

Exploring the brain with explainable artificial intelligence

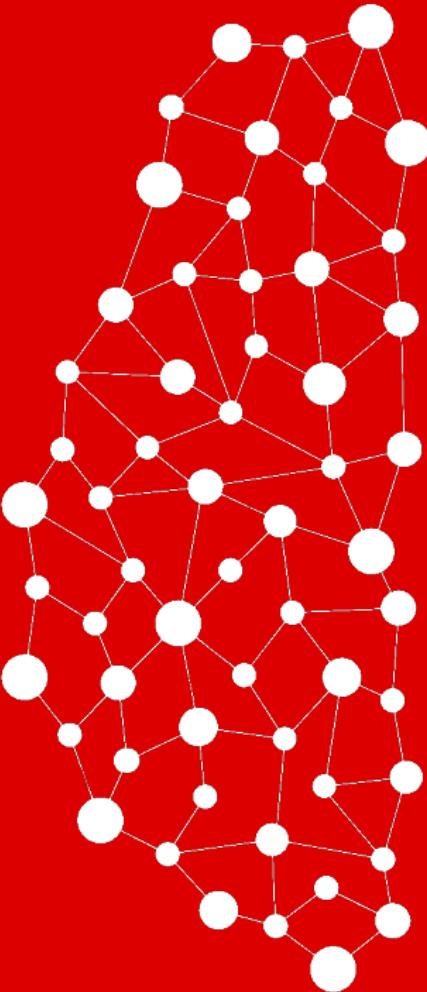
Finding patterns of abnormal brain aging
in patients with neuropsychiatric
disorders



Esten H. Leonardsen

Post-doc at the Department of Psychology,
University of Oslo

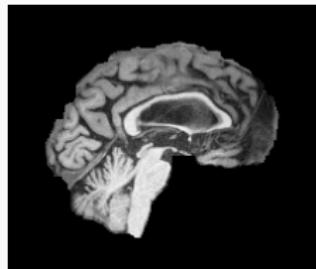
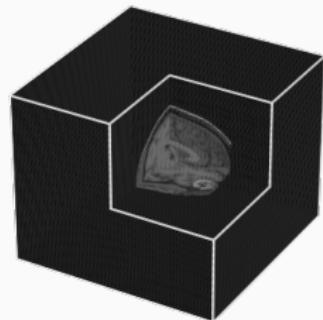
Chief Scientific Officer, baba.vision



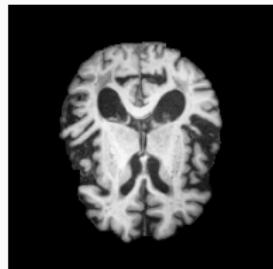
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Brain age: Motivation

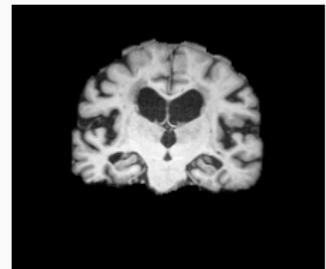
Structural Magnetic
Resonance Imaging (MRI) scans



Side



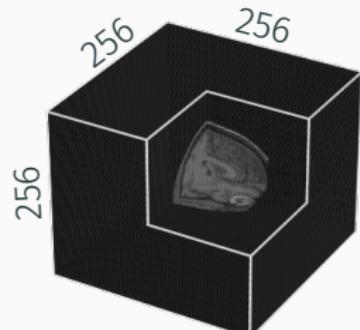
Above



Front



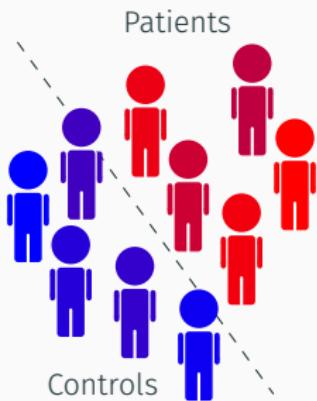
Brain age: Motivation



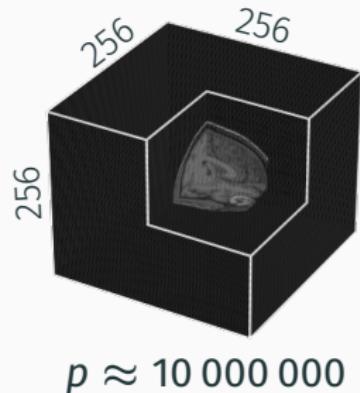
$p \approx 10\ 000\ 000$



Brain age: Motivation

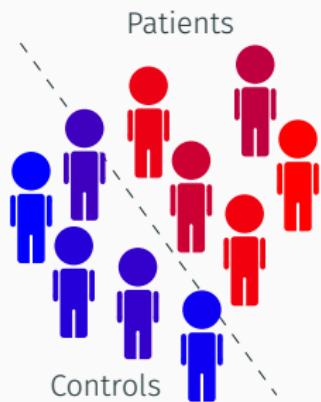


Clinical datasets
($n \approx 100$)

