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Fold opening dynamics during the aging process highlight new sulcus communities

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Context

As life expectancy is increasing, **maintaining brain health** is a prevailing societal challenge and calls for a better understanding of human cognitive decline.

The patterns of **cortical atrophy** associated with the spread of neurodegenerative diseases and the **effects of aging** are usually studied using features like cortical thickness, surface area or gyrification index [1]. In return, studies focusing on the **slow opening of the cortical folds** resulting from the continuous loss of tissues are rare [2-3]. To our knowledge, none of these studies have investigated the existence of **sulcus communities** following the same opening trajectory during aging: our work focuses on these communities and can be related to the study of structural cortical networks [4].

Data

- Two cohorts studied: **UK Biobank** and **MEMENTO**
- **T1-weighted MRIs**
- **Brain features** (cortical thickness and sulcal aperture) extracted for each sulcus using **BrainVISA**

UK Biobank

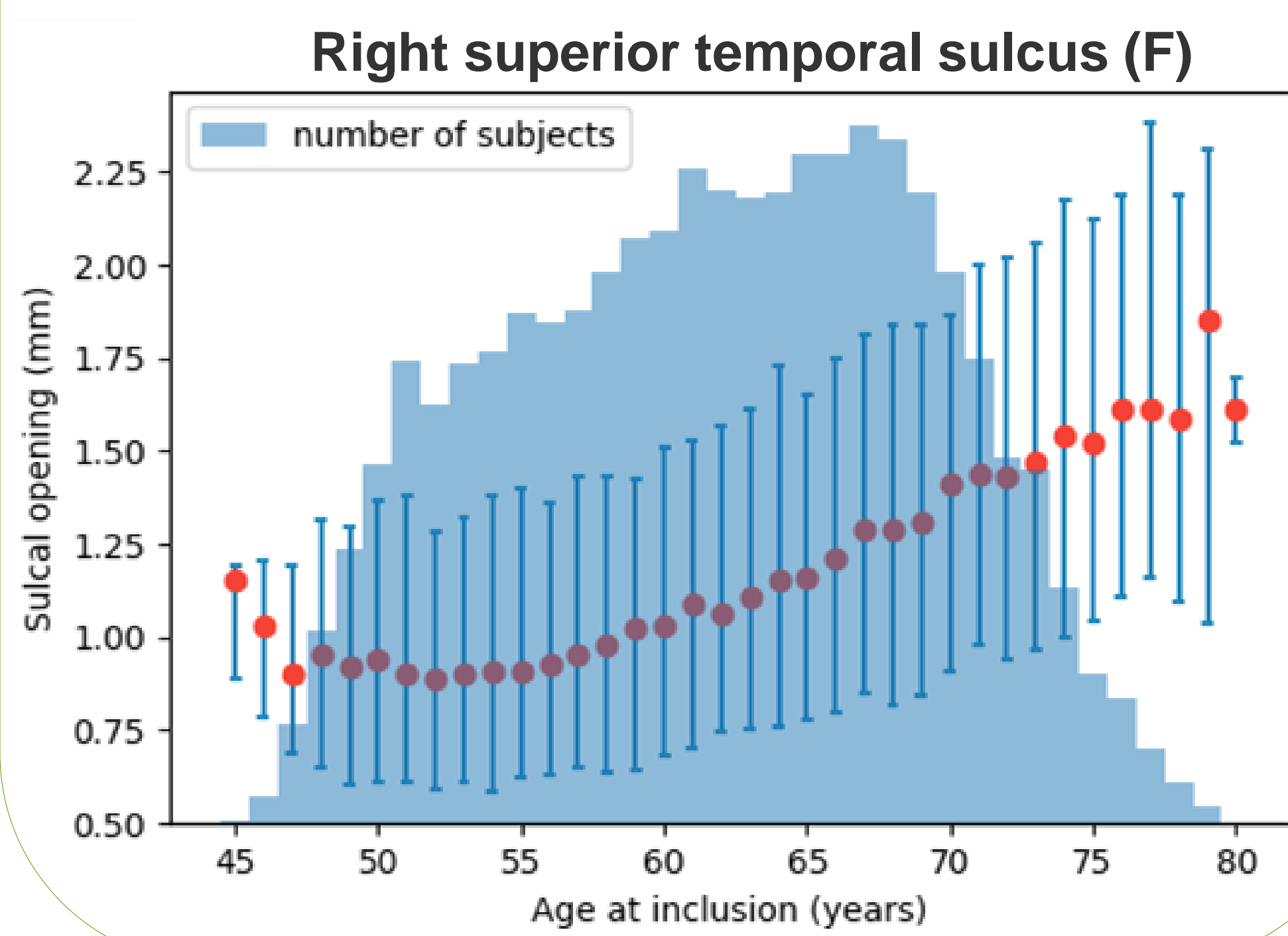
- 20,541 subjects
- No inclusion requirements
- Average age: 62 yrs
- No systematic memory tests

