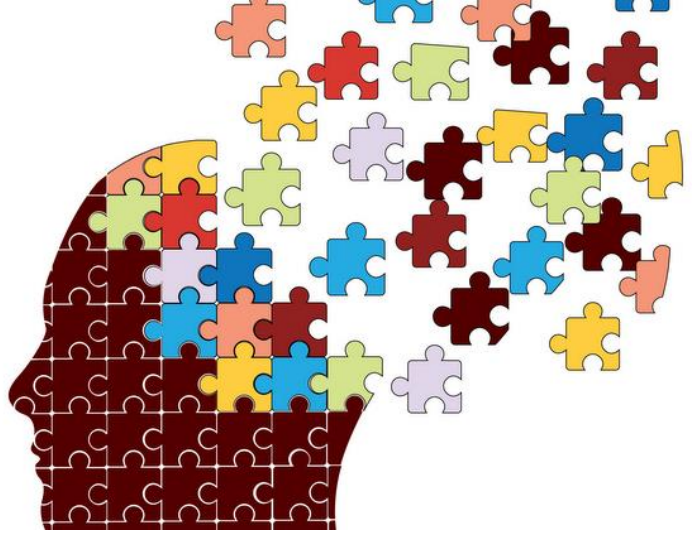
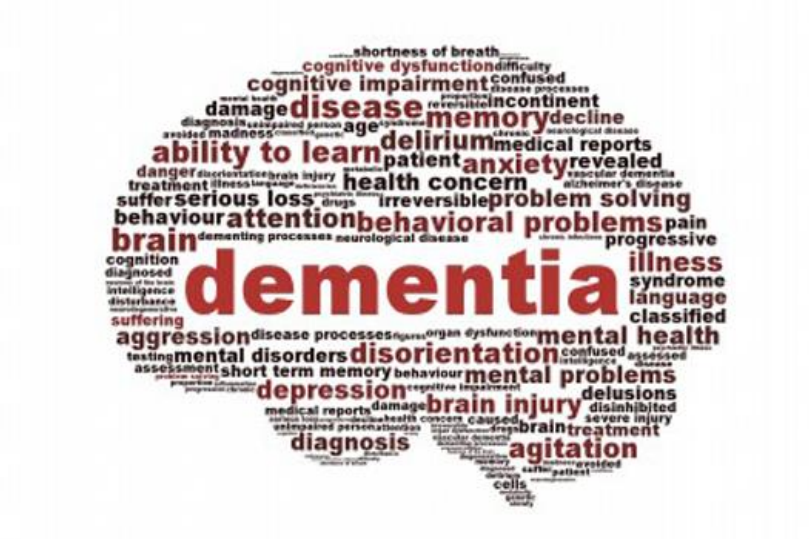
A Predictive Model for Dementia that overcomes the need for Cohort Harmonization



Team E - NaNs



Background

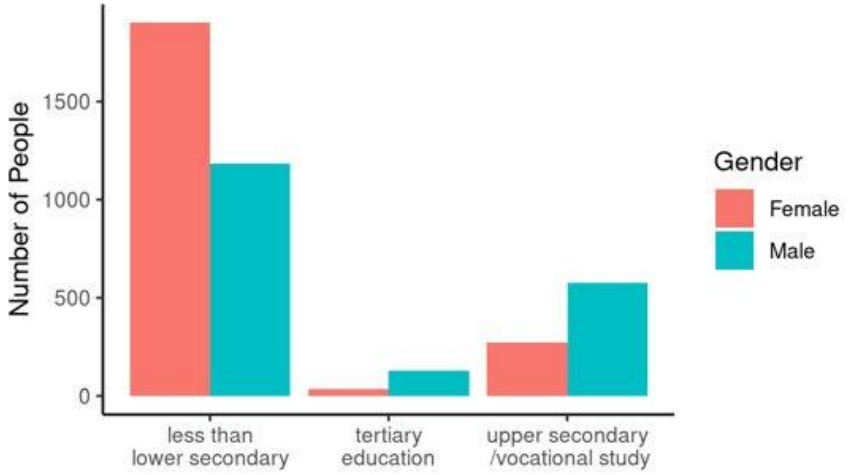
Scopus Text Mining: 184 ML articles filtered from more than 2×10^5 total research articles on "Dementia"

