Neural mechanisms underlying processing speed in healthy older adults

Ferreira, S.[1,4,5], Schu, G.[1,2], de Haan, S.[1,2], Amaral, L.[1,2], Martins, A.[1,2], Cuypers, K.[4,5], Simões, M. R.[1,3], Almeida, J.[1,2], Peres, A.[1,2]

[1]*Faculty of Psychology and Educational Sciences, University of Coimbra, Portugal*
[2]*Proaction Laboratory, Faculty of Psychology and Educational Sciences, University of Coimbra, Portugal*
[3]*Psychological Assessment and Psychometrics Laboratory (PsyAssessmentLab), Faculty of Psychology and Educational Sciences, University of Coimbra, Portugal*
[4]*Neuroplasticity and Movement Control Research Group, Rehabilitation Research Institute (REVAL), University of Hasselt, Belgium*
[5]*Movement Control and Neuroplasticity Research Group, Department of Movement Sciences, KU Leuven, Belgium*

INTRODUCTION

Processing speed (PS) corresponds to the rate of information processed in a determined amount of time and is one of the cognitive functions most affected by advancing age (Salthouse & Ferrer-Caja, 2003). Therefore, unraveling the neural mechanisms underlying processing speed in the elderly is essential for understanding the aging process and developing therapeutic strategies aiming at attenuating or reversing it (Gao et al., 2020).

Here, we investigate whether brain connectivity is associated with differences in processing speed in older adults, specifically focusing on the anatomical connectivity [measured by the fractional anisotropy (FA) and radial diffusivity (RD) metrics] of 10 relevant white matter tracts, and the functional connectivity between 12 regions of interest.

METHODS

57 healthy older adults

- Age: 68.61 ± 4.94
- Years of education: 12.28 ± 4.79

Screening

- Montreal Cognitive Assessment 7.1 (MoCA 7.1)
- Geriatric Depression Scale - 30 (GDS-30)
- *Inventário de Avaliação Funcional do Adulto Idoso* (IAFAI)

Neuroimaging

- Diffusion Tensor Imaging (DTI)
- Resting state functional Magnetic Resonance Imaging (rs-fMRI)

Neuropsychological Assessment of PS

- Digit Symbol-Coding from WAIS-III
- Symbol-Search from WAIS-III
- Stroop Color-Word Test

Composite measure of processing speed (PS)

Two groups (each of 15 older adults)

- High PS group
- Low PS group

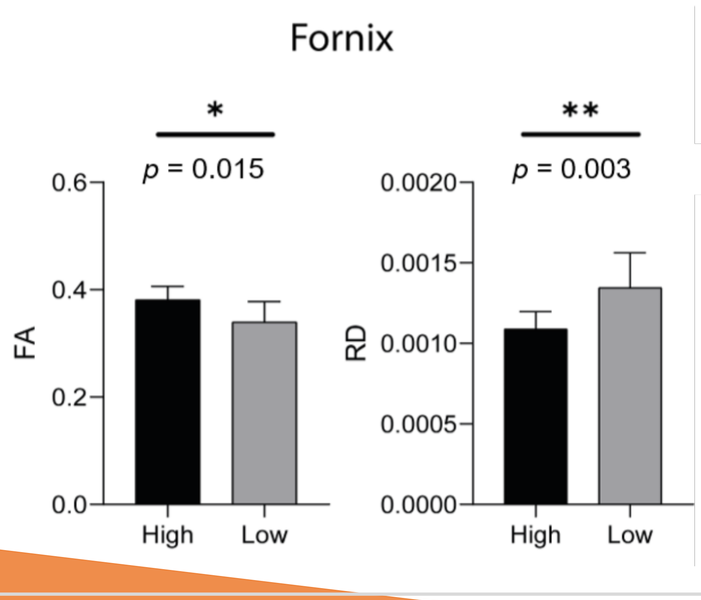
RESULTS

Anatomical Connectivity (DTI)

➢ Group differences
(two-tailed t-test ⟶ Bonferroni-corrected)

Fractional Anisotropy (↓ in Low PS group)
- Fornix

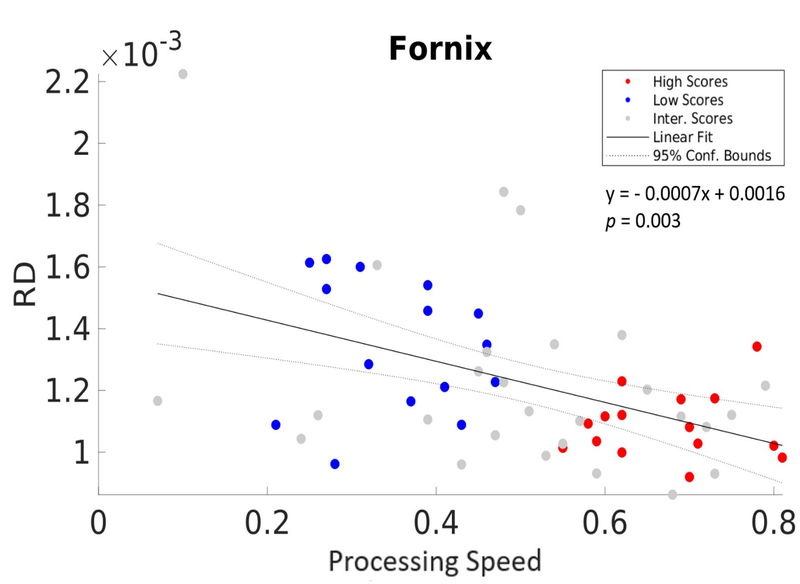
Radial Diffusivity (↑ in Low PS group)
- Fornix
- Splenium of the corpus callosum
- (L/R) Inferior fronto-occipital fasciculus



