

Neural mechanisms underlying the use of learned value to guide memory across development

Kate Nussenbaum, Daphne Valencia, Jamie Greer, Nora Keathley, & Catherine A. Hartley



How do we use the structure of our environment to determine how to prioritize information in memory?

- The ability to strategically encode high-value information may improve from childhood to adulthood. ^{1, 2}
- Studies examining value-guided memory have relied on *explicit value cues*, which are often absent in the real world.
- What neural mechanisms support strategic memory prioritization based on signals of information value learned from environmental statistics?

fMRI Task

A Frequency- Learning



2s + 2 - 6s ITI

B Encoding

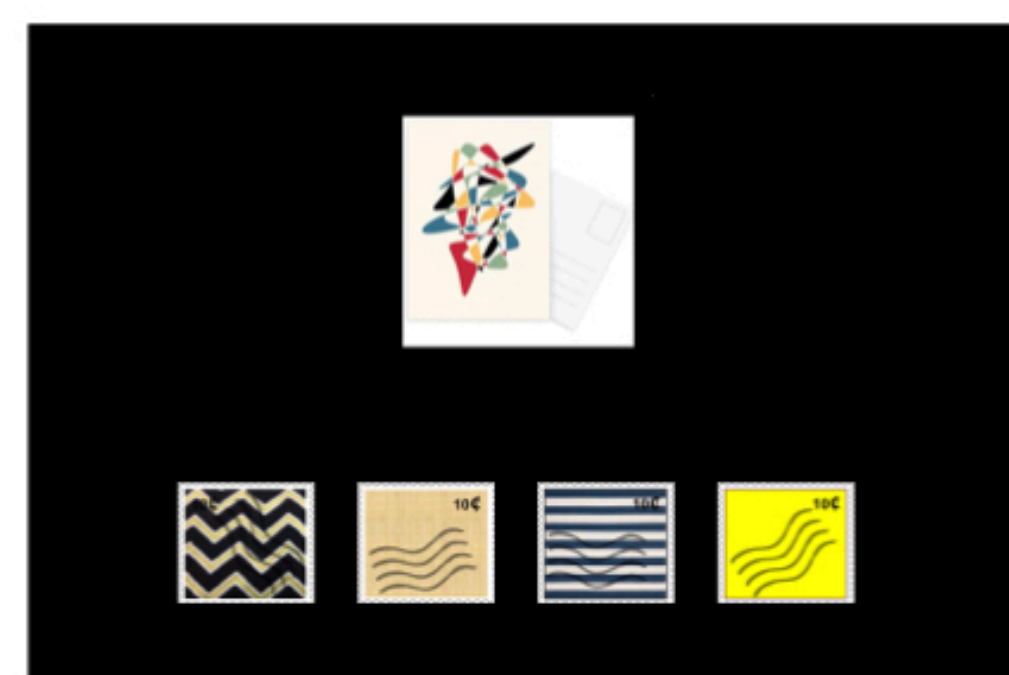


5s + 2 - 6s ITI

Participants first learned the frequencies (1 or 5) of each item, which corresponded to how many points they could earn for remembering information about it.

They then saw information associated with each item once.

