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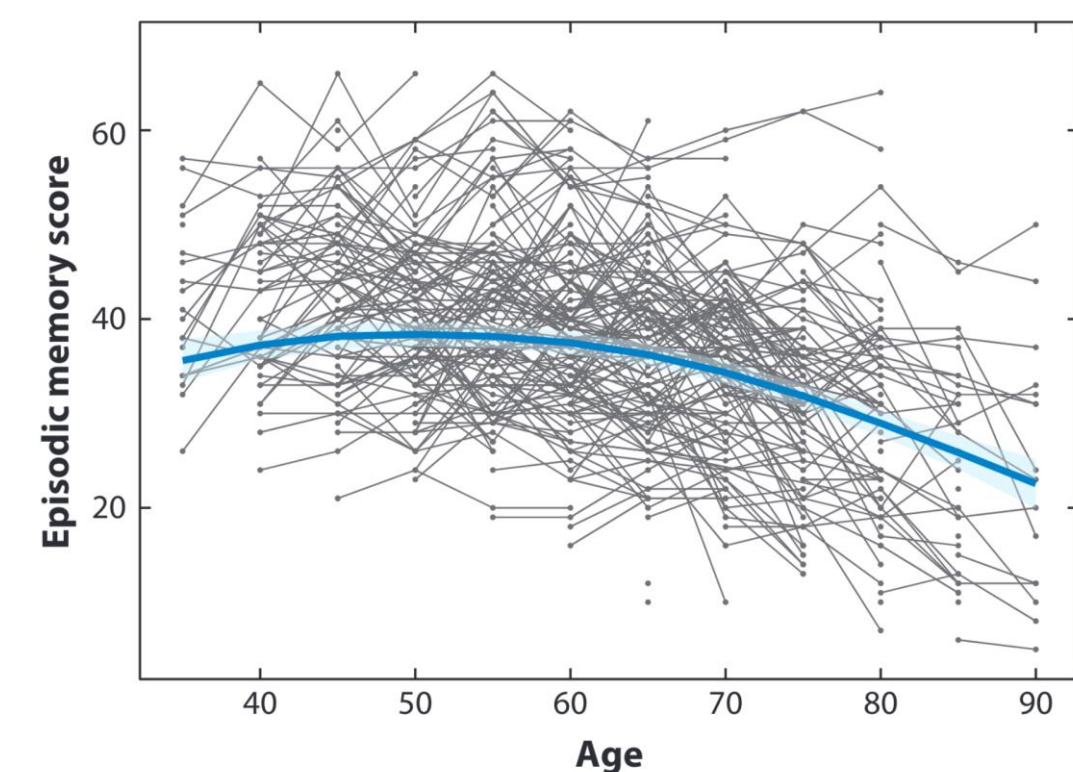
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Background



Nyberg & Pudas (2019). Annual Review of Psychology

- **Episodic memory decline** is common after age 60 – but not inevitable
- **Superagers** retain memory performance typical of adults 30 to 40 years younger

Objectives

STEP 1. Explore whether **structure-function coupling (SFC)** differentiates superagers from non-superagers beyond functional connectivity or structural connectivity alone

STEP 2. Examine **global SFC** and **regional SFC** (superagers vs non-superagers) & the relationship between **SFC** and **episodic memory**

Methods

Participants



- **N** = 240
- **Age**_{baseline}: 67.8 years
 - Range: 60-82 years
- **Sex**: 64.2% female
- Mean **follow-up**: 2.2 years

Superager Criteria

- **Superager** criteria at baseline and follow-up:
 - **RAVLT** delayed recall score $\geq$ mean of 16–29-year-olds
 - **Trail Making Test B**, **semantic fluency**, and **inverse digits** score within 1SD of the mean for age and education

35.8% of the cohort (N = 86) met longitudinal superager criteria

Analyses

STEP 1.

Logistic elastic-net models
(superagers vs non-superagers)

Covariates: age, sex, education

STEP 2.

