Spatial navigation behavior correlates with specific components of attentional function

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1. Motivation

Spatial navigation and **attentional function** are essential tasks that often deteriorate during aging[1,2]

Spatial navigation relies on attending to appropriate information as it enters our senses, and parietal[3,4] and temporal[5,6] cortices have both been implicated in different aspects of these tasks

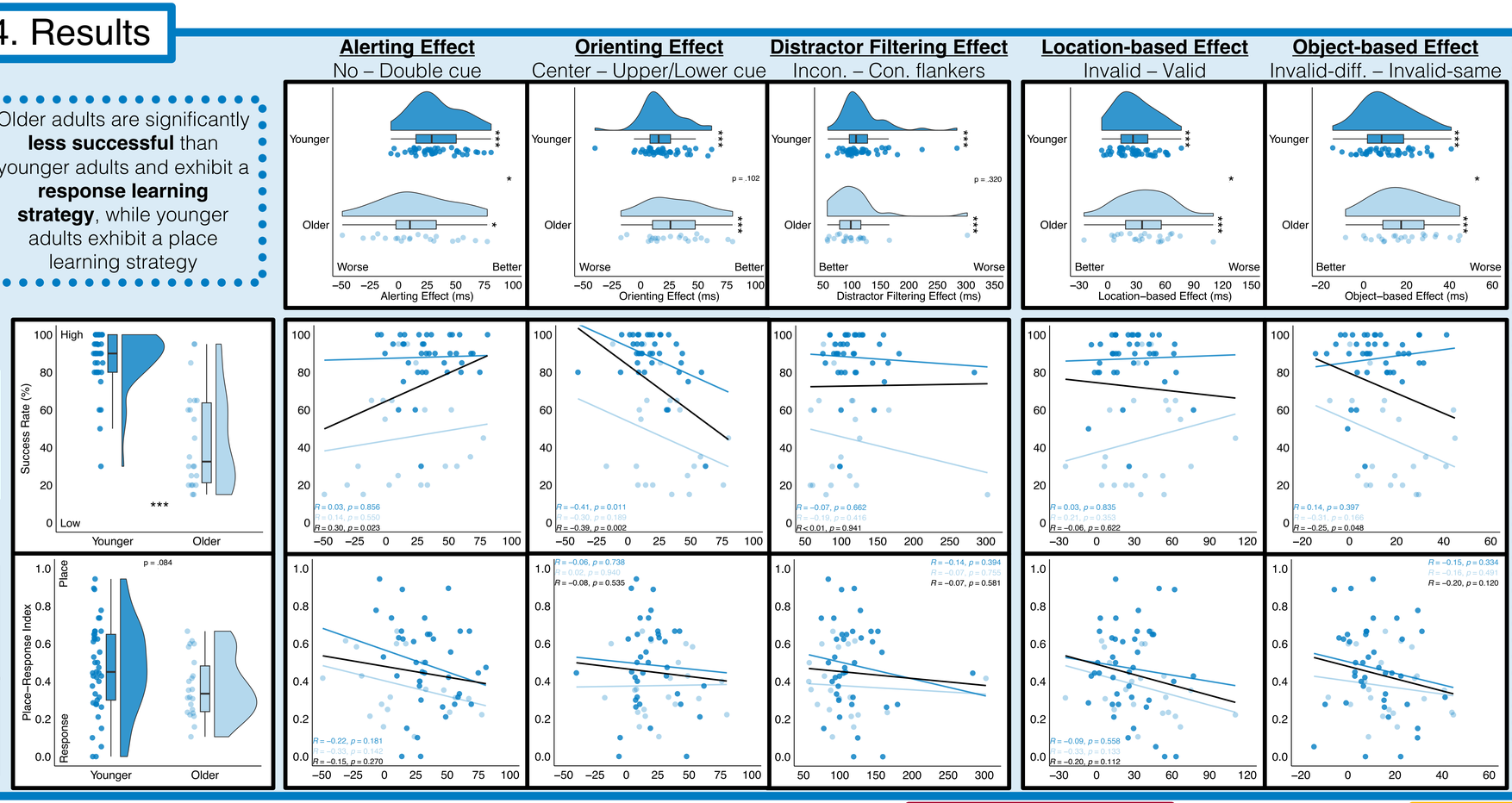
Hypothesis: Behavioral impairments in spatial navigation correlate with behavioral impairments in attentional functioning in older adults

2. Sample

	Younger	Older
N	46	23
Age (years)	18-27 *M* = 20.33	55-83 *M* = 70.65
Gender	31 women 15 men	11 women 12 men
Education (years)	14.25	16.00
MoCA	22-30 *M* = 28.00 (*N* = 22)	24-30 *M* = 28.00