MEMENTO

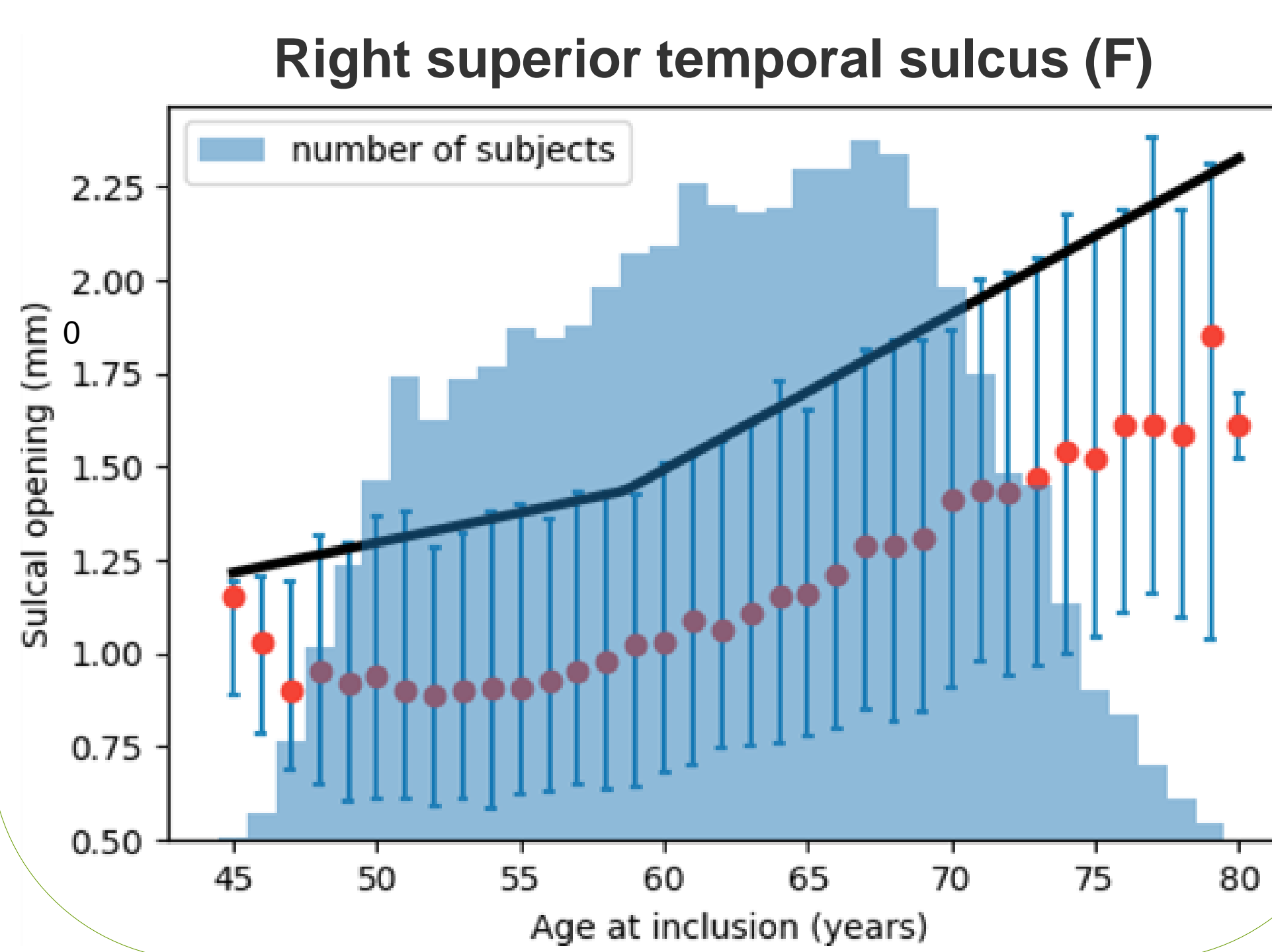
- 2,323 subjects
- At-risk subjects only (isolated SCCs or MCI while not demented)
- Average age: 71 yrs
- Systematic memory tests

