

# Aging effects on the structural and functional connectivity of cognitive control: An fMRI study in arithmetic

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## Background

Age-related decline of working memory and inhibition processes

-We studied inhibition of irrelevant arithmetic knowledge (8 x 4 = 12)<sup>1</sup> and maintenance/ updating of rules in working memory

## Goals

To understand: 1) Age-related differences on structural and functional connectivity underlying cognitive control

2) Individual differences in cognitive control processes, functional connectivity, and white matter tract specific microstructure<sup>2</sup>

## Results

-Larger interference effects in older adults and low-control individuals

-Larger frontal activations in older adults

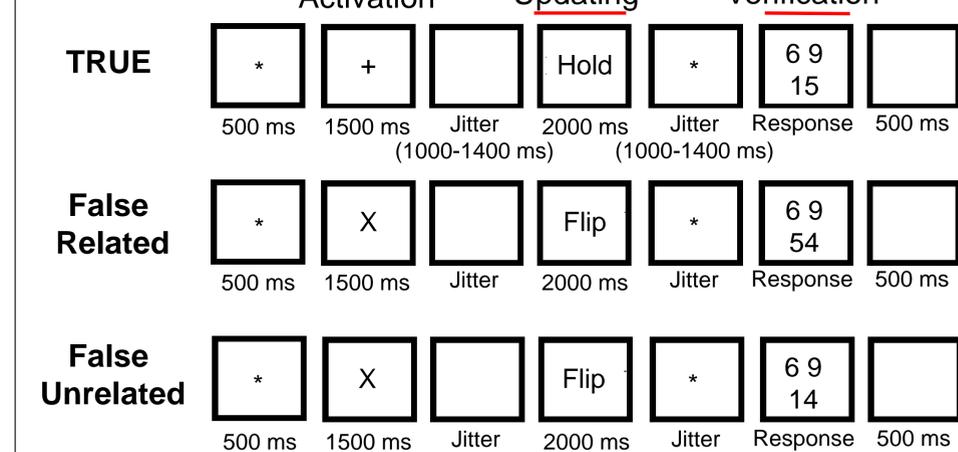
-Alteration of the integrity of fronto-posterior white matter tract and functional connectivity in low-control older adults

## Conclusion

-Age-related decline in working memory and inhibition are related to individual differences in functional and structural connectivity.

-Fronto-posterior connectivity is associated with efficient interference resolution

## Methods



### Verification of arithmetic problems

-Data Collection 34 young and 34 older adults  
-fMRI: 54 slices, multi-band factor : 6, RT: 621ms, ET: 30 ms, 3.0 mm slice thickness

-Diffusion sequence: 64 noncollinear directions, b=1000 s/mm<sup>2</sup>

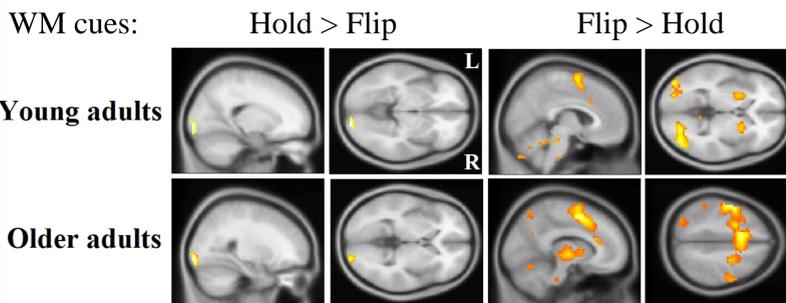
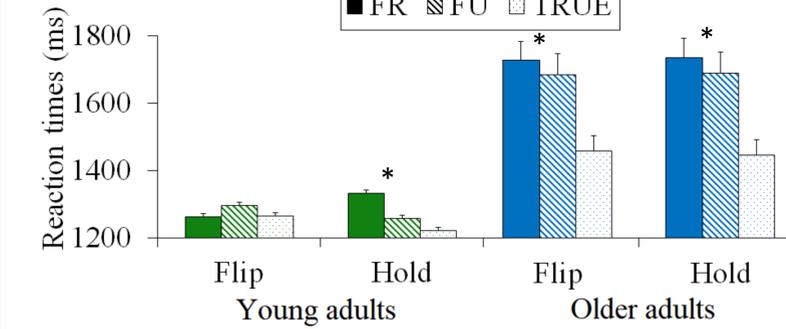
-Data Analysis: Low/High control groups defined based on a composite z-score (Stroop interference and digit backward span)

