Centre for Ageing and Neuroscience (CamCAN). CamCAN funding was provided by the UK Biotechnology and Biological Sciences Research Council (grant number BB/H008217/1), together with support from the UK Medical Research Council and University of Cambridge, UK.”
12. I will include language similar to the following in the methods section of my manuscripts in order to accurately acknowledge data gathering by the CamCAN investigators. Depending upon the length and focus of the article, it may be appropriate to include more or less than the example below. However, inclusion of some variation of the language shown below is mandatory: “Data used in the preparation of this work were obtained from the CamCAN repository (available at http://www.mrc-cbu.cam.ac.uk/datasets/camcan), (Taylor et al., 2016, Shafto et al., 2015). Citation: Taylor, J.R., Williams, N., Cusack, R., Auer, T., Shafto, M.A., Dixon, M., Tyler, L.K., CamCAN, Henson, R.N. (2016). The Cambridge Centre for Ageing and Neuroscience (CamCAN) data repository: Structural and functional fMRI, MEG, and cognitive data from a cross-sectional adult lifespan sample. NeuroImage. doi: 10.1016/j.neuroimage.2015.08.018.


I understand that failure to abide by these guidelines will result in termination of my privileges to access CamCAN data.

I understand that any details I enter on this website and any other communication I have with the CamCAN team will be handled according to our data use policy, and I agree for my data to be stored and used in this way.

☐ I agree to the above terms and conditions

Submit
For each dataset requested, Cognitive data will also appear separate directories. For physiological and demographic data, additional tab-delimited text file will be added to your home space containing the approved variables. Raw MRI data and all MEG conform to BIDS standard. Pre-processed MRI data are stored in aa folders for each stage in the pipeline. MRI and MEG pre-processing scripts are also available:

- **Automatic Analysis (aa)** User Master Script (UMS) for MRI
- **Automatic Analysis (aa)** Recipe (XML) for MRI
- **Automatic Analysis (aa)** User Master Script (UMS) for MEG
- **Automatic Analysis (aa)** Recipe (XML) for MEG
- MindBoggle Docker Shell Script

You will automatically get a file in your home directory called "standard_data.csv", which contains, for each of the 39281 unique CamCAN IDs (CIDO) who took the Home Interview, the participant's Age (at time of Home Interview, in years), biological Sex (Male/Female), Handedness (on Edinburgh scale from -100 to +100), whether any MRI data were acquired before or after the scanner coil change (see Data Issues tab at top of webpage) and finally what MNI TR was used (50ms or 30ms). (There are additional "participant_data.tsv" files within the BIDS folders for each imaging modality of raw data, which will contain a subset of participants who had valid data for that modality.)

The demographic data are from Stage I (Home Interview), and includes a range of interview and self-completion questionnaires designed to collect lifestyle variables, demographic data, physical and social activity etc. The lists are divided into four categories: Home Interview (homeint_prefix), Electronic Personal Assessment Questionnaire (epaq_prefix), Self-Completion Questionnaire (scq_prefix), Additional Scores (additional_prefix).

Please select the datasets and variables you would like to use from the following list:

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG</td>
<td>Imaging Data: MEG Resting state from phase II</td>
</tr>
<tr>
<td>Maxfiltered</td>
<td>Imaging Data: MEG active Sensorimotor task from phase II</td>
</tr>
<tr>
<td>No movement compensation</td>
<td>Imaging Data: MEG passive Sensory (audiospatial) from phase II</td>
</tr>
<tr>
<td>imaging_meg_mf_nocm_rest</td>
<td>Imaging Data: MEG Resting state from phase II</td>
</tr>
<tr>
<td>imaging_meg_mf_nocm_smt</td>
<td>Imaging Data: MEG active Sensorimotor task from phase II</td>
</tr>
<tr>
<td>imaging_meg_mf_nocm_pass</td>
<td>Imaging Data: MEG passive Sensory (audiospatial) from phase II</td>
</tr>
<tr>
<td>With movement compensation</td>
<td>Imaging Data: MEG active Sensorimotor task from phase II</td>
</tr>
<tr>
<td>imaging_meg_mf_rest</td>
<td>Imaging Data: MEG active Sensorimotor task from phase II</td>
</tr>
<tr>
<td>imaging_meg_mf_smt</td>
<td>Imaging Data: MEG passive Sensory (audiospatial) from phase II</td>
</tr>
<tr>
<td>imaging_meg_mf_passive</td>
<td>Imaging Data: MEG passive Sensory (audiospatial) from phase II</td>
</tr>
<tr>
<td>Transformed to default space</td>
<td>Imaging Data: MEG Resting state from phase II</td>
</tr>
</tbody>
</table>