Method

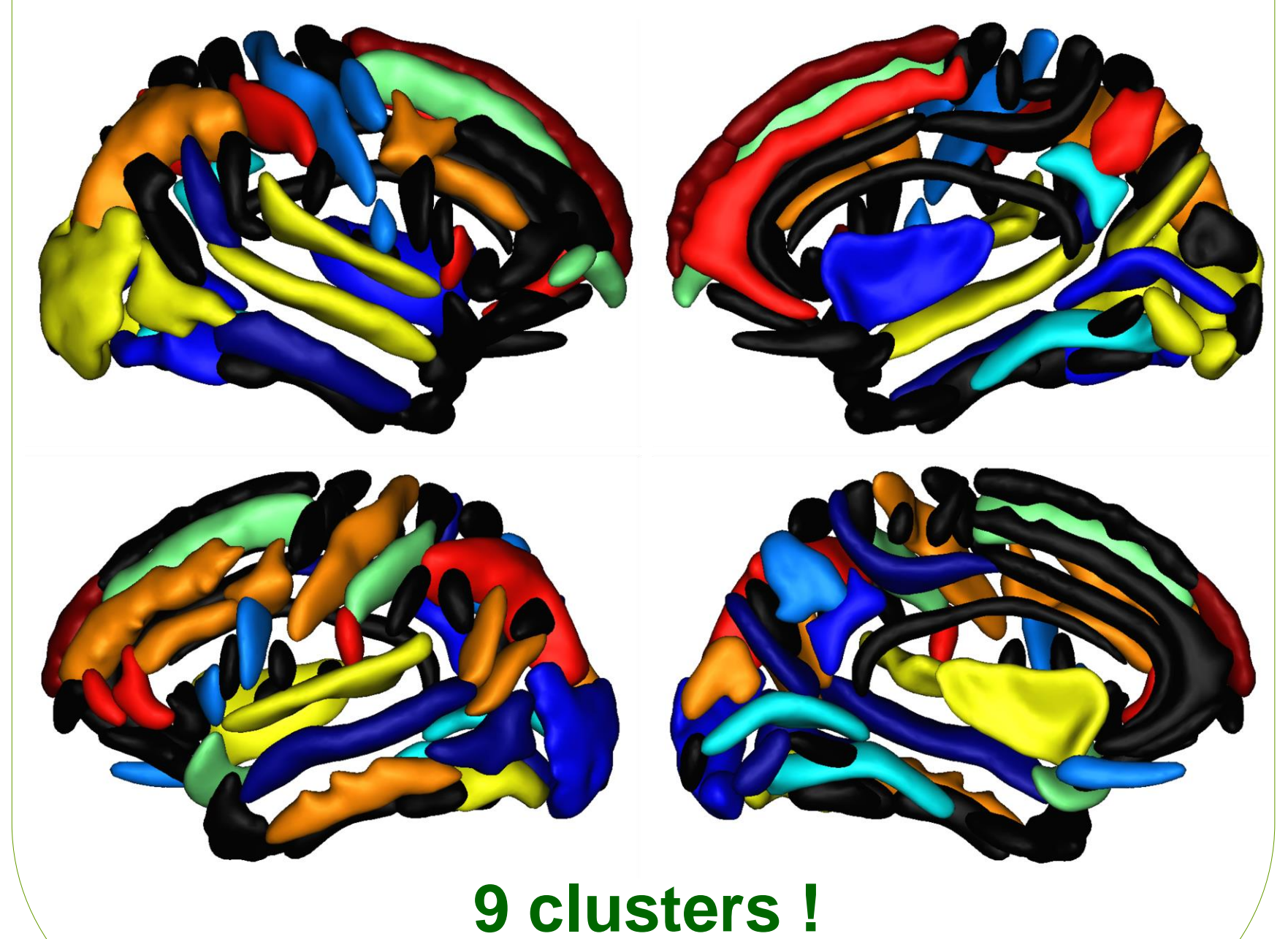
Observing an atrophy acceleration on a general population (UK Biobank)