4. Results

Older adults are significantly **less successful** than younger adults and exhibit a **response learning strategy**, while younger adults exhibit a place learning strategy



Older adults exhibit a significant **alerting impairment** compared to younger adults, suggesting difficulty achieving and maintaining an alert state in response to a cue[8,10,11]

Older adults exhibit both significant **location- and object-based selection impairments** compared to younger adults, indicating increased costs shifting visual attention between spatial locations and objects[2,9,12]

Across age groups, **alerting and object-based selection impairments** are significantly correlated with **low spatial navigation success**, meaning that being alert and efficiently shifting between objects are associated with successful spatial navigation

Note: 4 YAs and 2 OAs were excluded from the Attention Network Task due to low task accuracy

3. Tasks

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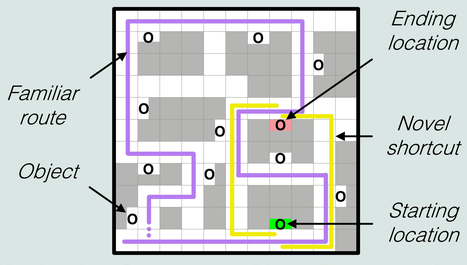
Dual Solution Paradigm[7]

Virtual environment task that measures **spatial navigation strategy** and **navigation success**



Navigation Strategy → Place-Response Index

Response learning

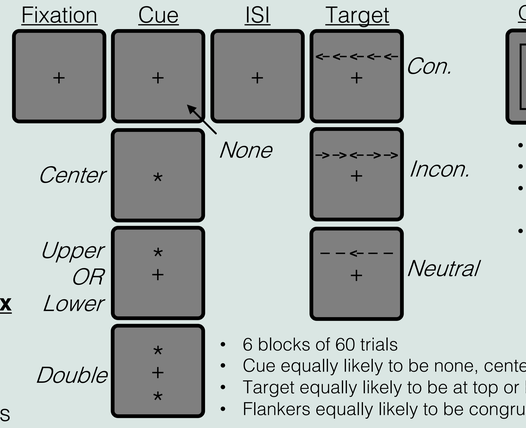
Memorized sequence of turns at intersections

Place learning

Map-like representation allowing novel shortcuts

Attention Network Task[8]

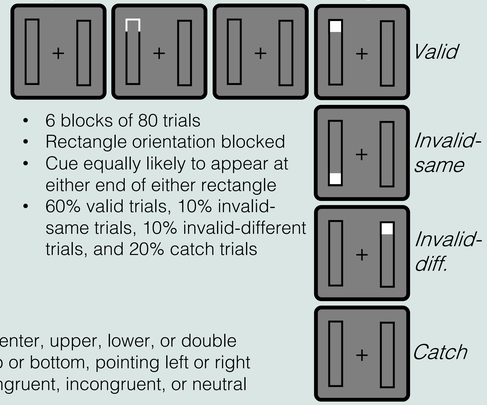
Measures attentional mechanisms of **alerting, orienting,** and **distractor filtering**



- 6 blocks of 60 trials
- Cue equally likely to be none, center, upper, lower, or double
- Target equally likely to be at top or bottom, pointing left or right
- Flankers equally likely to be congruent, incongruent, or neutral

Double Rectangle Task[9]

Measures attentional selection of **spatial locations** and **objects**



- 6 blocks of 80 trials
- Rectangle orientation blocked
- Cue equally likely to appear at either end of either rectangle
- 60% valid trials, 10% invalid-same trials, 10% invalid-different trials, and 20% catch trials

5. Conclusion

Across age groups. spatial navigation success is significantly correlated with specific components of visual attention (alerting and object-based selection)

However, these correlations are not significant in older adults, likely due to an inadequate sample size

Additionally, no significant correlations were observed between spatial navigation strategy and visual attention

These results provide provisional support to the theory of attentional function as a cognitive mechanism that guides spatial navigation behavior

Up next: Are similar navigation-attention correlations also observed in structural and functional MRI?

6. References

[1]Allison et al. (2016). *J. Alzheimers Dis.*; [2]Buck et al. (1997). *Brain*; [3]Goldberg et al. (2006). *Prog. Brain Res.*; [4]Andersen et al. (1997). *Annu. Rev. Neurosci.*; [5]Baldauf & Desimone (2014). *Science.*; [6]Packard & McGaugh (1996). *Neurobiol. Learn. Mem.*; [7]Marchette et al. (2011). *J. Neuro.*; [8]Fan et al. (2002). *J. Cogn. Neurosci.*; [9]Egly et al. (1994). *J. Exp. Psychol. Gen.*; [10]McDonough et al. (2019). *Yale J. Biol. Med.*; [11]Gamboz et al. (2010). *Exp. Aging Res.*; [12]Pilz et al. (2012). *PLoS One*

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