➢ Linear regression
(Bonferroni-corrected)

Fractional Anisotropy (↓ in Low PS group)
- Fornix

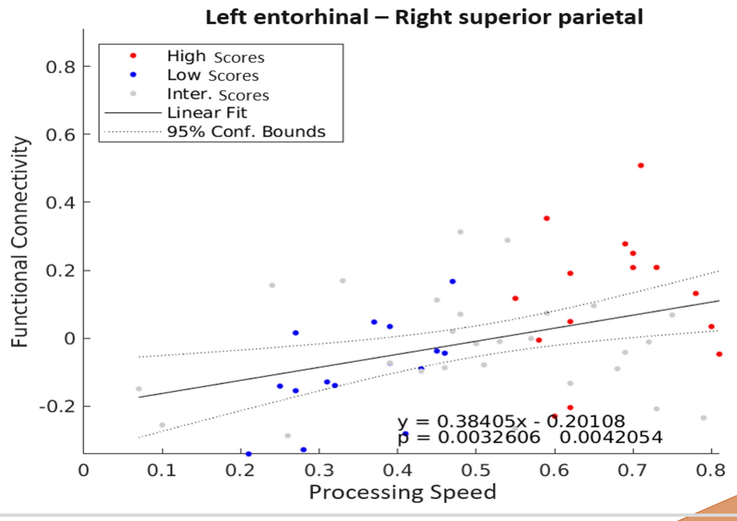
Radial Diffusivity (↑ in Low PS group)
- Fornix
- (L/R) Superior longitudinal fasciculus
- (L/R) Uncinate fasciculus



Functional Connectivity (rs-fMRI)

➢ Group differences
(two-tailed t-test ⟶ FDR-corrected)
- No significant results

➢ Linear regression (FDR-corrected)
↓ Functional Connectivity in Low PS group
- Left entorhinal ✕ left superior parietal
- Left entorhinal ✕ right superior parietal
- Posterior cingulate ✕ anterior cingulate
- Posterior cingulate ✕ precuneus
- Left precentral ✕ right superior parietal



CONCLUSION

- Demyelination highly impacts the processing speed performance of healthy older adults.
- In the elderly, processing speed performance is associated with the optimal functioning of memory systems, with particular emphasis on episodic memory, as well as motor planning, attention, and executive functioning.

Fernandes, S. (2013). *Stroop - Teste de Cores e Palavras: Manual*. CEGOC.
Freitas, S., Simões, M. R., Santana, I., Martins, C., & Nasreddine, Z. (2013). *Montreal Cognitive Assessment (MoCA): Versão 1*. Faculdade de Psicologia e Ciências da Educação da Universidade de Coimbra.
Gao, M., Wong, C. H. Y., Huang, H., Shao, R., Huang, R., Chan, C. C. H., & Lee, T. M. C. (2020). Connectome-based models can predict processing speed in older adults. *NeuroImage, 223*, 1- 14. https://doi.org/10.1016/j.neuroimage.2020.117290
Salthouse, T. A., & Ferrer-Caja, E. (2003). What needs to be explained to account for age-related effects on multiple cognitive variables. *Psychology and Aging, 18*(1), 91-110. https://doi.org/10.1037/0882-7974.18.1.91
Simões, M. R., Freitas, S., Santana, I., Firmino, H., Martins, C., Nasreddine, Z., & Vilar, M. (2008). *Montreal Cognitive Assessment (MoCA): Versão final portuguesa*. Faculdade de Psicologia e de Ciências da Educação da Universidade de Coimbra.
Sousa, L. B., Vilar, M., & Simões, M. R. (2013). *Inventário de Avaliação Funcional de Adultos e Idosos (IAFAI)*. Faculdade de Psicologia e de Ciências da Educação da Universidade de Coimbra.
Wechsler, D. (1997). *WAIS_III/ Wechsler Adult Intelligence Scale. Administration and scoring manual*. Psychological Corporation.
Wechsler, D. (2008). *Escala de Inteligência de Wechsler para Adultos – Terceira Edição (Wechsler Adult Intelligence Scale – Third Edition; WAIS-III)*. CEGOC-TEA.

CONTACT ME

sara.ferreira@uhasselt.be

SCAN ME