Linear mixed effects models

Covariates: age, sex, education, time; random intercept per participant

Baseline models

Baseline + slope models

Nested cross-validation

$$\frac{\Delta X}{\Delta age}$$

- **AUC** 95% CI 2,000 bootstrap resamples
- **Model-level p-values** 1,000 label permutations FDR-corrected p-values

SFC

$\sim \beta_{\text{group}}$

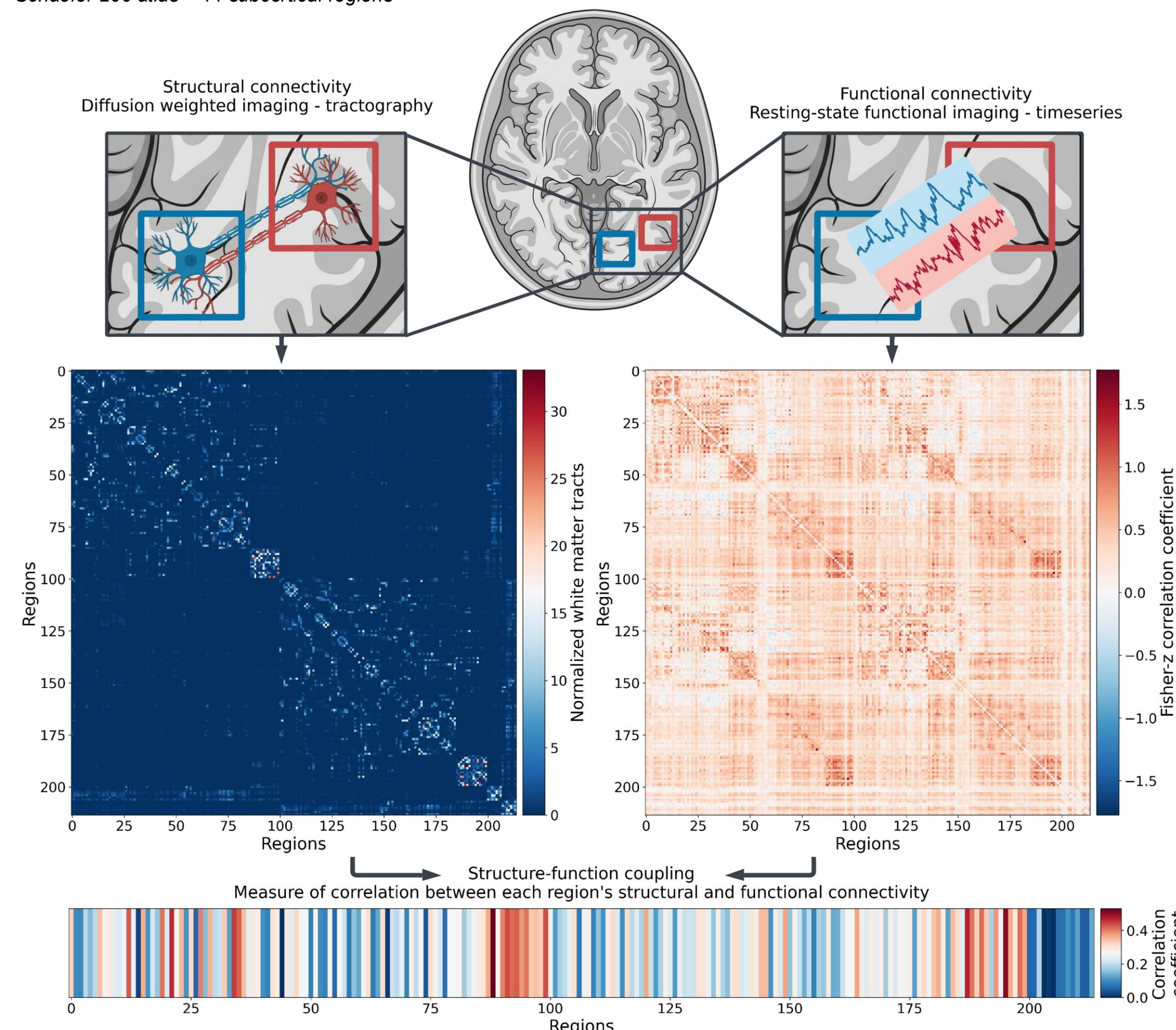
} superagers vs non-superagers

Episodic memory

$\sim \beta_{\text{SFC}}$

Measures

Schaefer 200 atlas + 14 subcortical regions



Results

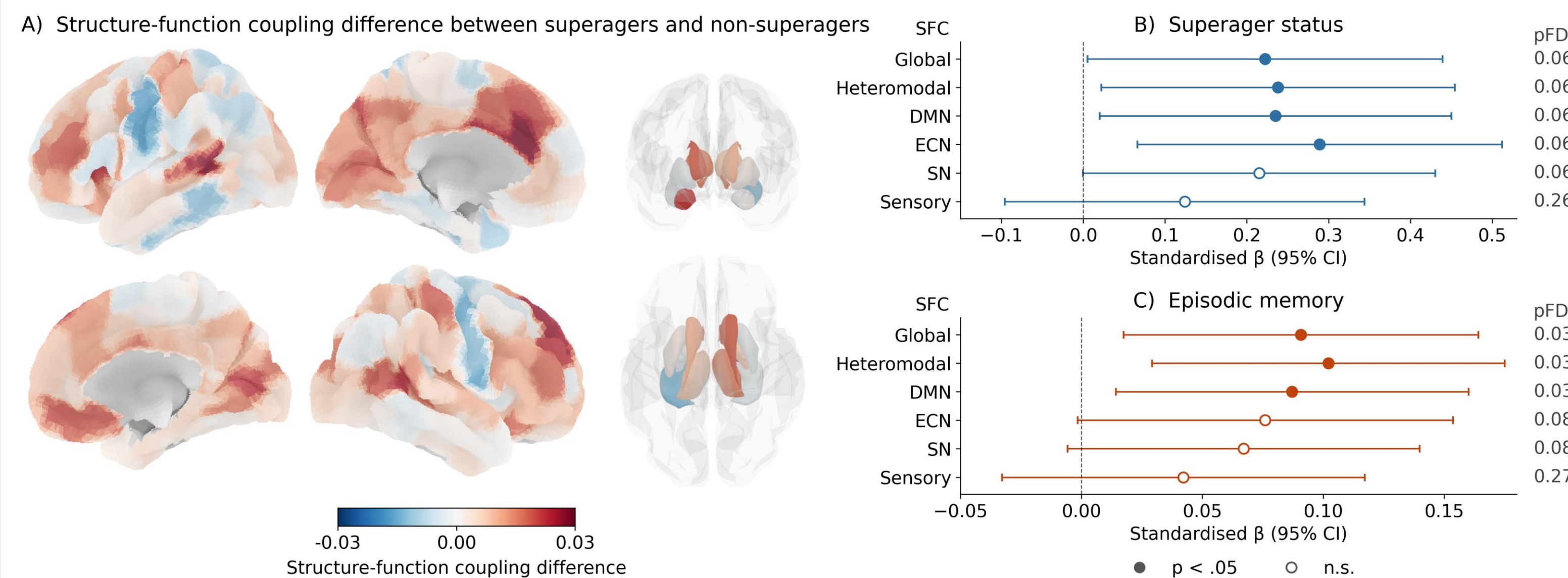
STEP 1.

SFC was the only modality that significantly classified superagers across models

Modality	Features	AUC	95% CI	pFDR
SFC	Baseline	0.581	[0.505, 0.656]	0.036*
SFC	Baseline + slope	0.582	[0.501, 0.657]	0.045*
Functional Connectivity	Baseline	0.497	[0.423, 0.573]	0.517
Functional Connectivity	Baseline + slope	0.526	[0.454, 0.604]	0.266
Structural Connectivity	Baseline	0.561	[0.487, 0.636]	0.087
Structural Connectivity	Baseline + slope	0.555	[0.481, 0.633]	0.087

STEP 2.

- **Superagers** had **higher SFC**
- **Higher SFC** was associated with **better episodic memory**



(A) *Unthresholded mean difference in global SFC (superagers vs non-superagers), with warm colors indicating higher coupling in superagers.*
(B, C) *Linear mixed-effects model coefficients and confidence intervals.*

Abbreviations: FDR false discovery rate, DMN default mode network, ECN executive control network, SN salience network

Discussion

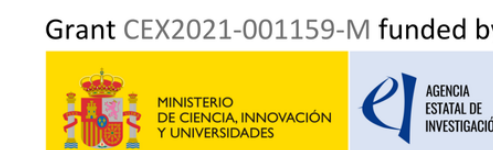
Implications

- SFC classified superagers better than functional and structural connectivity alone and was associated with better episodic memory.
- Preservation of exceptional memory in aging may rely on SFC, positioning it as a candidate neural marker of cognitive resilience.

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