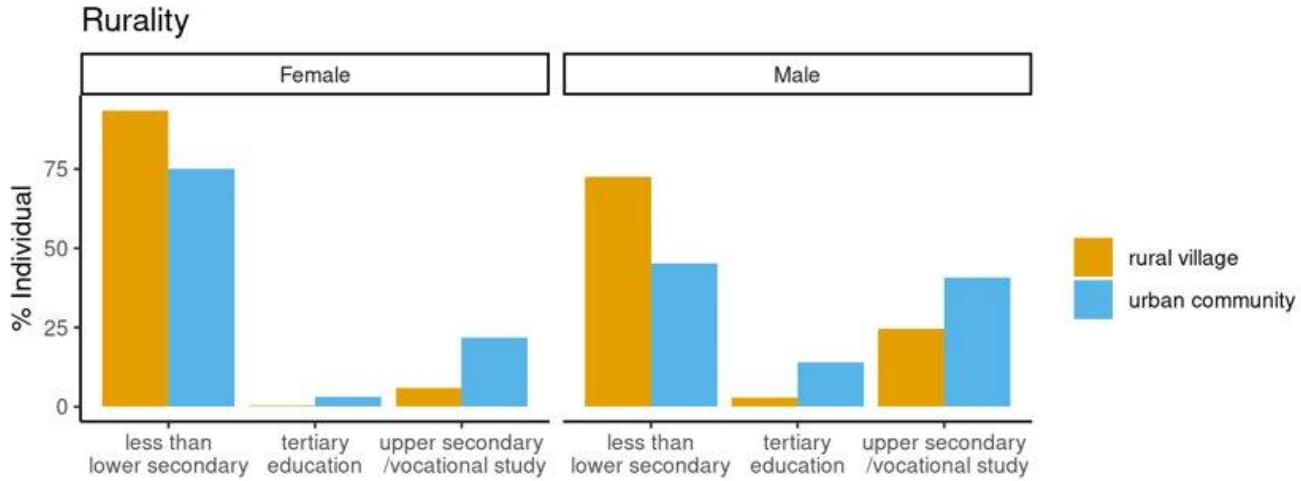
Dementia

- 2017-2022: 54k publications
- Diagnosis features poorly understood
- Only 184 (0.003%) on ML
- LASI-DAD database related: Total 10 articles

Research Gaps

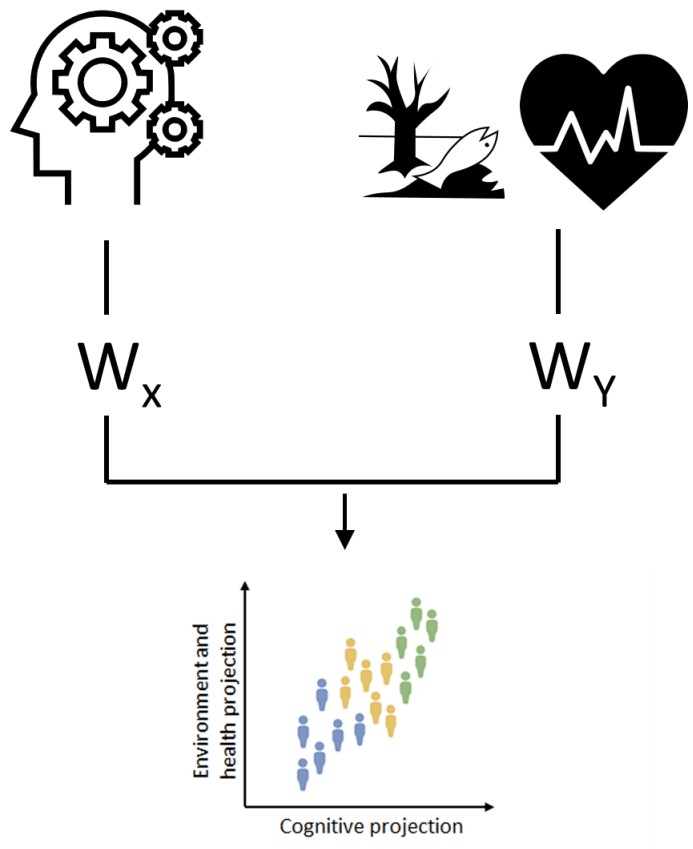
- Most focus on Western cohorts
- Unique challenges to LASI-DAD cohort that must be considered



