Age information is required for the detection of dementia and mild cognitive impairment in brain images

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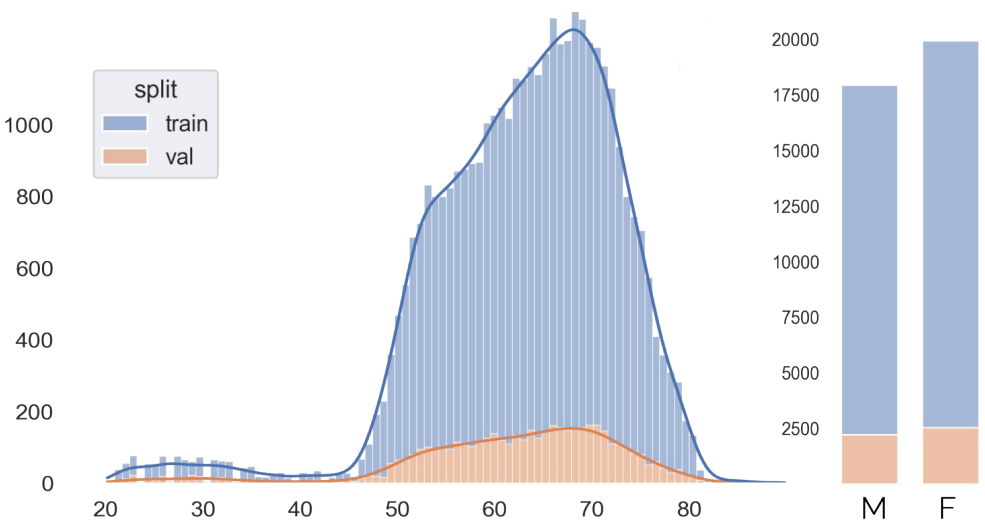
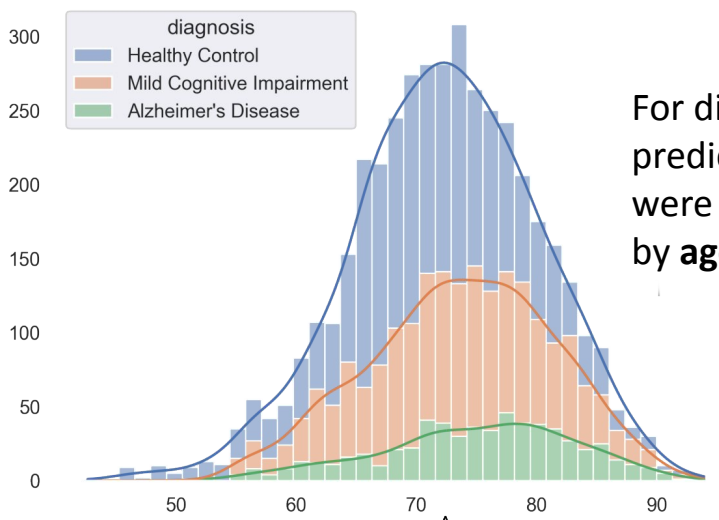
- When looking at brains affected by dementia, **age estimations** evidence a **discrepancy** between predicted and chronological brain age. This mismatch fuels the **premature aging hypothesis of neurodegeneration.**
- In this work, we challenge a **key assumption** of this hypothesis: **is age information *needed* for dementia detection?**

General Population (GP) brain images



33,110 brain images from the general population were used for model **training** and **4,731** for model **evaluation.**