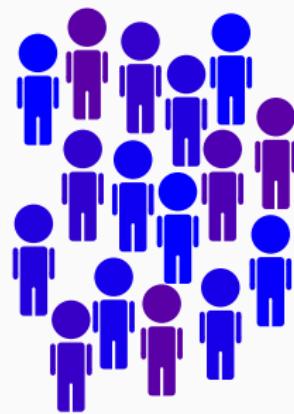


$p \approx 10\,000\,000$

Brain age: Motivation



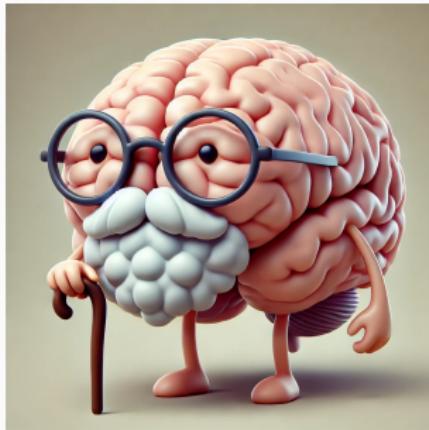
Clinical datasets
 $(n \approx 100)$



Population datasets
 $(n \approx 10\,000)$



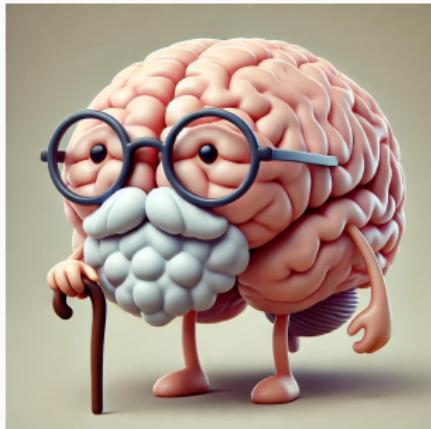
Brain age: Motivation



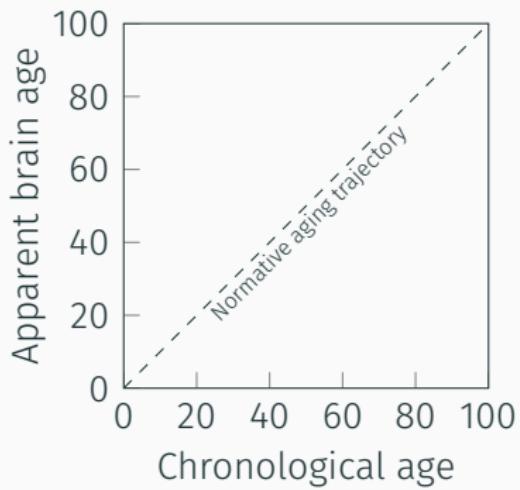
Generated by Dall-E 3



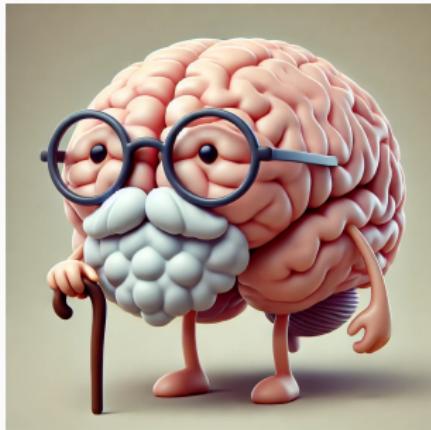
Brain age: Motivation



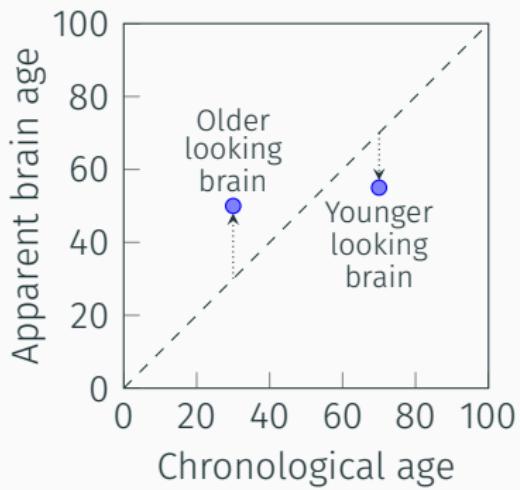
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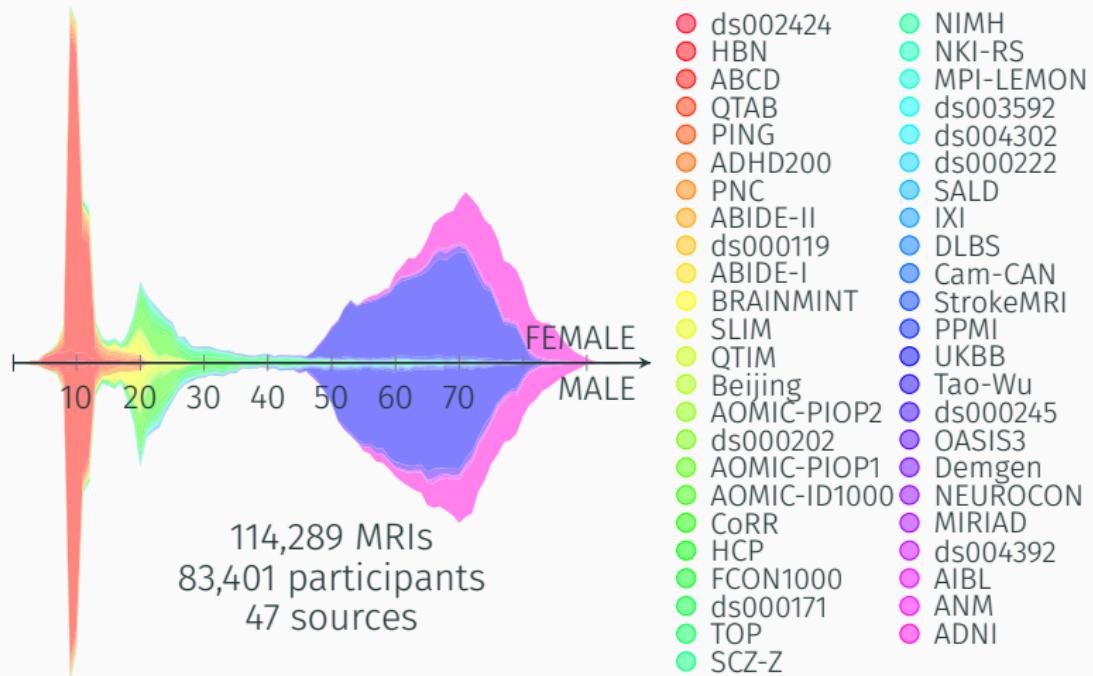
Brain age: Motivation