-Dynamic Causal Modeling: One fully connected model; Bayesian parameter averaging + GPPI

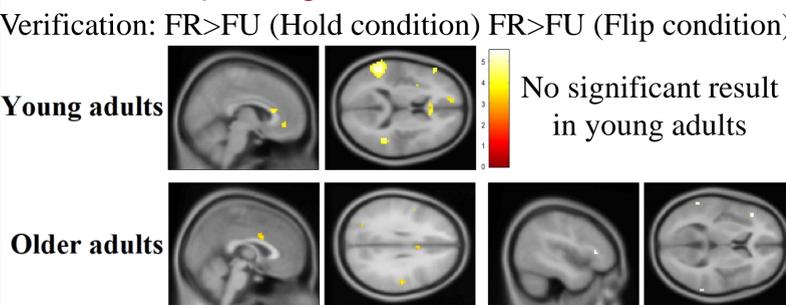
## References

<sup>1</sup>Grabner, R. H., Ansari, D., Koschutnig, K., Reishofer, G., & Ebner, F. (2013). The function of the left angular gyrus in mental arithmetic: Evidence from the associative confusion effect. *Human Brain Mapping*, 34(5), 1013–1024.  
<sup>2</sup>Walsh, M., Montojo, C. A., Sheu, Y.-S., Marchette, S. A., Harrison, D. M., Newsome, S. D., ... Courtney, S. M. (2011). Object Working Memory Performance Depends on Microstructure of the Frontal-Occipital Fasciculus. *Brain Connectivity*, 1(4), 317–329.

## Results

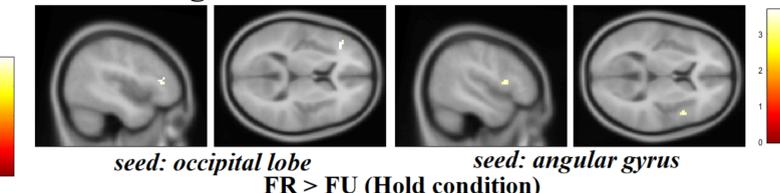
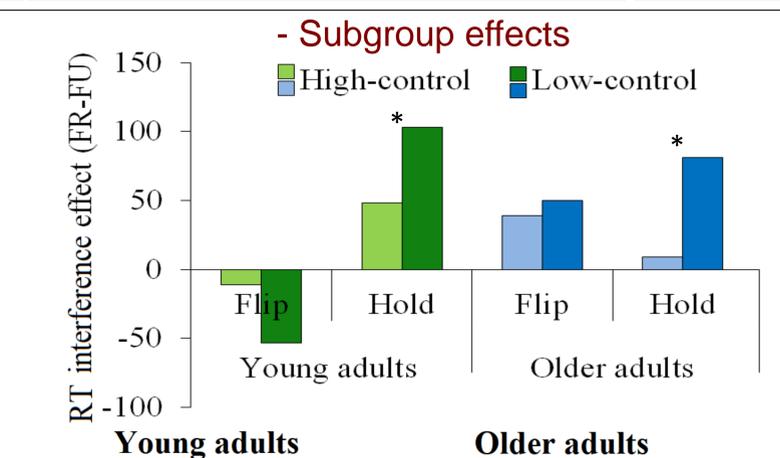