Diseased and healthy controls brain images

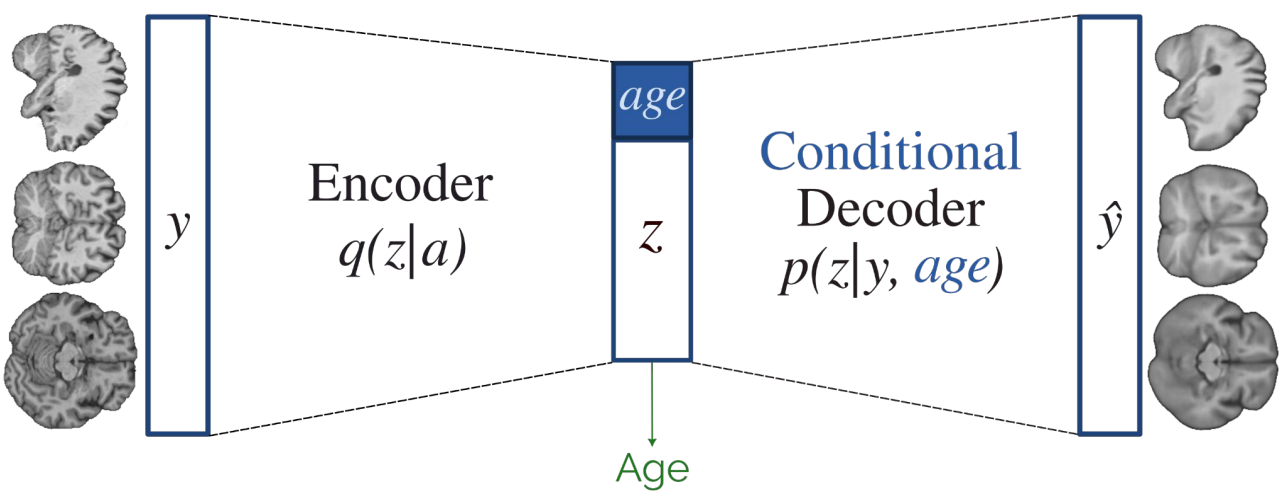


For disease prediction, these were **matched 1:1** by **age and sex.**

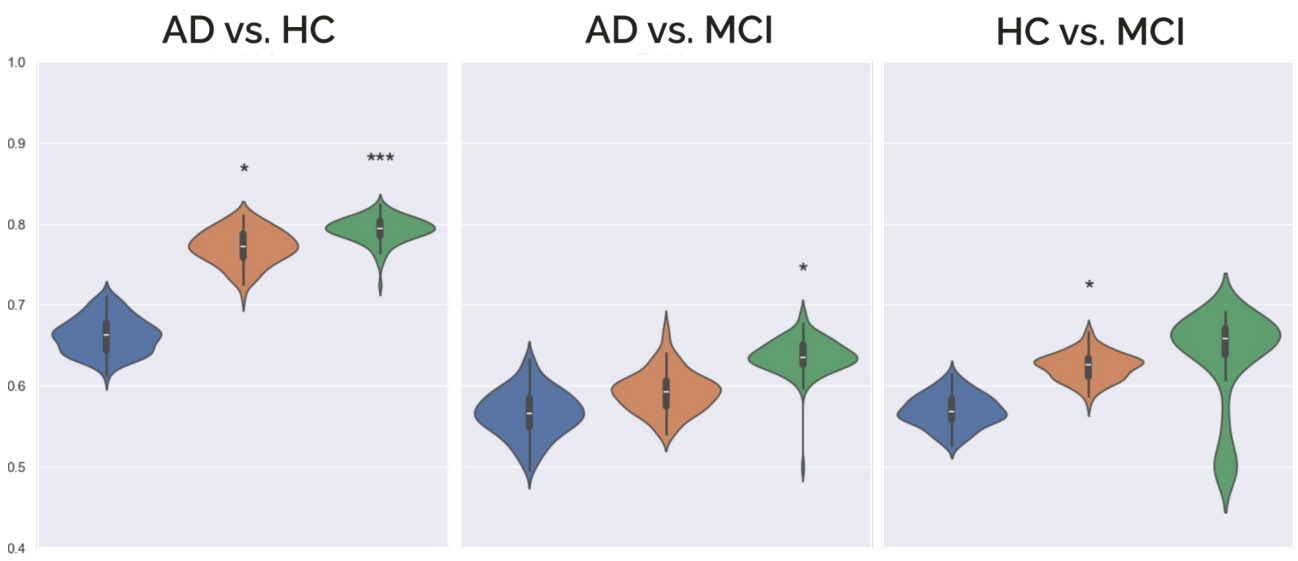
2,118 Healthy Controls **(HC)**, **1,547** Mild Cognitive Impairment **(MCI)**, **600** Alzheimer Disease **(AD).**