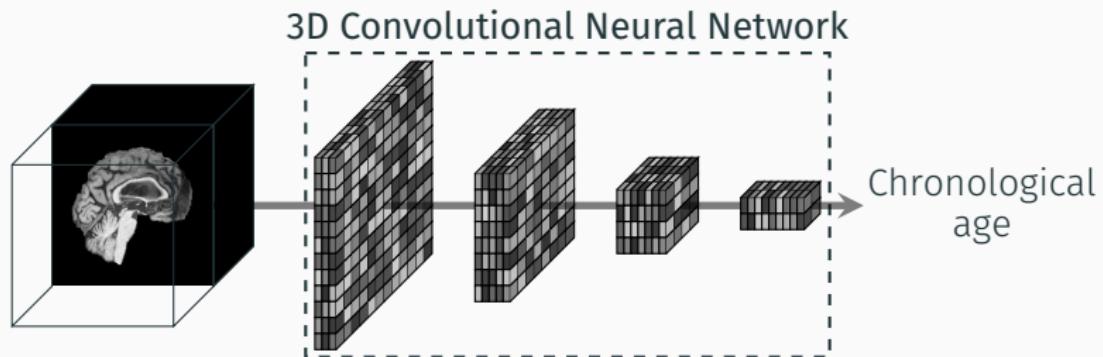
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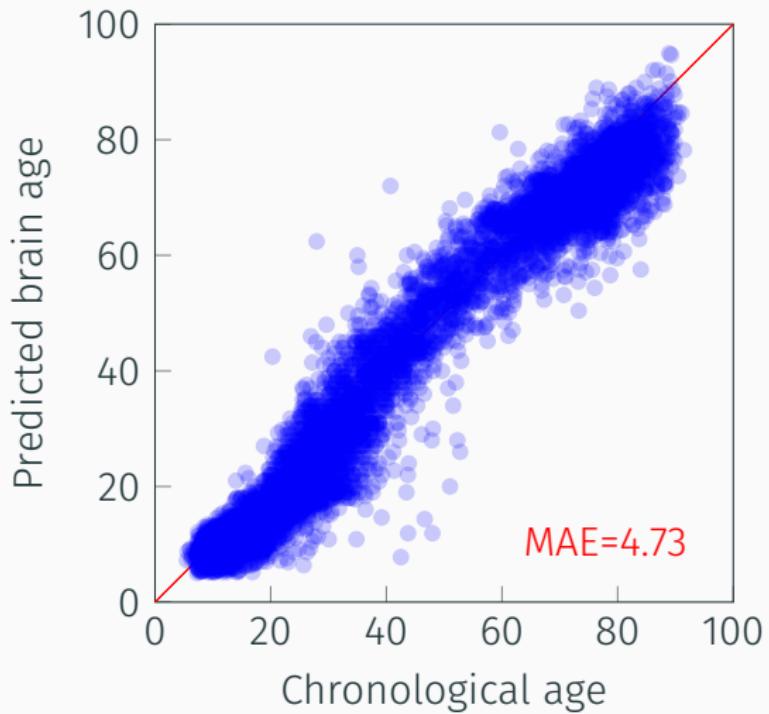
Brain age modelling: Methods