**Requested Variables**

Submit
Scientific Publications

For CamCAN members and affiliates with approved projects, please refer to this page for publication conditions; for non-CamCAN researchers with approved access via the data-sharing portal, please refer to this page for publication conditions.

Preprints


Peer-Review

2022


2021


2020

• Vascular changes (fMRI+MEG)
• Latency effects (MEG+DTI)
• Effects of APO-E (sMRI+fMRI+MEG)
• Cognitive Reserve (sMRI+fMRI)
• Vascular changes (fMRI+MEG)
• Latency effects (MEG+DTI)
• Effects of APO-E (sMRI+fMRI+MEG)
• Cognitive Reserve (sMRI+fMRI)
1. Adjust data… e.g, adjust BOLD activation by RSFA (Tsvetanov et al., 2015)

Arthurs & Boniface, 2002
The Effect of Ageing on fMRI: Correction for the Confounding Effects of Vascular Reactivity Evaluated by Joint fMRI and MEG in 335 Adults

Kamen A. Tsvetanov, Richard N. A. Henson, Lorraine K. Tyler, Simon W. Davis, Meredith A. Shafto, Jason R. Taylor, Nitin Williams, Cam-CAN, and James B. Rowe

Kamen Tsvetanov
Effect of Age, unscaled by RSFA

Scaled by RSFA

Is RSFA scaling fair?

Vascular mediator (PulseOx/ECG/BP)

Path (c - c₁)***

Path (c - c₂) n.s.

Age

Neural mediator (MEG)

Path c ***

Path a₁ ***

Path a₂ ***

Path b₁ ***

Path b₂ *

RSFA

Vascular mediator (PulseOx/ECG/BP)

1. Adjust data… e.g, adjust BOLD activation by RSFA (Tsvetanov et al., 2015) or BOLD connectivity by mean FC (Geerligs et al., 2017)

2. …or have more complex model (e.g, Dynamic Causal Modelling, DCM)…
Resting state DCM

Connectivity Model

Dorsal Attention Network (DAN)

Default Mode Network (DMN)

Salience Network (SN)

Activity Model

\[ A = \alpha f^{-\beta} \]

Haemodynamic Model

Age
Effects of Age on DCM parameters:

Effective Connectivity (DCM)

Canonical Correlation Analysis (CCA):

Canonical Correlation Analysis (CCA):

• Standard fMRI FC is influenced by vascular health, and once you allow for vascular contributions, relationship of (neural) FC with cognition gets stronger…

• So if you want to study age effects on neural connectivity, either:
  – Adjust FC by mean FC, or independent vascular measures (BP, ECG)  
  – Or separate neural and vascular components with a model (eg DCM)  
    Tsvetanov et al (2016), Journal of Neuroscience
  – Use an non-haemodynamic measure, eg MEG…  
• Vascular changes (fMRI+MEG)
• Latency effects (MEG+DTI)
• Effects of APO-E (sMRI+fMRI+MEG)
• Cognitive Reserve (sMRI+fMRI)
Age-related delay in visual and auditory evoked responses is mediated by white- and grey-matter differences