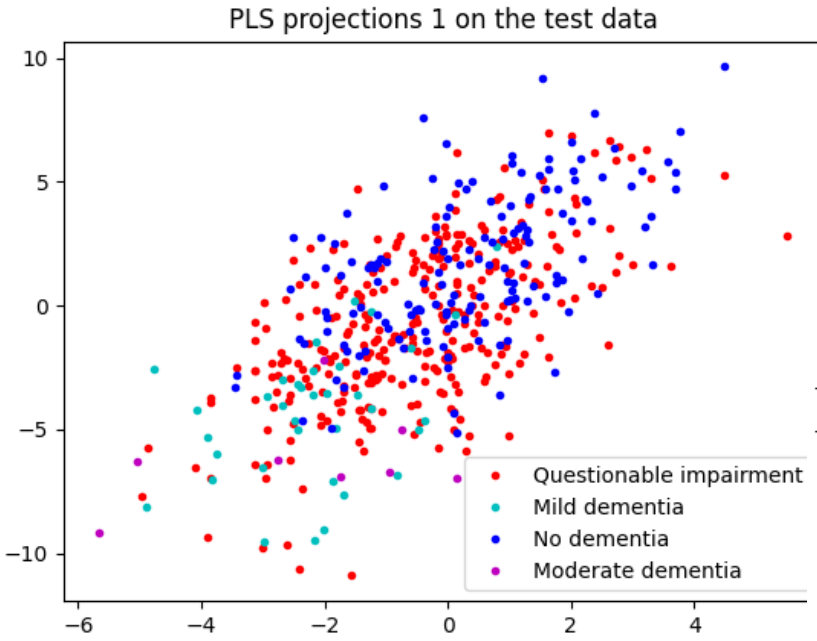


Research Objectives

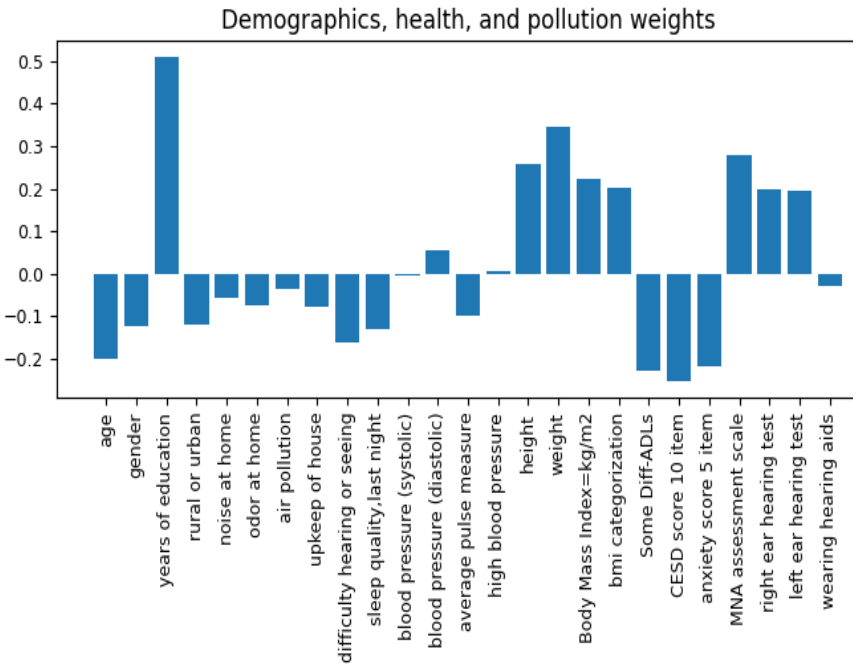
1. To understand the relationship between different features with cognitive performance
2. Develop a predictive model that harmonizes these features practically to predict clinical dementia score