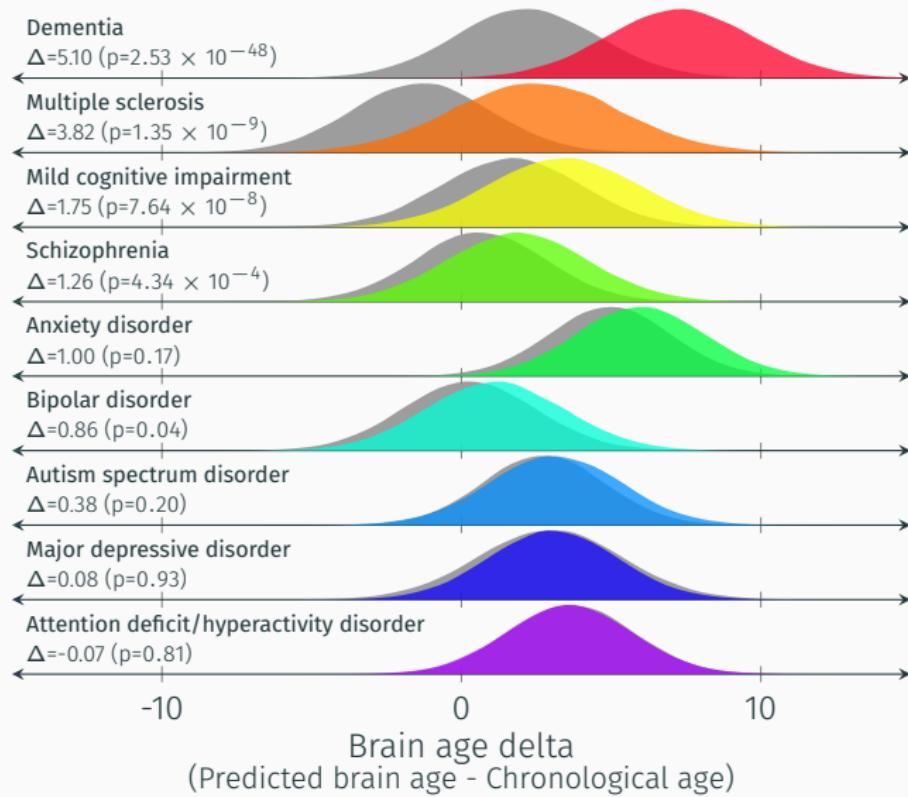
Brain age modelling: Methods



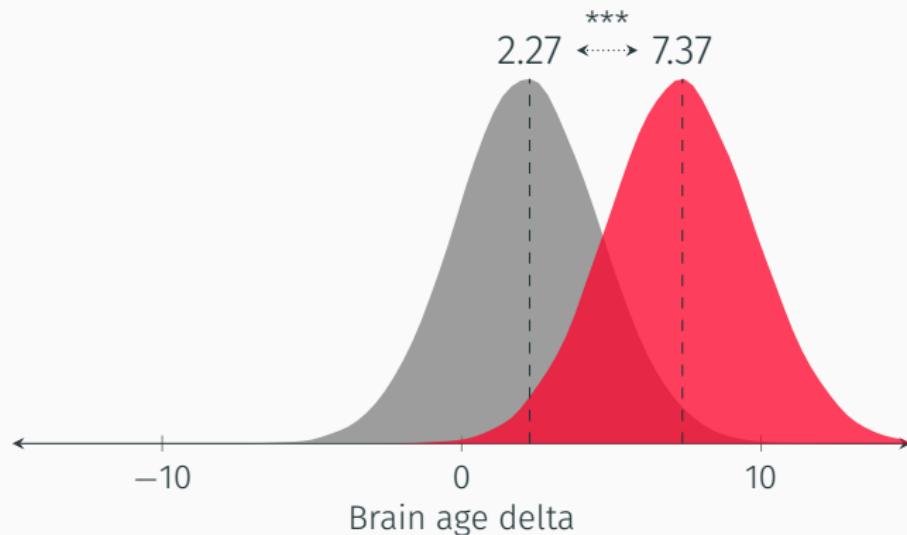
Brain age modelling: Results



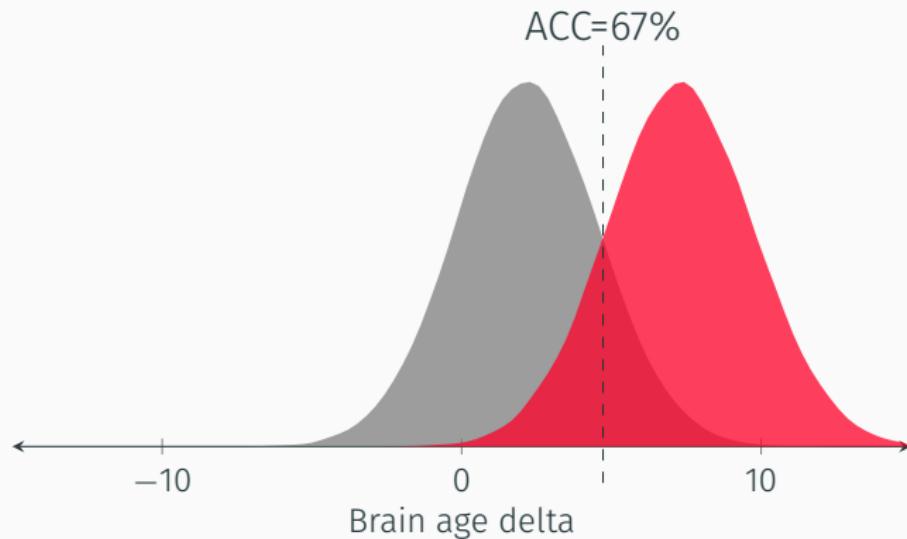
Brain age modelling: Results



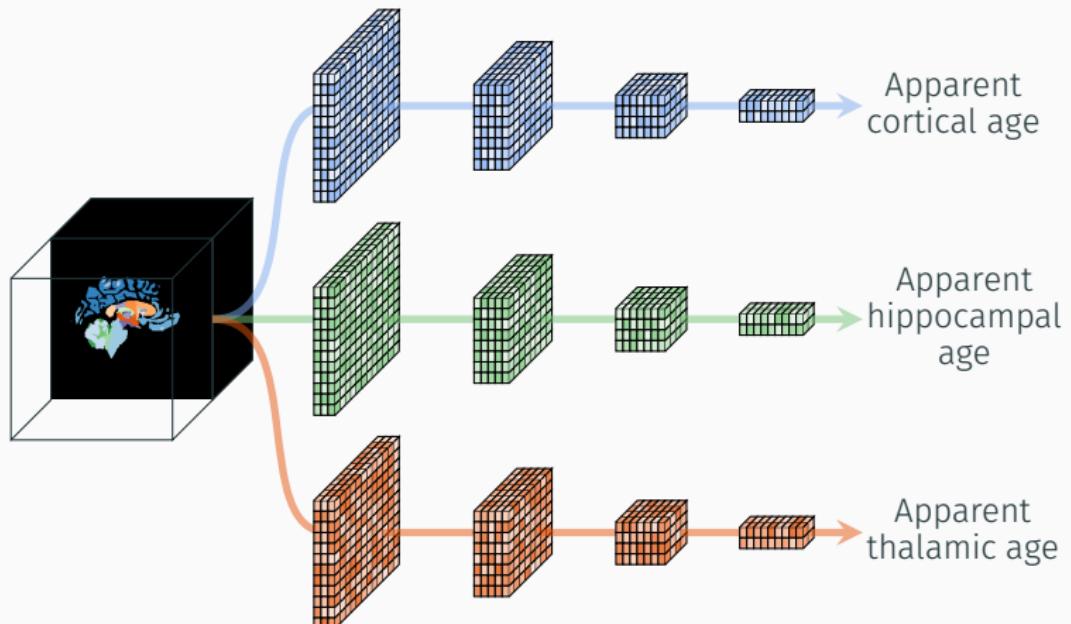