Sensory Evoked Responses in MEG

Auditory ERFs

Visual ERFs

Price et al (2017), Nat Com
Analysis

MRI Acquisition / Pre-processing

Coregistration
MEG / MNI

Head Model
Single Shell

Multiple Sparse Priors

MEG Acquisition / Preprocessing

Trial Averages
Each Condition

Temporal Concatenation

PCA

Temporal Components

Compute Grand Average ERF

ERF Fitting

Temporal Components

2 Delay Parameters:
Constant + Cumulative

Price et al (2017), Nat Com
Correlation of Visual Constant delay and Auditory Cumulative delay surprisingly low, $R^2(504) < 1\%$, disappearing after adjusting for age...
Voxel-wise Mediation

A) Model: \(X = \text{Age}, M = \text{Mean Kurtosis}, Y = \text{Visual Constant Delay}, Cov = \text{TIV}\)

C) Model: \(X = \text{Age}, M = \text{Grey Matter}, Y = \text{Auditory Cumulative Delay}, Cov = \text{TIV}\)

\[\text{% mediation effect} = \frac{ab}{c}\]
• Age exerts differential and uncorrelated effects on visual evoked latency (constant delay) and auditory evoked latency (cumulative delay)

• White Matter integrity (MK) in optic radiation mediates effect of Age on Visual Constant delay
  – delayed transmission?

• Grey-Matter Volume (GMV) within auditory cortex mediates effect of Age on Auditory Cumulative delay
  – local computation?

• MEG reveals multiple contributions to age-related neural slowing

Price et al (2017), *Nature Communications*
• Vascular changes (fMRI+MEG)
• Latency effects (MEG+DTI)
• Effects of APO-E (sMRI+fMRI+MEG)
• Cognitive Reserve (sMRI+fMRI)
Effect of apolipoprotein E polymorphism on cognition and brain in the Cambridge Centre for Ageing and Neuroscience cohort

Richard N. Henson¹,², Sana Suri³,⁴, Ethan Knights¹, James B. Rowe¹,⁵, Rogier A. Kievit¹, Donald M. Lyall⁶, Dennis Chan⁷, Else Eising⁸ and Simon E. Fisher⁹
• Presence of an e4 allele (relative to more common e3) in APOE gene is associated with cognitive decline in old age, specifically Alzheimer’s Disease

• The “Antagonistic Pleiotropy” hypothesis claims that e4 offers benefits earlier in life (which could contribute to its prevalence in population)

• The e2 polymorphism, on other hand, is claimed to be neuroprotective in old age
• We published a Registered Report (i.e., APOE status de-blinded after acceptance) to test Antagonistic Pleiotropy hypothesis, in terms of a (quadratic) Age X APOE interaction

• We tested interaction on 6 outcomes:
  1. Fluid Intelligence
  2. Episodic Memory
  3. Hippocampal Volume
  4. White Matter FA
  5. DMN FC from fMRI
  6. FC from MEG

• Though small N for genetic study (N~600), prior APOE effect sizes so large that should be detectable
In no case was there a significant Age-by-APOE interaction for either e4 or e2 (or dose effect), and Bayes Factors favoured the null…

… i.e., evidence against the Antagonistic Pleiotropy hypothesis
• Vascular changes (fMRI+MEG)
• Latency effects (MEG+DTI)
• Effects of APO-E (sMRI+fMRI+MEG)
• Cognitive Reserve (sMRI+fMRI)
Brief communication

Lifestyle activities in mid-life contribute to cognitive reserve in late-life, independent of education, occupation, and late-life activities

Dennis Chan\textsuperscript{a,\textdagger}, Meredith Shafto\textsuperscript{b}, Rogier Kievit\textsuperscript{b}, Fiona Matthews\textsuperscript{c}, Molly Spink\textsuperscript{b}, Michael Valenzuela\textsuperscript{d,e}, Cam-CAN, Rik N. Henson\textsuperscript{b}
• Cognitive Reserve (CR) is used to explain why some people maintain
cognitive health despite brain changes owing to, e.g., ageing and dementia
(Stern, 2002).

• One factor commonly associated with CR is level of education.

• Here, we explore more *modifiable* factors, such as mid-life activities.