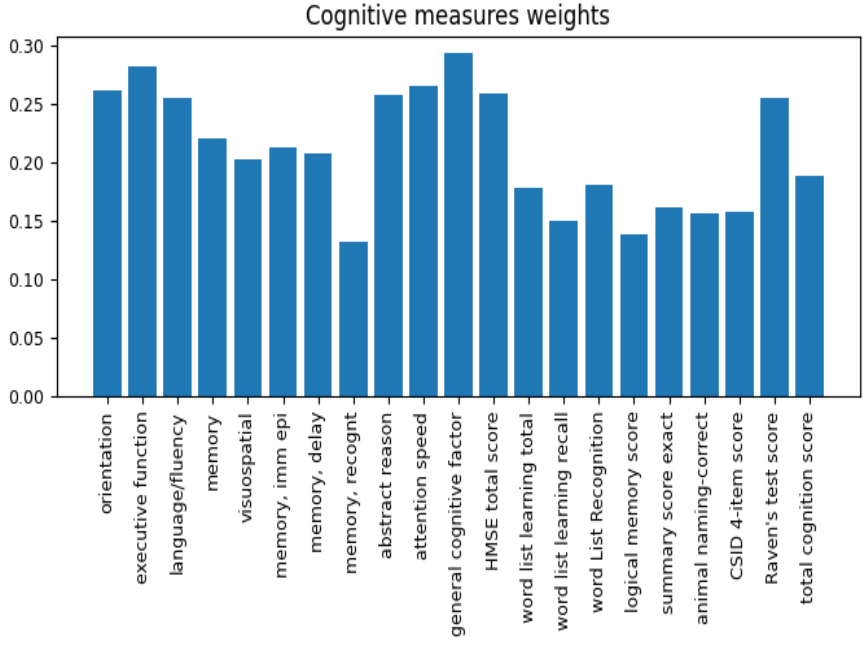


Associations between health, pollution, and demographic measures with cognitive measures

