Neural correlates of strategy shifts in navigation behavior

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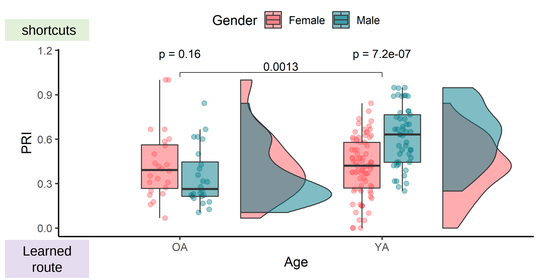
INTRODUCTION

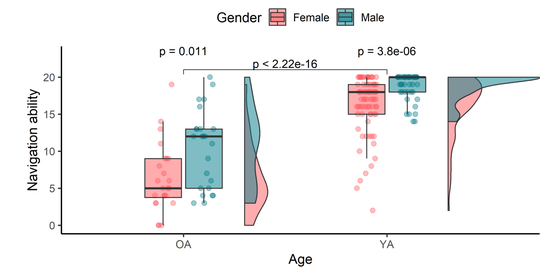
- Navigation strategy – **how a person finds their way around the world,** varies independently from navigation ability – **how successfully one can find their way**[1].
- Animal and human-based research[2–3] reveals two main navigation strategies:

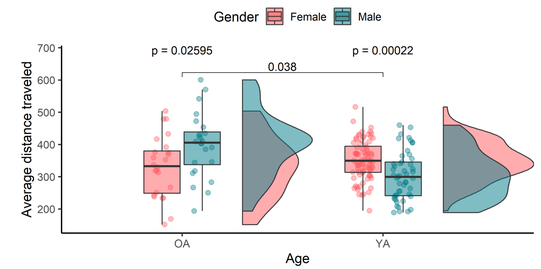
  Response-based (caudate dependent)
  Place-based (hippocampal dependent)
- In healthy aging, older adults tend to use a caudate dependent strategy[4–6].
- **Research Question:** How do neural correlates of spatial navigation strategy track behavioral differences across age groups?
- **Behavioral Hypothesis:** Older adults will be more likely to use a familiar route compared to younger adults.
- **Neural Hypothesis:** Older adults will show a decrease in hippocampal activation and an increase in caudate nucleus activation compared to young adults.

RESULTS

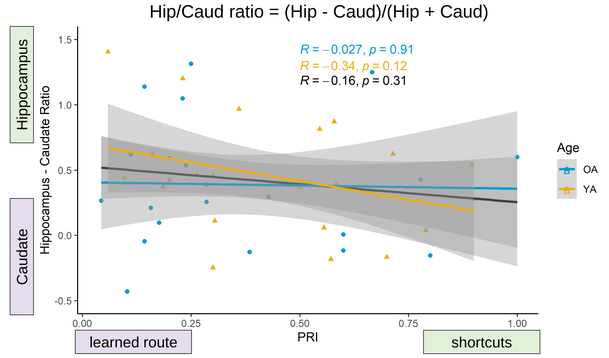
Behavioral age and gender differences for all subjects

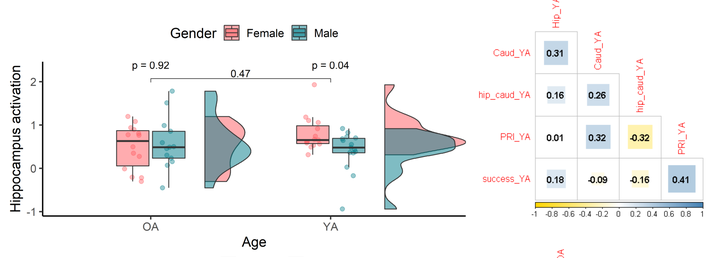


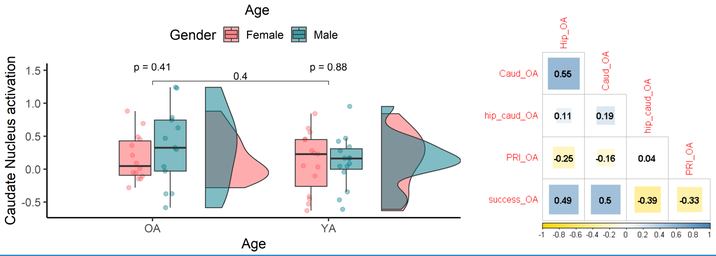




ROI analysis of age and gender by hippocampal and caudate activation for fMRI subsample