- Larger activations in older adults during WM updating vs. maintenance

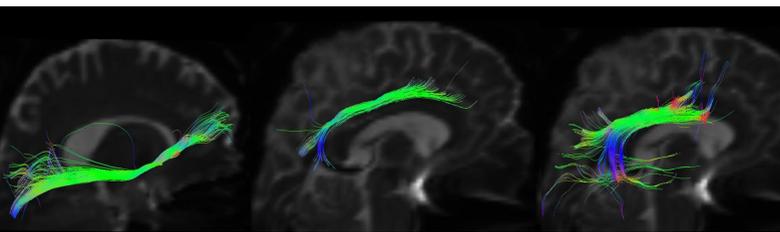


- Age-related differences during interference processing (FR>FU contrast) for both WM cues

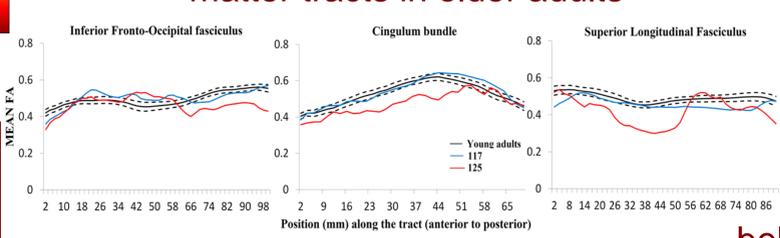
IFG: Inferior frontal gyrus OFC: Orbito-frontal cortex  
ACC: Anterior cingulate cortex AG: Angular gyrus  
OL: Occipital lobe SFS: Superior frontal sulcus



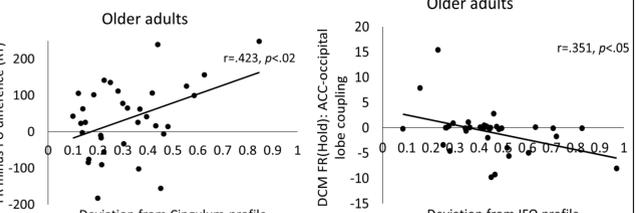
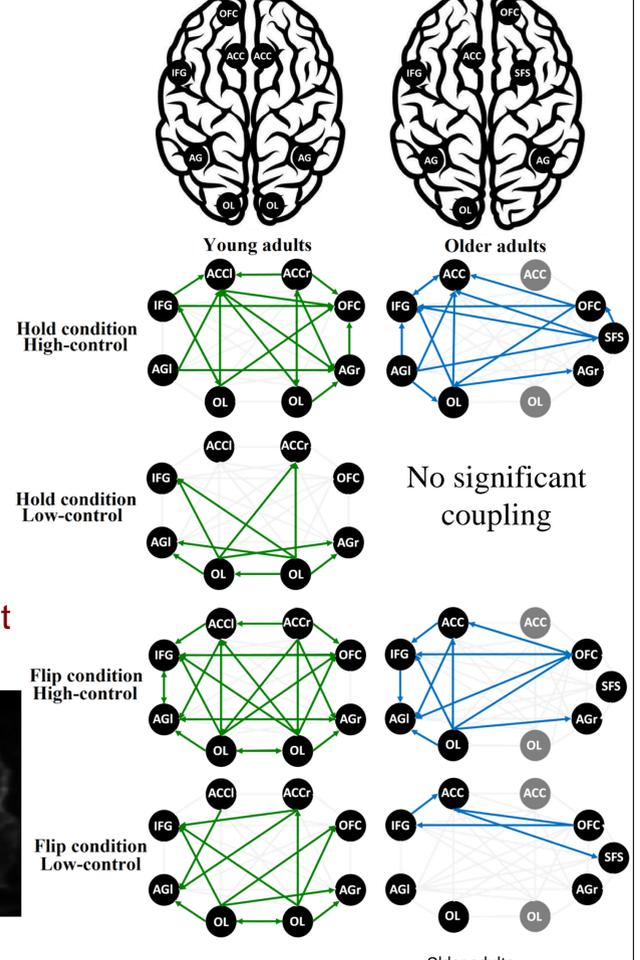
- Fronto-parietal functional connectivity significant only in high-control individuals.



- Reduced integrity of fronto-posterior white matter tracts in older adults



## - DCM models: FR problems



- Correlation between DTI deviation, behavioral interference and DCM couplings