C Retrieval



6s + 2 - 6s ITI

D Frequency Reports



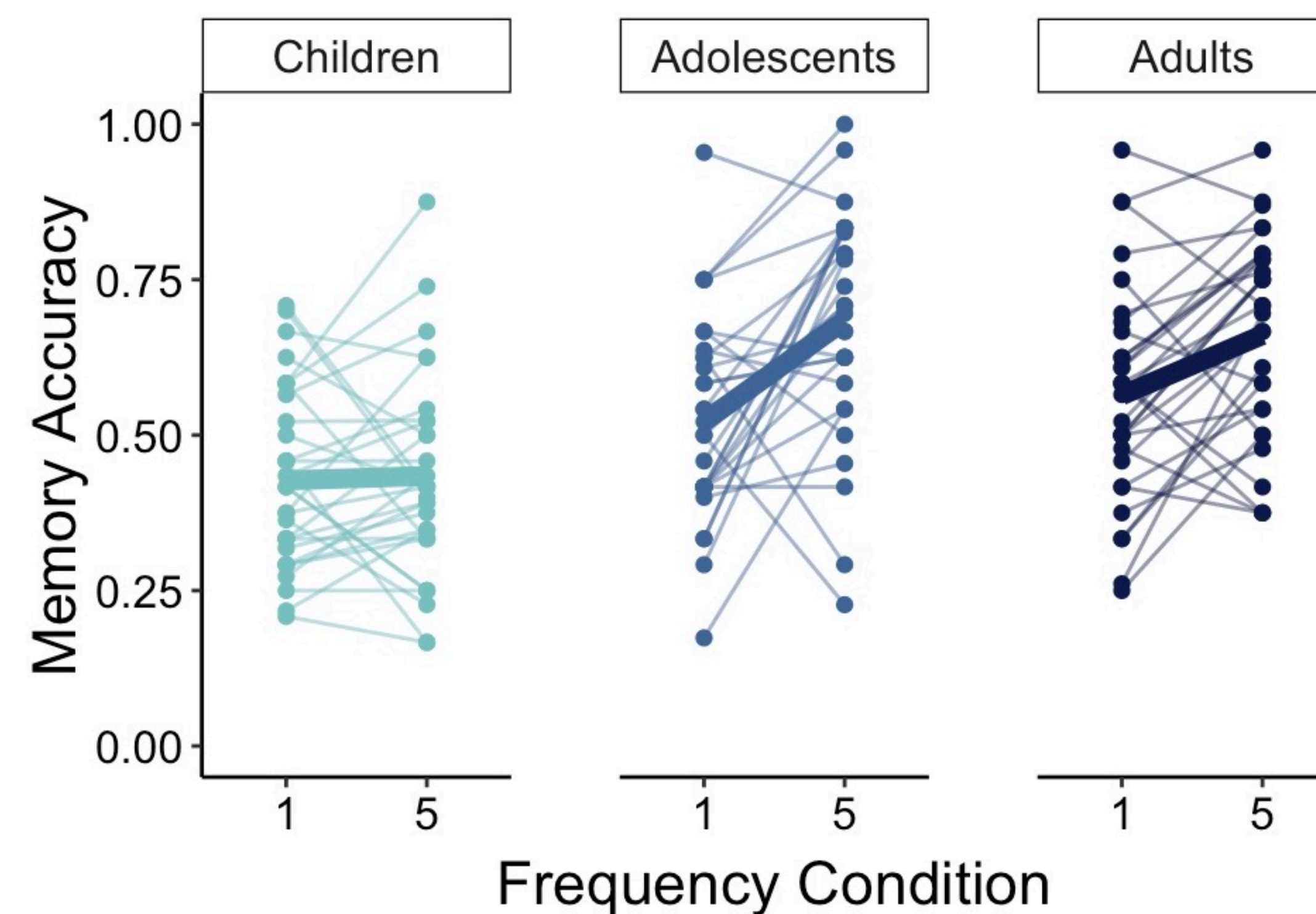
6s + 2 - 6s ITI

In the memory test, participants had to select the information associated with each item (C) and the item's original frequency (D).

Participants

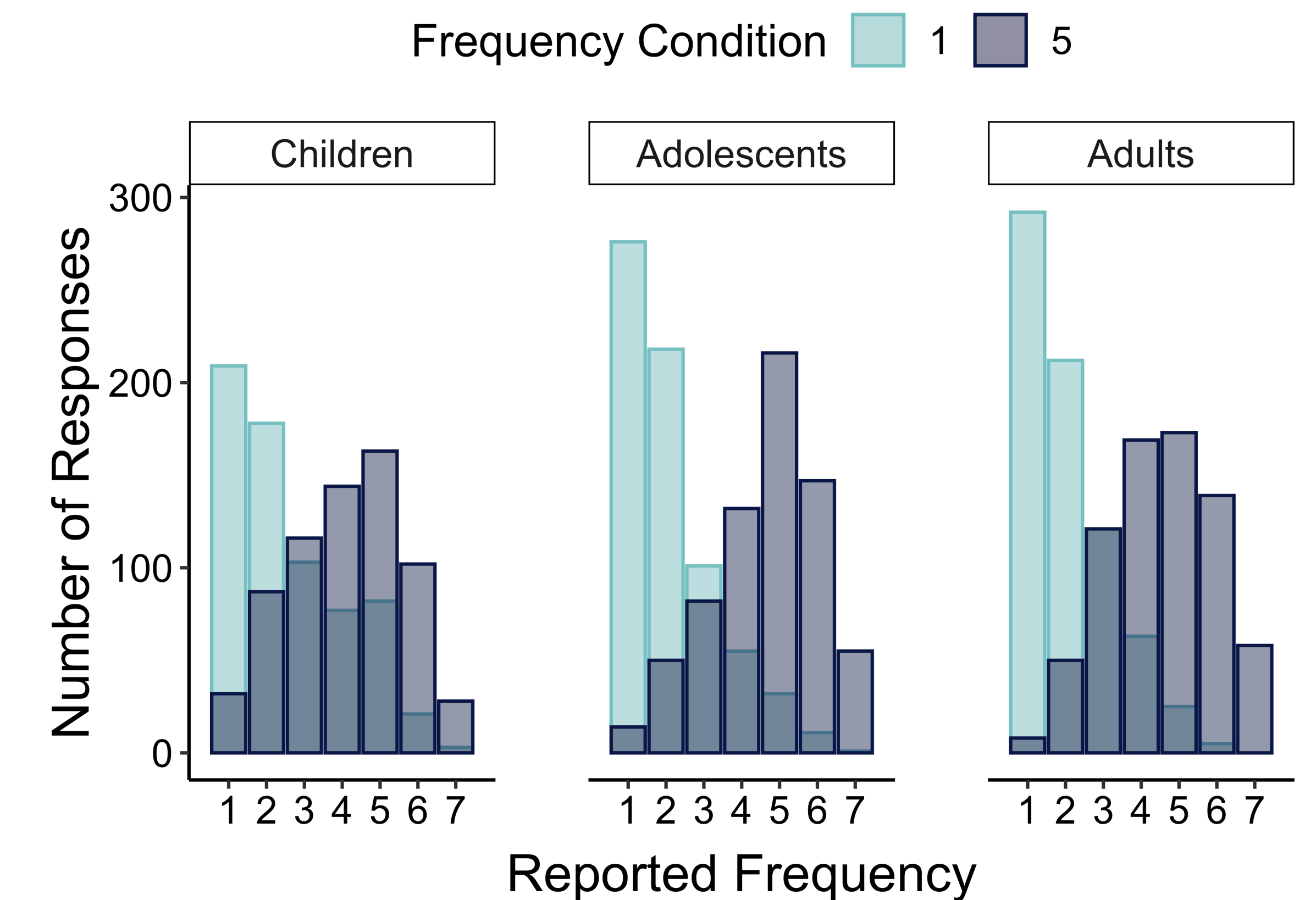
- N = 90 (after exclusions); Age range: 8 - 25 years