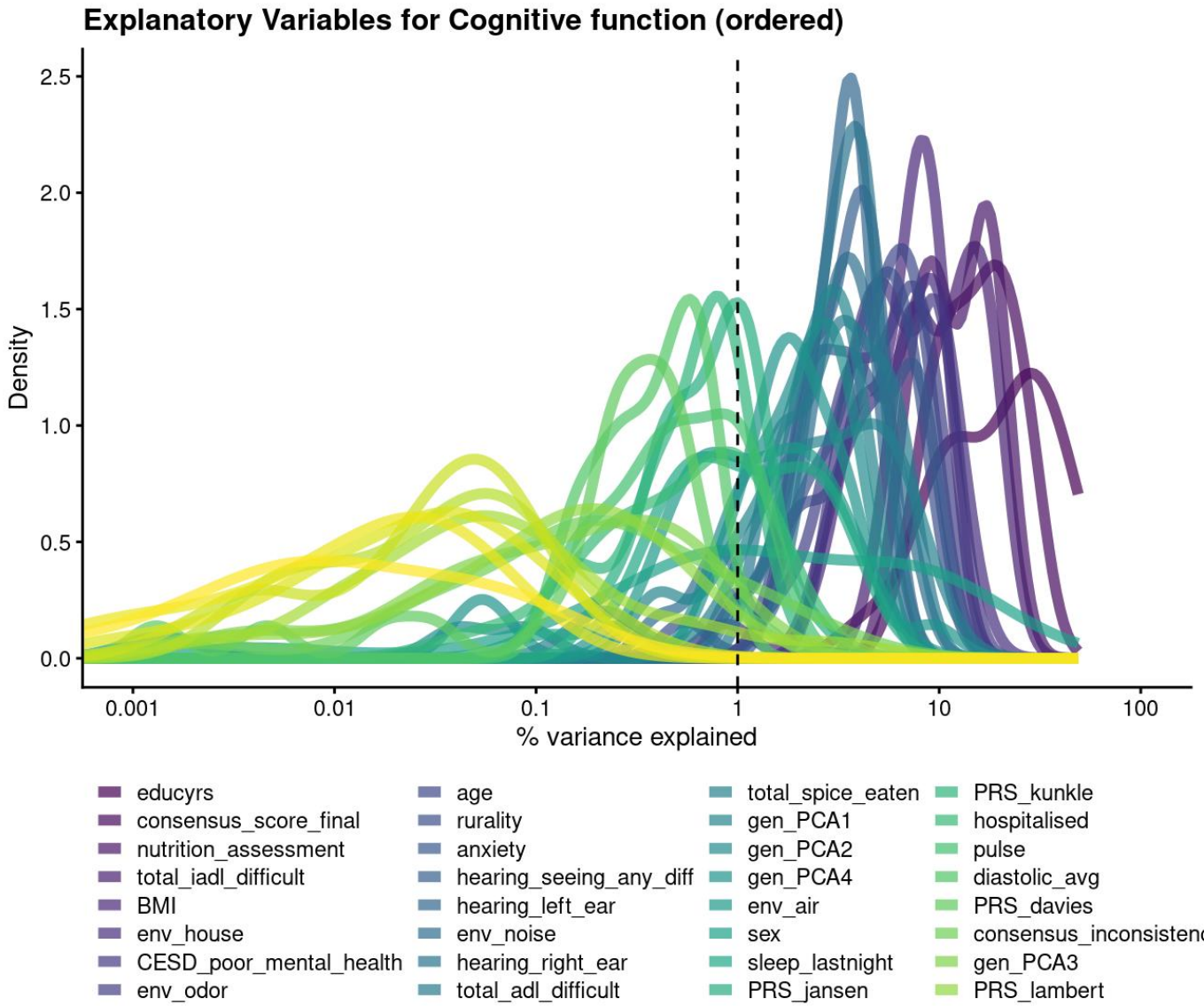


Correlation of 0.657 between the projections of the data





Association of each factor with standardized cognitive scores



Correlation of Features

Association Between Hearing and Vision Impairment and Risk of Dementia: Results of a Case-Control Study Based on Secondary Data