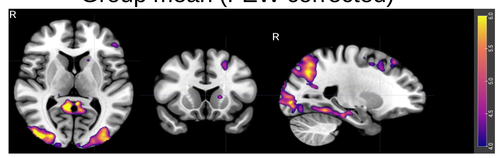




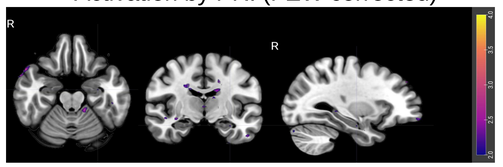


Whole brain analyses for task > control

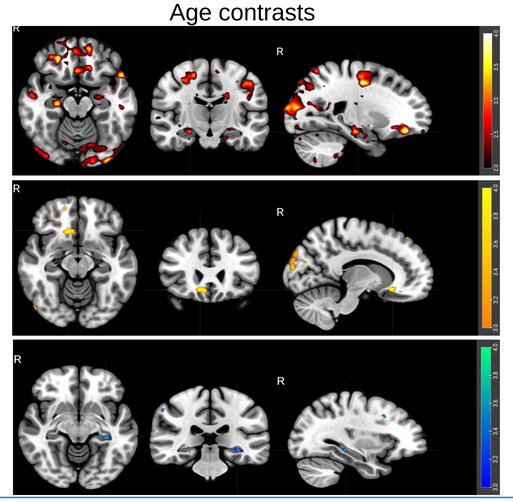
Group mean (FEW corrected)



Activation by PRI (FEW corrected)



Age contrasts



METHODS

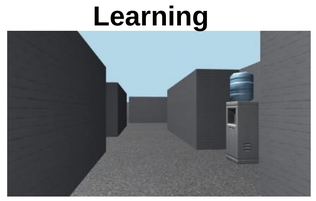
All participants were generally healthy younger and older adults; all underwent extensive health screenings to determine inclusion

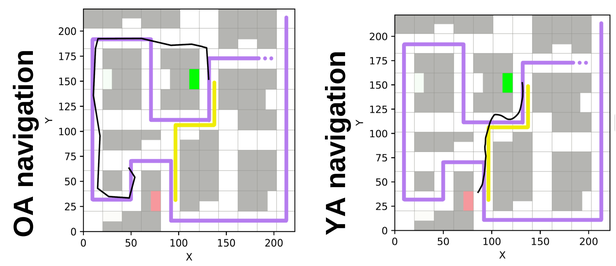
Exclusion criteria: psychological disorder, severe or progressive medical illness, ineligibility for MRI, cutoff score ≤ 30 on Telephone Interview for Cognitive Status (TICS)[7]

Sample:

Behavioral		
Age group	**Gender**	
OA (M = 69 years)	Female	7
	Male	7
YA (M = 20 years)	Female	63
	Male	34
	Total	111

fMRI		
Age group	**Gender**	
OA (M = 71 years)	Female	17
	Male	17
YA (M = 23 years)	Female	16
	Male	15
	Total	65





Place response index (PRI): using path planning algorithms
total number of shortcuts taken/ shortcuts + learned route + reverse learned route

⬆ PRI = ⬆ shortcut taking (place strategy) = ⬆ hippocampal activation[8]

fMRI Design:

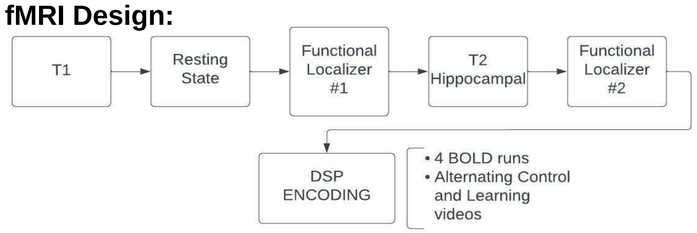


Image Acquisition: 3T Philips Achieva MR Scanner w/ 32-channel head coil
Image Processing: Data were pre-processed using fmriprep, Standard whole-brain general linear model (GLM) analyses using FSL.ROIs were extracted using FSL's Harvard-Oxford Cortical and Subcortical Atlases

CONCLUSION

Behavioral:

- Older adults rely more on a response-based (learned route) strategy compared to younger adults.
- Younger adults find the goal more often than older adults.
- Older adult travel longer distances than younger adults to reach the goal.

fMRI:

- Unlike previous research, hippocampal/caudate activity ratio does not correlate positively with navigation strategy.
- Age-related contrasts reveal increased activity in younger adults in regions associated with decision-making (vmPFC), vestibular function, and a place-based strategy (hippocampal).
- Age- and gender-related differences exist in general hippocampal and caudal activation, which correlate differently with behavior across groups.

REFERENCES

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