Brain age modelling: Results



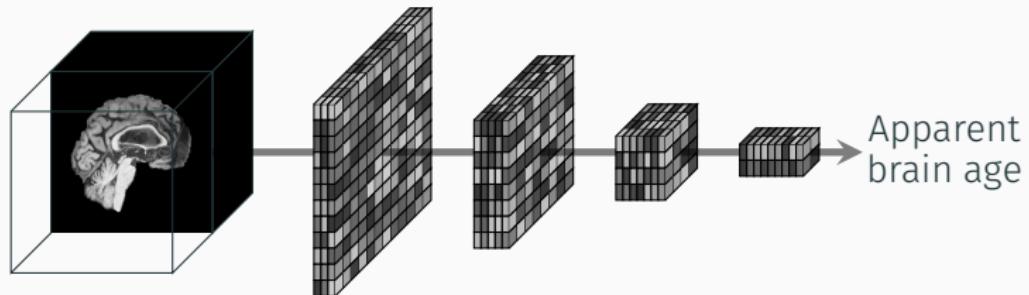
Brain age modelling: Results



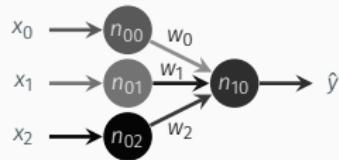
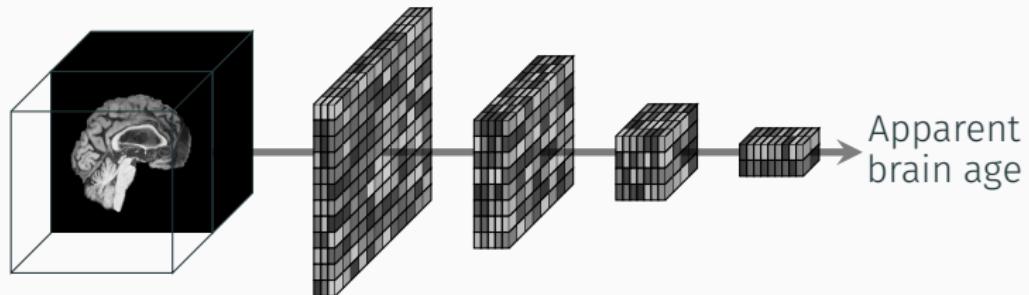
Explainable artificial intelligence: Methods