Brain representations (z) obtained from General Population (GP) brain images

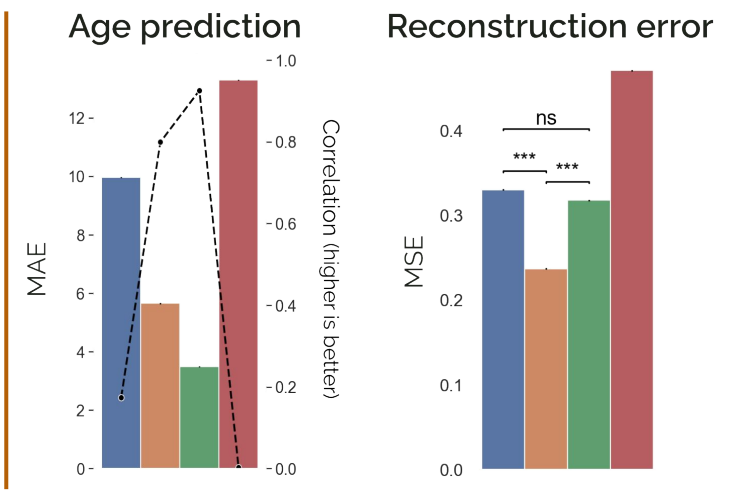
- **Age-invariant:** these embeddings are invariant with respect to age.
- **Age-agnostic:** these embeddings are obtained without imposing any conditions on age.
- **Age-aware:** contrary to the *age-invariant*, these predict age during the reconstruction.



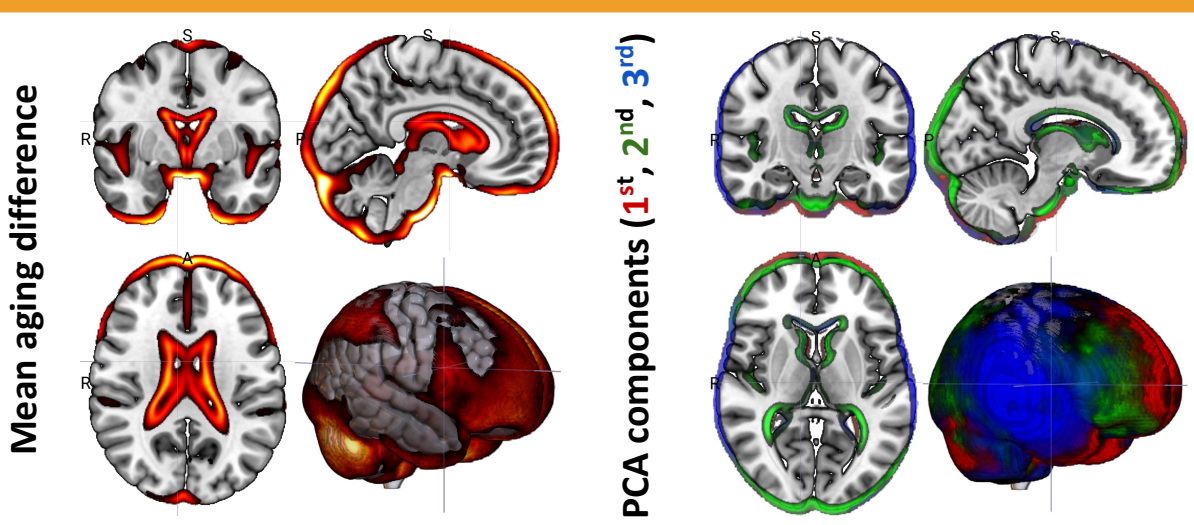
Disease prediction from brain representations (ROC-AUCs)



Performance on GP



Age information: synthetically aged brains



Conclusions

Removing aging information specifically **impairs neurodegeneration detection.**

We found multiple independent dimensions of variation, supporting a **multidimensional view of brain aging.**

Going forward, we are aiming at mapping **brain images** to a **high dimensional space** that predicts their **aging trajectory.**

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