*Bernhard Michalowsky[1], Wolfgang Hoffmann[1,2] and Karel Kostev[3]**

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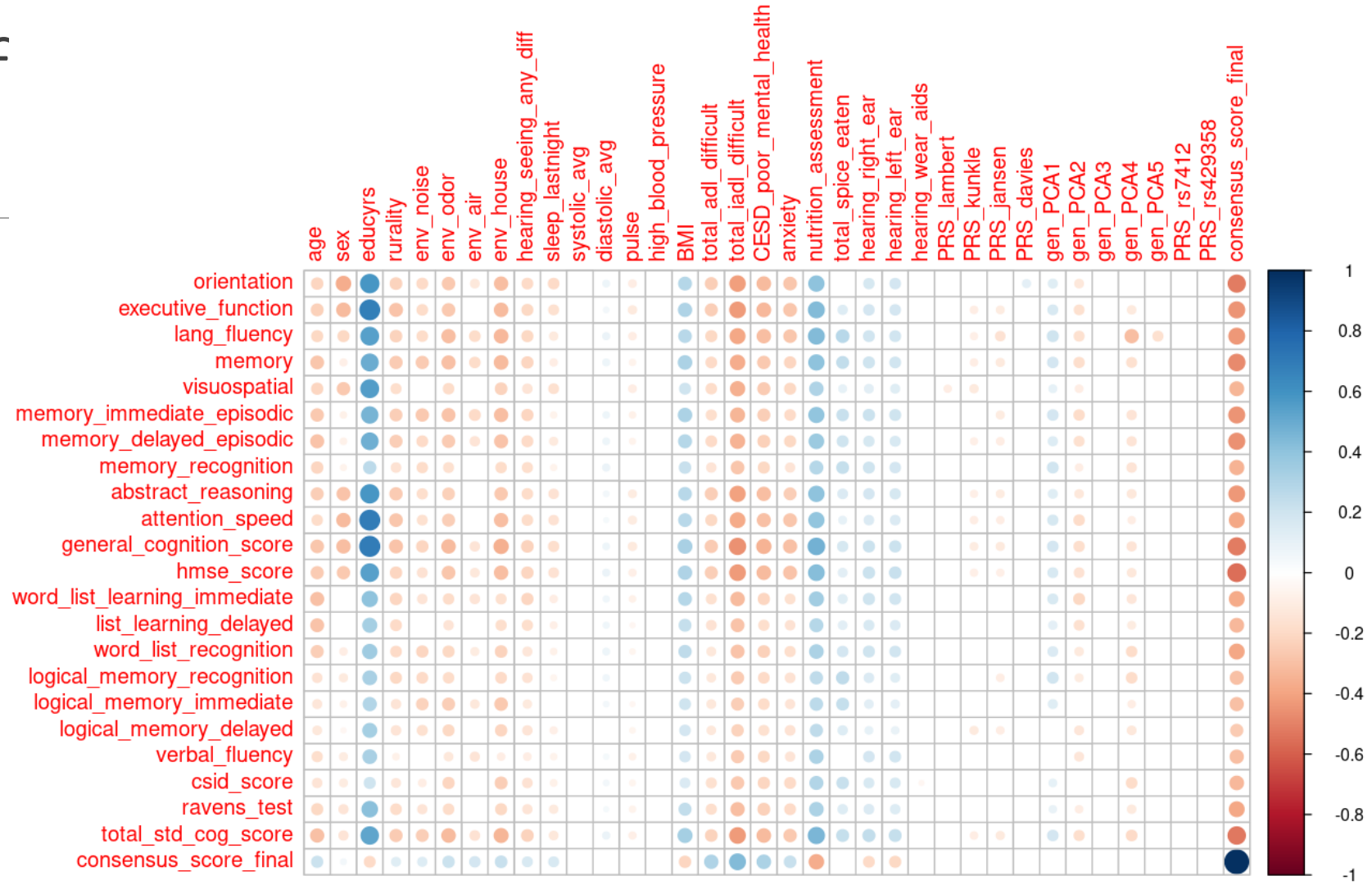
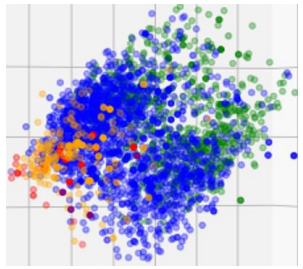
Anxiety and 10-Year Risk of Incident Dementia—An Association Shaped by Depressive Symptoms: Results of the Prospective Three-City Study

Marion Mortamais[1], Meriem Abdennour[1], Valérie Bergua[2], Christophe Tzourio[2], Claudine Berr[1], Audrey Gabelle[1,3] and Tasnime N. Akbaraly[4,5,6]*

[1] Institut National de la Santé et de la Recherche Médicale, Université de Montpellier, Neuropsychiatry: Epidemiological and Clinical Research, Montpellier, France, [2] University of Bordeaux, Institut National de la Santé et de la Recherche Médicale, Bordeaux Population Health Research Center, UMR 1219, CHU Bordeaux, Bordeaux, France, [3] Memory Resources and Research Center, Department of Neurology, Gui de Chauliac Hospital, Montpellier, France, [4] MMDN, Université de Montpellier, EPHE, Institut National de la Santé et de la Recherche Médicale, U1198, Montpellier, France, [5] Department of Epidemiology and Public Health, University College London, London, United Kingdom, [6] Autism Resources Centre of Languedoc-Roussillon, University Hospital of Montpellier, CHRU de Montpellier, Montpellier, France



Multiclass PCA+SVM Model Pipeline for CDR Prediction



Pre-processing and Predictive Model Construction

Input data LASI-DAD

Feature Selection 490 – features (Tried: statistical feature selection)

Up-sampling Imbalanced classes (Tried: imputing data)

Data Visualisation [PCA, T-SNE, Histogram]