Explainable artificial intelligence: Methods



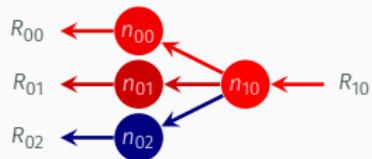
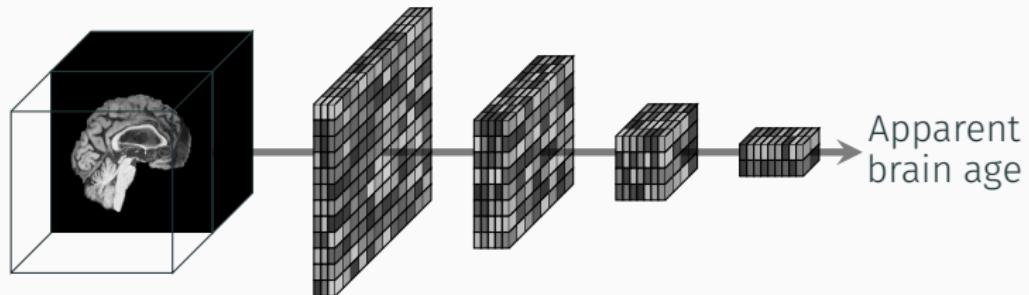
Explainable artificial intelligence: Methods



$$\hat{y} = f \left(\sum_i^N w_i \cdot n_{0i} \right)$$

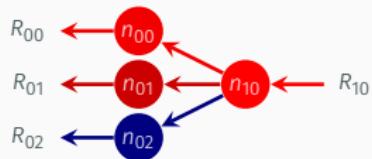
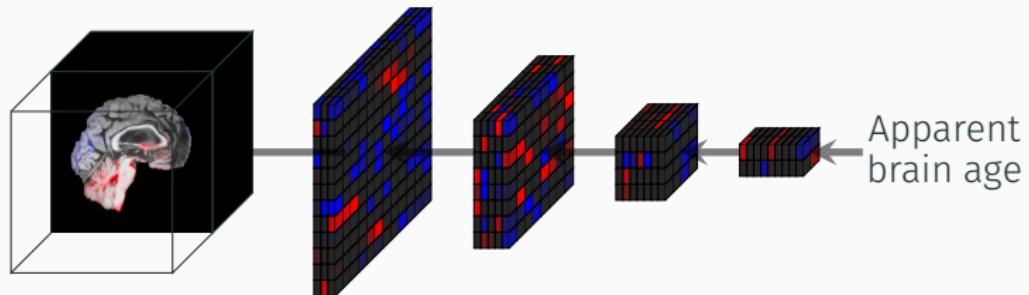


Explainable artificial intelligence: Methods



$$R_{0i} = \sum_j \frac{n_{0i} w_i}{\sum_k n_{0k} w_k} R_{1j}$$

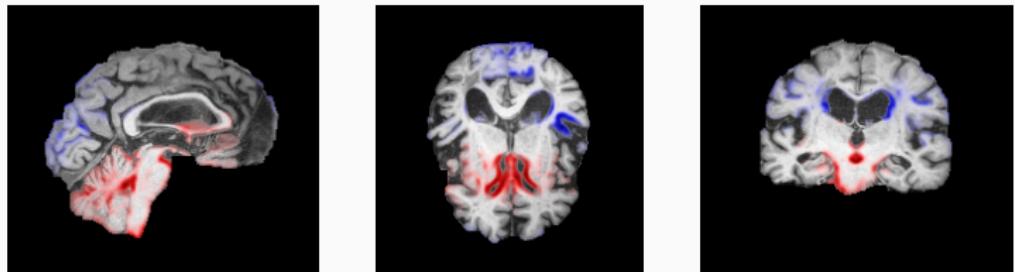
Explainable artificial intelligence: Methods