• Identifying such factors will enable public health strategies for maintaining
cognitive health in old age and dementia (Gow et al., 2017).
• We analysed data from the “Lifetime Experience Questionnaire” (LEQ; Valenzuela & Sachdev, 2007)

• N=205 population-derived healthy individuals >65 years of age in CC700 phase of CamCAN

• We defined Cognitive Health by the Cattell test of fluid intelligence (similar results obtained when taking the first principal component across 12 more specialised cognitive tests.)
LEQ

Total LEQ score

- YA score
  - Specific (education)
  - Non-specific mental activities

- ML score
  - Specific (occupation)
  - Non-specific mental activities

- LL score
  - Specific (social and intellectual activity)
  - Non-specific mental activities

Younger participants

Middle participants

Older participants
<table>
<thead>
<tr>
<th></th>
<th>Specific</th>
<th>Non-specific</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Young Adult (18-29)</strong></td>
<td><strong>Education</strong></td>
<td>Eg family outings, musical instrument, physical activity, board games</td>
</tr>
<tr>
<td></td>
<td>(national careers service, level multiplied by number of years)</td>
<td></td>
</tr>
<tr>
<td><strong>Mid-Life (30-65)</strong></td>
<td><strong>Occupation</strong></td>
<td>Eg family outings, musical instrument, physical activity, board games</td>
</tr>
<tr>
<td></td>
<td>(standard occupational scores, multiplied by number of years)</td>
<td></td>
</tr>
<tr>
<td><strong>Late-Life (66-88)</strong></td>
<td><strong>Other roles</strong></td>
<td>Eg family outings, musical instrument, physical activity, board games</td>
</tr>
<tr>
<td></td>
<td>(social, charity, family, etc, summed score)</td>
<td></td>
</tr>
</tbody>
</table>
- (All LEQ scores positively related to Cognition in separate regressions)
- **Multiple** linear regression of the LEQ scores, together with age and sex, revealed unique contributions of:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Normalised Coefficient</th>
<th>Percentage Variance</th>
<th>P-value (df=196)</th>
</tr>
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<tbody>
<tr>
<td>Young Adult Specific</td>
<td>+0.259</td>
<td>6.70</td>
<td>3.58e-4</td>
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<tr>
<td>Young Adult Non-specific</td>
<td>+0.027</td>
<td>0.08</td>
<td>.723</td>
</tr>
<tr>
<td>Mid-Life Specific</td>
<td>+0.096</td>
<td>0.93</td>
<td>.164</td>
</tr>
<tr>
<td>Mid-Life Non-specific</td>
<td>+0.324</td>
<td>10.50</td>
<td>2.53e-5</td>
</tr>
<tr>
<td>Late-Life Specific</td>
<td>+0.010</td>
<td>0.99</td>
<td>.110</td>
</tr>
<tr>
<td>Late-Life Non-specific</td>
<td>-0.098</td>
<td>0.96</td>
<td>.195</td>
</tr>
<tr>
<td>Age</td>
<td>-0.287</td>
<td>8.26</td>
<td>1.93e-6</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.082</td>
<td>0.67</td>
<td>.201</td>
</tr>
</tbody>
</table>
• While mid-life activities may help preserve cognition in old age, to qualify for Cognitive Reserve, these activities need to moderate the relationship between Cognition and Brain.

• On n=195 individuals, Brain health was estimated from T1+T2-weighted MRIs as Total Gray Matter, adjusted for head size (aTGM).