Piecewise modeling of age-dependency on sulcal openings

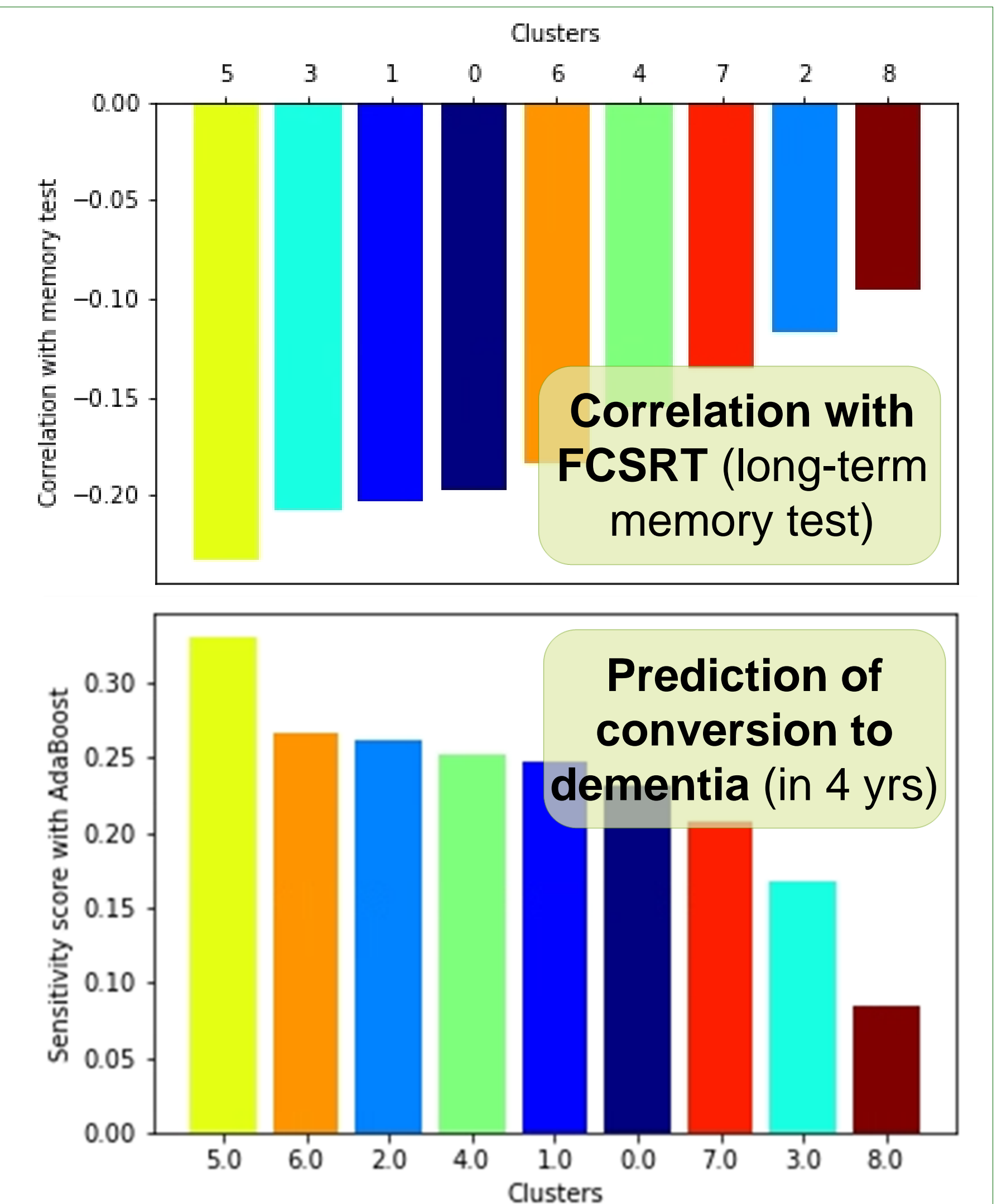
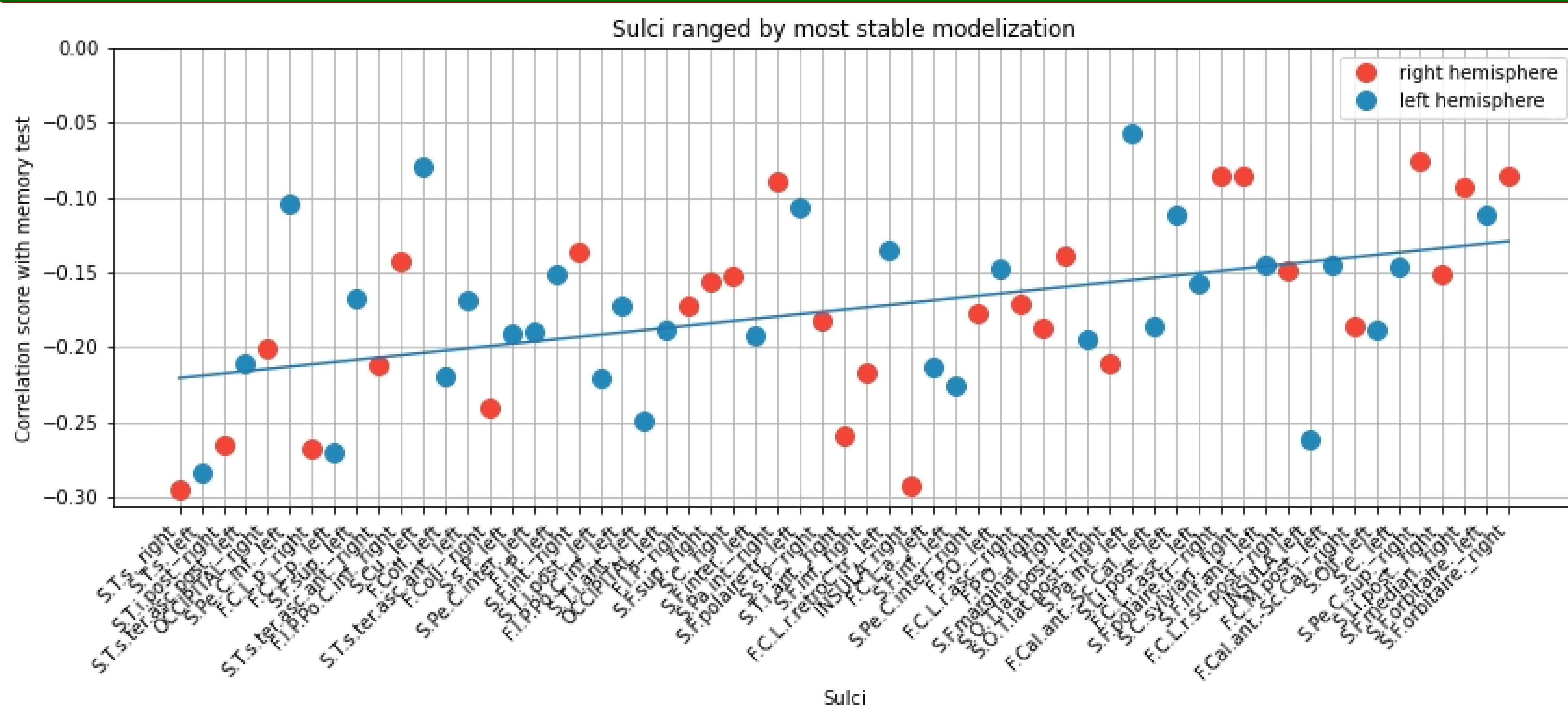


Identification of new sulcus communities (spectral clustering)



Results Transposition to an at-risk population (MEMENTO)

- Sulci with most stable modelization during bootstrap have higher correlation scores with FCSRT
- The fifth cluster (in yellow) yields higher correlation with FCSRT and higher predictive power for conversion to dementia



Discussion

- ❖ **Sulcal aperture** is a **better feature** than cortical thickness to visualize and **model brain atrophy** during the aging process.
- ❖ The modelization is *not relevant for some sulci*, probably due to other ongoing aging phenomena.
- ❖ **Physio-pathological processes in large-scale general population translate into older at-risk population study**, hinting at result reproducibility and overlay of the most common brain diseases in the general population (≠ healthy aging)