$$R_{0i} = \sum_j \frac{n_{0i} w_i}{\sum_k n_{0k} w_k} R_{1j}$$



Explainable artificial intelligence: Methods

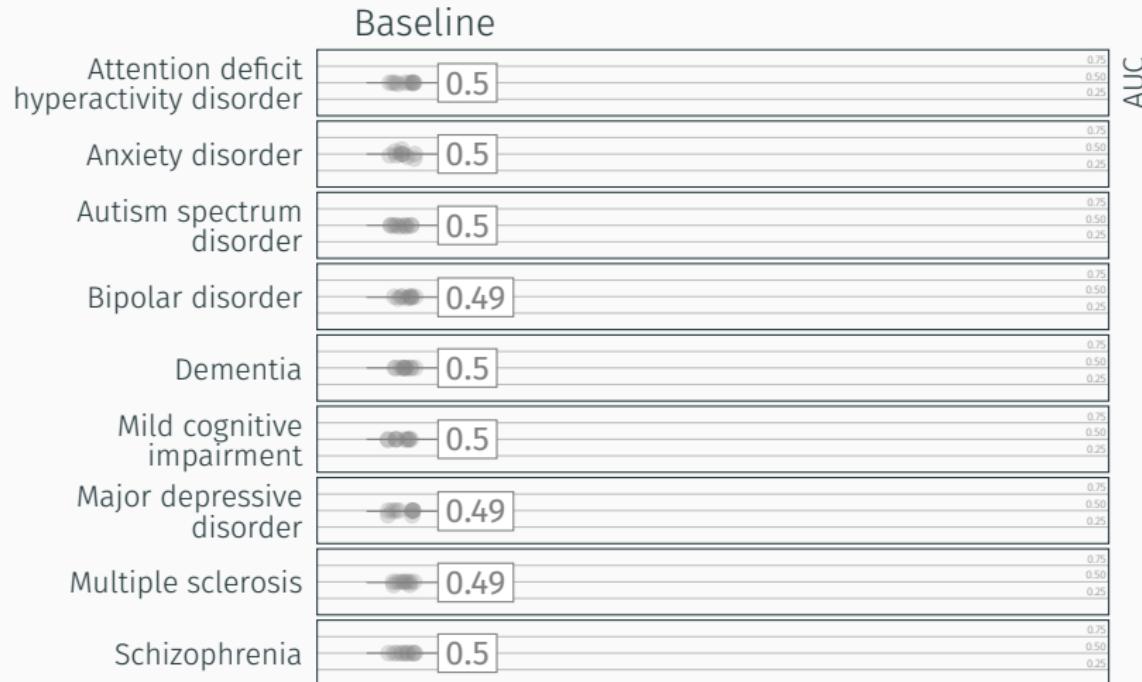


Younger
appearing

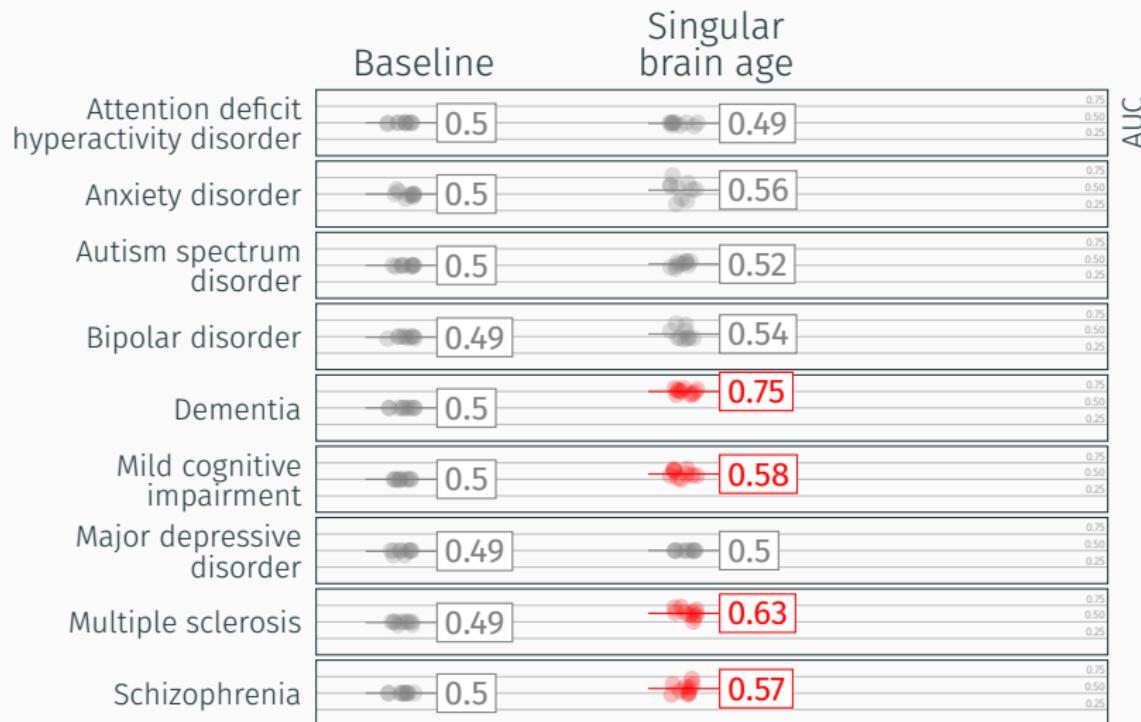
Older
appearing



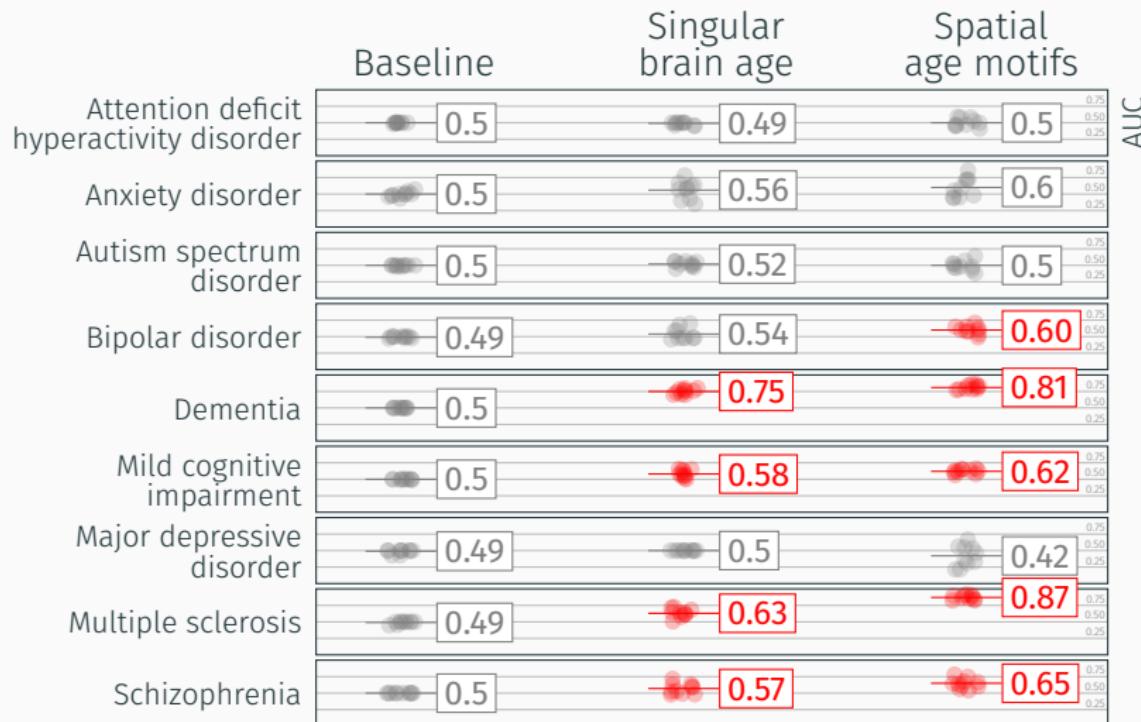
Explainable artificial intelligence: Results