• Tested for the interaction (moderation) between Mid-Life Non-specific Activities and aTGM in predicting Cognition.
  (for visualisation purposes, split the group into High (n=103) and Low (n=92) levels of Mid-Life Non-specific activities)
• Significant linear interaction (adjusting for education, age, sex), in that Cognition was less related to (structural) Brain health when Mid-Life Nonspecific Activities were high…
• …as expected if Mid-Life activity is a form of Cognitive Reserve
We identified a type of Cognitive Reserve – Mid-Life Nonspecific activity (i.e., beyond occupation) – which:

1) predicted Cognition years later in old age, over and above Education in youth and current activities in old age

2) reduced the dependency of Cognition on Brain Structure

3) is potentially modifiable by simple interventions (perhaps easier than for other determinants of Cognitive Reserve like Education)
• Apart from being beyond occupation, we could not distinguish whether key mid-life activities are physical, intellectual and/or social

• Warning: “reverse causation” still possible (i.e, cognition caused lifestyle):
  • Lifestyle could be influenced by past (stable) cognitive ability (no direct childhood measure of cognition like Gow et al, 2017)
    • Though childhood cognition likely to correlate with education?
  • Lifestyle Reporting could be affected by current cognitive ability
    • Though autobiographical memory not severely affected in healthy ageing?

• Prospective studies, with *objective* measures of mid-life physical / social / intellectual activity will need to replicate in future…

(which is why longitudinal cohorts are vital, and need funding, eg CamCAN…)
But Cognitive Reserve must have some brain correlate (even if not Brain Structure)…. what about Brain Function?

Functional segregation of large-scale networks may be key….
• Functional connectivity can be measured while recording brain activity during rest, leading to a number of large-scale “networks”

• Functional segregation refers to how well those networks are separated (within-network minus between-network connectivity)
• Previous fMRI work has shown that SyS decreases with Age...
• ...and this correlates with age-related decreases in Episodic Memory
• SyS being used as proxy for cognitive reserve in dementia (eg, Ewers et al, 2021, Brain)...
• Previous fMRI work has shown that Segregation decreases with Age…
• …and this correlates with age-related decreases in Episodic Memory

• Functional (system) segregation (SyS) may be a functional correlate of Cognitive Reserve…
• Does it mediate effect of Midlife activities on Old-Age Cognition?
• Vascular changes (fMRI+MEG)
• Latency effects (MEG+DTI)
• Effects of APO-E (sMRI+fMRI+MEG)
• Cognitive Reserve (sMRI+fMRI)
• “Healthy” Ageing
  • The “Cam-CAN” dataset
    • Vascular changes (fMRI+MEG)
    • Latency effects (MEG+DTI)
    • Effects of APO-E (sMRI+fMRI+MEG)
    • Cognitive Reserve (sMRI+fMRI)

• “Unhealthy” Ageing
  • The BioFIND dataset
    • MEG add beyond sMRI?
    • Neurophysiological Models (DCM of MEG)
Early Detection of AD with MEG?
Biomagnetic biomarkers for dementia: A pilot multicentre study with a recommended methodological framework for magnetoencephalography

Laura E. Hughes\textsuperscript{a,b,g,1}, Richard N. Henson\textsuperscript{b,c,1}, Ernesto Pereda\textsuperscript{d,e,1}, Ricardo Bruña\textsuperscript{d,f,1}, David López-Sanz\textsuperscript{d,g}, Andrew J. Quinn\textsuperscript{h,i}, Mark W. Woolrich\textsuperscript{h,i}, Anna C. Nobre\textsuperscript{h,i,j}, James B. Rowe\textsuperscript{a,b}, Fernando Maestú\textsuperscript{d,f,g}, the BioFIND Working Group

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\textsuperscript{j}Department of Experimental Psychology, University of Oxford, Oxford, UK
BioFIND Resting-state dataset

• BioFIND: first publically-available MEG dementia dataset

• MEG data from 324 participants during rest:
  • 158 MCI patients
  • 166 healthy controls of similar age (mean=72) and sex (~50%)
  • 2 sites (Cambridge and Madrid, approximately 50% each)
  • Structural MRI (sMRI) also on vast majority

• Hope to extend in future with 100s more participants …

• Available for analysis on DPUK:
  https://portal.dementiasplatform.uk/CohortDirectory/Item?fingerPrintID=BioFIND
## BioFIND