SVM Hypermeter tuning with Grid Search

PCA + Multiclass SVM based CDR Prediction Model

Transform training data with **PCA** + scaling -> PCs

Training Multiclass SVM + regularisation and weighted penalty

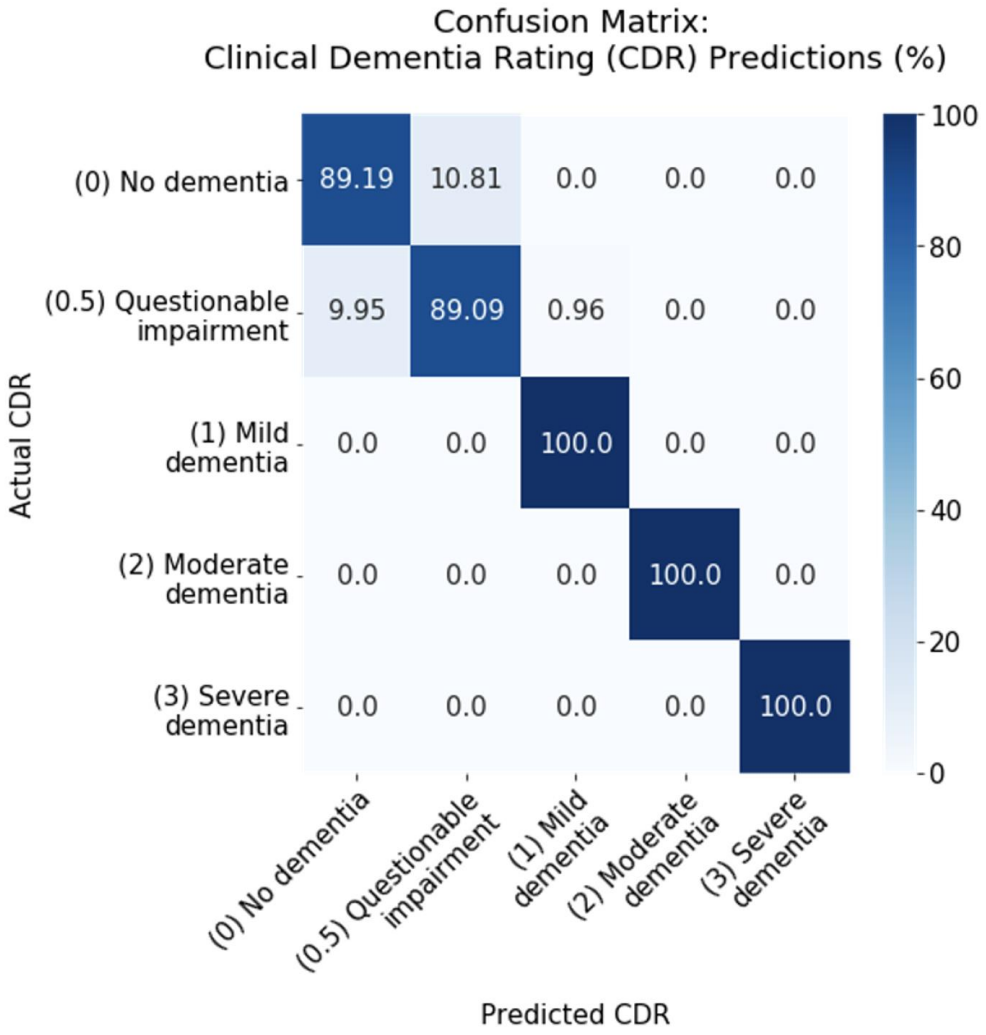
10-fold cross validation

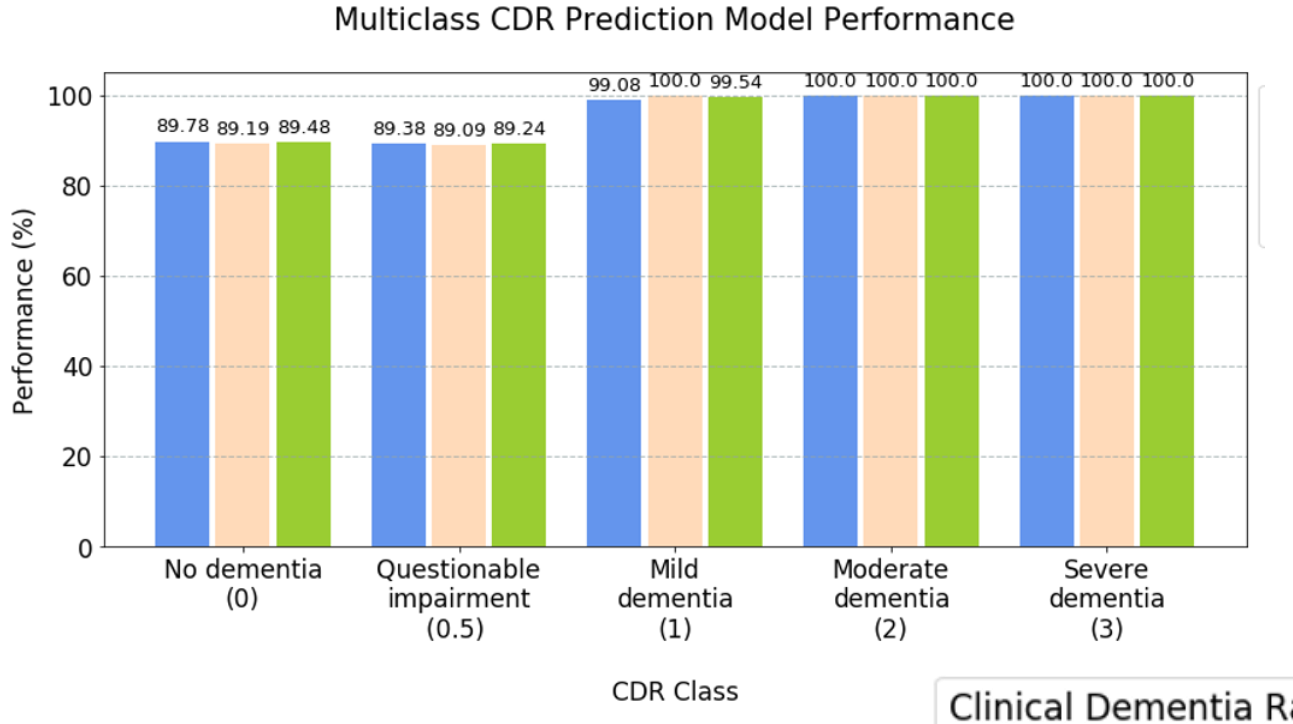
Prediction of 5 CDR classes on unseen test set

Model Performance Evaluation [Precision, Recall, f1-score]

Complete code and pipeline is available on DEMON-Neurohack GitHub

Multiclass Prediction Model Performance





Accuracy on test data: **95.72%**

Accuracy on training data: 98.81%

MSE Loss: 0.043

Future work

- Extension to LASI & ADAMS dataset
- Using FAMD or PLS components rather than PCA components
  - To deal with mixed datasets & improve results
- Extending features through Social Media Analytics e.g., Twitter.
  - Ask: how social stigma to dementia impact patients
  - Improve information on social isolation

Impact

- Broad Application in predicting cognitive impairment
  - PCA approach – blind to feature missingness
  - No harmonization needed
  - Fantastic prediction accuracy (95.72%)
- Objectively predict cognitive impairment in public level cohorts such as the UK Bio-Bank
- Method can potentially be extended to other diseases

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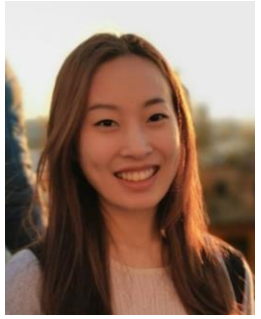

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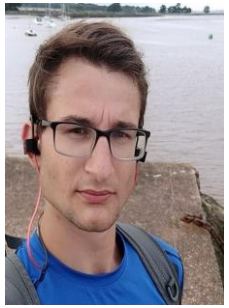

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