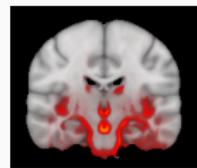
Explainable artificial intelligence: Results



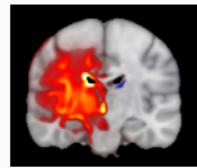
Explainable artificial intelligence: Results



Explainable artificial intelligence: Results



Dementia

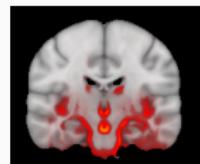


Multiple
sclerosis



Explainable artificial intelligence: Results

AUC



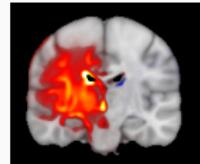
Dementia

Singular
brain age

0.75

Spatial
age motifs

0.81



Multiple
sclerosis

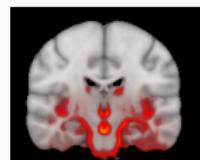
0.63

0.87



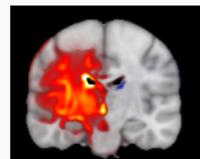
Explainable artificial intelligence: Results

AUC



Dementia

Singular brain age	Spatial age motifs
0.75	0.81
0.06	

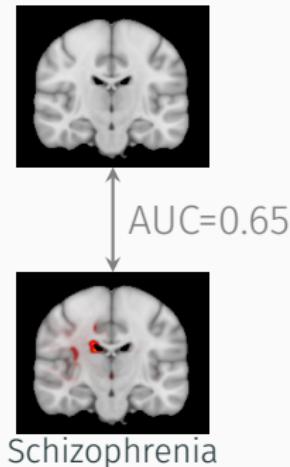
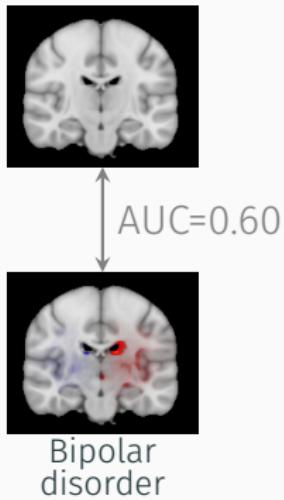


Multiple
sclerosis

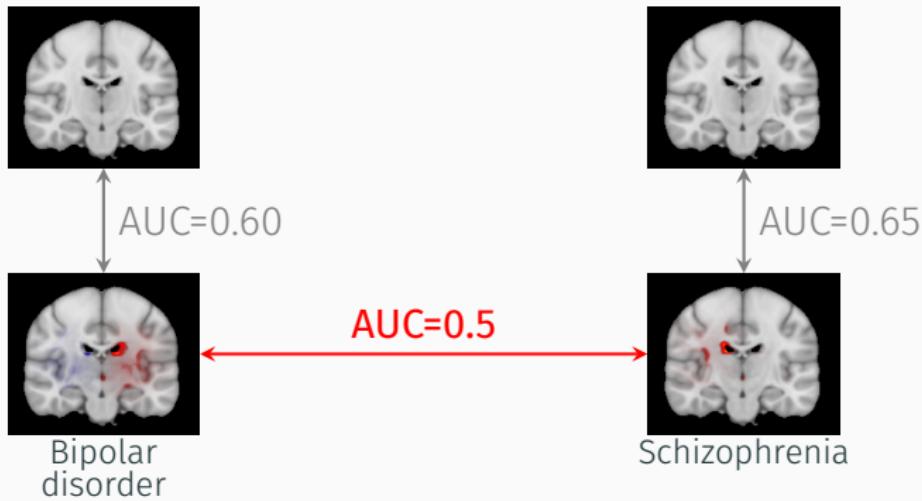
0.63 → 0.87
0.24



Explainable artificial intelligence: Results



Explainable artificial intelligence: Results



Thank you for your attention!



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