### Cohort Descriptives

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>RESPONSE</th>
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<tbody>
<tr>
<td>Cohort Name</td>
<td>Biomagnetic biomarkers for dementia</td>
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<tr>
<td>Cohort Acronym</td>
<td>BioFIND</td>
</tr>
<tr>
<td>Study Overview</td>
<td>Resting-state MEG data and T1 structural MRI data on ~100 MCI patients and ~50 healthy controls</td>
</tr>
<tr>
<td>#Subjects at Baseline</td>
<td>334</td>
</tr>
<tr>
<td>Institution Name</td>
<td>University of Cambridge</td>
</tr>
<tr>
<td>Department Name</td>
<td>MRC Cognition &amp; Brain Sciences Unit</td>
</tr>
<tr>
<td>City</td>
<td>Cambridge</td>
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A multi-site, multi-participant magnetoencephalography resting-state dataset to study dementia: The BioFIND dataset

Delshad Vaghari, Ricardo Bruno, Laura E. Hughes, David Nosbett, Roni Tison, James B. Rowe, Fernando Maestu, Richard N. Hennessy

This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and should not be used to guide clinical practice.

Abstract

Early detection of Alzheimer’s Disease (AD) is vital to reduce the burden of dementia and for developing effective treatments. Neuroimaging can detect early brain changes, such as hippocampal atrophy in Mild Cognitive Impairment (MCI), a prodromal state of AD. However, selecting the most informative imaging features by machine learning requires many cases. While large publically-available datasets of people with dementia or prodromal disease exist for Magnetic Resonance Imaging (MRI), comparable datasets are missing for Magnetoencephalography (MEG). MEG offers advantages in its millisecond resolution, revealing physiological changes in brain oscillations or connectivity, before structural changes are evident with MRI. We introduce a MEG dataset with 324 individuals: patients with MCI and healthy controls. Their brain activity was recorded while resting with eyes closed, using a 306-channel MEG scanner at one of two sites (Madrid or Cambridge), enabling tests of generalization across sites. A T1-weighted MRI is provided to assist source localisation. The MEG and MRI data can be formatted according to international BIDS standards, and analysed freely on the DPUP platform (https://portal.dementiasplatform.uk/Apply).

Competing Interest Statement

The authors have declared no competing interest.

Delshad Vaghari
• “Healthy” Ageing
  • The “Cam-CAN” dataset
    • Vascular changes (fMRI+MEG)
    • Latency effects (MEG+DTI)
    • Effects of APO-E (sMRI+fMRI+MEG)
    • Cognitive Reserve (sMRI+fMRI)

• “Unhealthy” Ageing
  • The BioFIND dataset
    • MEG add beyond sMRI?
    • Neurophysiological Models (DCM of MEG)
Late combination shows that MEG adds to MRI in classifying MCI versus controls.

Delshad Vaghi, Ehsanollah Kabir, Richard N. Henson

- Multi-Kernel Learning (MKL) of Support Vector Machines (SVM) to ask whether MEG (sensor covariance) adds information beyond sMRI (GMV in 110 regions) in classifying MCI...
MEG provides complimentary information above sMRI…

(particularly for higher frequencies, eg low Gamma)

Vaghari et al. (2022) Neuroimage
• “Healthy” Ageing
  • The “Cam-CAN” dataset
    • Vascular changes (fMRI+MEG)
    • Latency effects (MEG+DTI)
    • Effects of APO-E (sMRI+fMRI+MEG)
    • Cognitive Reserve (sMRI+fMRI)

• “Unhealthy” Ageing
  • The BioFIND dataset
    • Biomarker for early Alzheimer’s Disease?
    • Neurophysiological Models
GABA-ergic Dynamics in Human Frontotemporal Networks Confirmed by Pharmaco-Magnetoencephalography

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• “Healthy” Ageing
  • The “Cam-CAN” dataset
    • Vascular changes (fMRI+MEG)
    • Latency effects (MEG+DTI)
    • Effects of APO-E (sMRI+fMRI+MEG)
    • Cognitive Reserve (sMRI+fMRI)

• “Unhealthy” Ageing
  • The BioFIND dataset
    • MEG add beyond sMRI?
    • Neurophysiological Models (DCM of MEG)