Older participants showed greater effects of learned value on memory



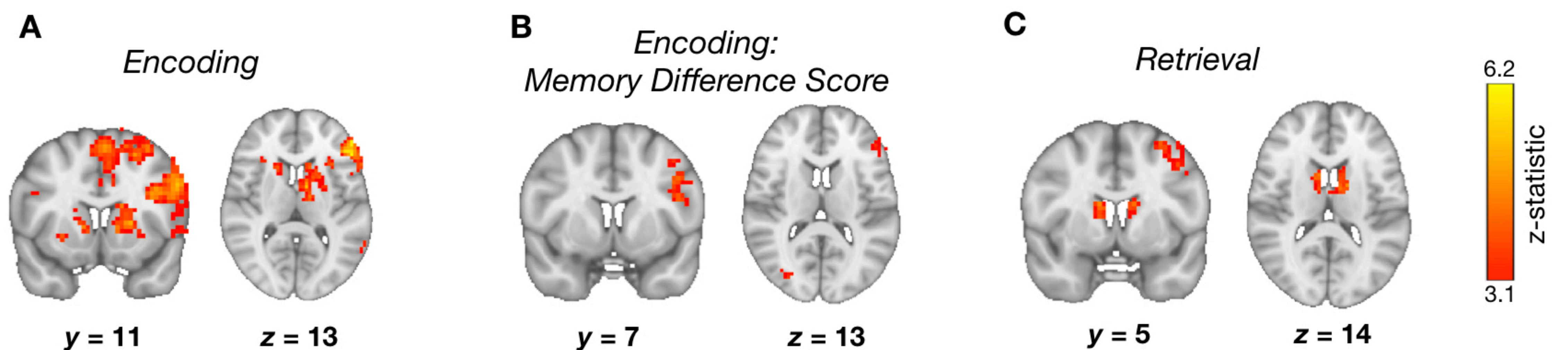
With increasing age, participants demonstrated higher memory accuracy for information associated with items in the high- relative to the low-frequency condition, enabling them to earn more points.

Knowledge of the structure of the environment increased with age



Participants across the entire age range were able to distinguish high- and low- frequency items in their explicit reports, but older participants were more accurate.

Activity in the prefrontal cortex and caudate was greater during encoding and retrieval of high- versus low-value items



Whole-brain contrasts revealed that participants demonstrated increased recruitment of the right IPFC and bilateral caudate when presented with pairs involving high- versus low-frequency items at both encoding (A) and retrieval (C). Participants who demonstrated the greatest difference in memory performance between the high- and low-frequency conditions also showed the greatest difference in right IPFC engagement at encoding (B). We did not observe modulation of this difference in neural activity by age at either encoding or retrieval.

- References:**
1. Castel et al., (2011). The development of memory efficiency and value-directed remembering across the lifespan. *Developmental Psychology*.
 2. Nussenbaum et al. (2020). Memory's reflection of learned information value increases across development. *JEP:G*.

Acknowledgements: We thank the Department of Defense and the National Science Foundation for their funding of this work.