Manipulating associative encoding strategy impacts neural discriminability at encoding and retrieval

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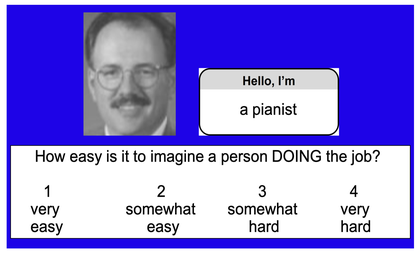
Introduction

- Unitization occurs when two or more items are encoded such that they are perceived as a single entity, or unit[1].
- Verbal memory tasks have promoted unitization, as an explicit strategy, to improve associative memory performance in young and older adults[1-5].
- Neuroimaging studies have identified a critical role of the hippocampus (HC) in supporting associative memory through binding of item-item associations, whereas the parahippocampal cortex (PHC) and perirhinal cortex (PrC) have been shown to support item encoding[7].
- Unitization shifts neural functioning from HC-based associative processing to cortical-based item processing within the PHC and PrC[3,6,7].

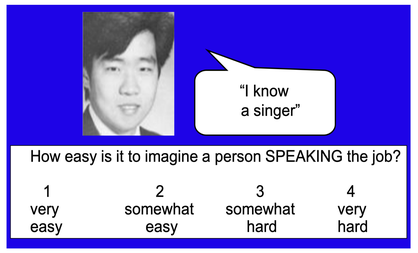
Hypothesis: Using strategies that promote unitization at encoding will lead to discriminable neural patterns of activity at retrieval in HC, PHC, and PrC.

Method & Procedure

DOING

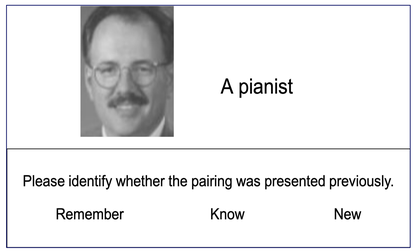


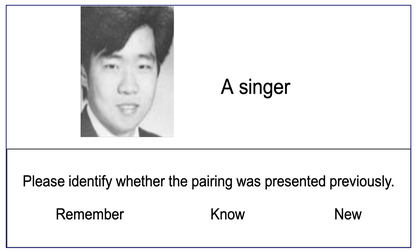
SPEAKING



Encoding

- Each trial required participants to make a judgment on how easy it was to imagine the face and occupation together.
- The only difference between trials was the strategy used.
  DOING = unitized condition
  SPEAKING = non-unitized condition





Retrieval

- Visual display at retrieval was identical for all trials
- SPEAKING and DOING targets were intermixed with rearranged lures

Design

- 4 alternating runs of encoding & retrieval

Analyses

Behavioral:
- ANOVA

Multivariate:
- Linear Support Vector Machine classifier
- Cross-validation leave one out procedure to try to discriminate between SPEAKING vs. DOING conditions

ROIs

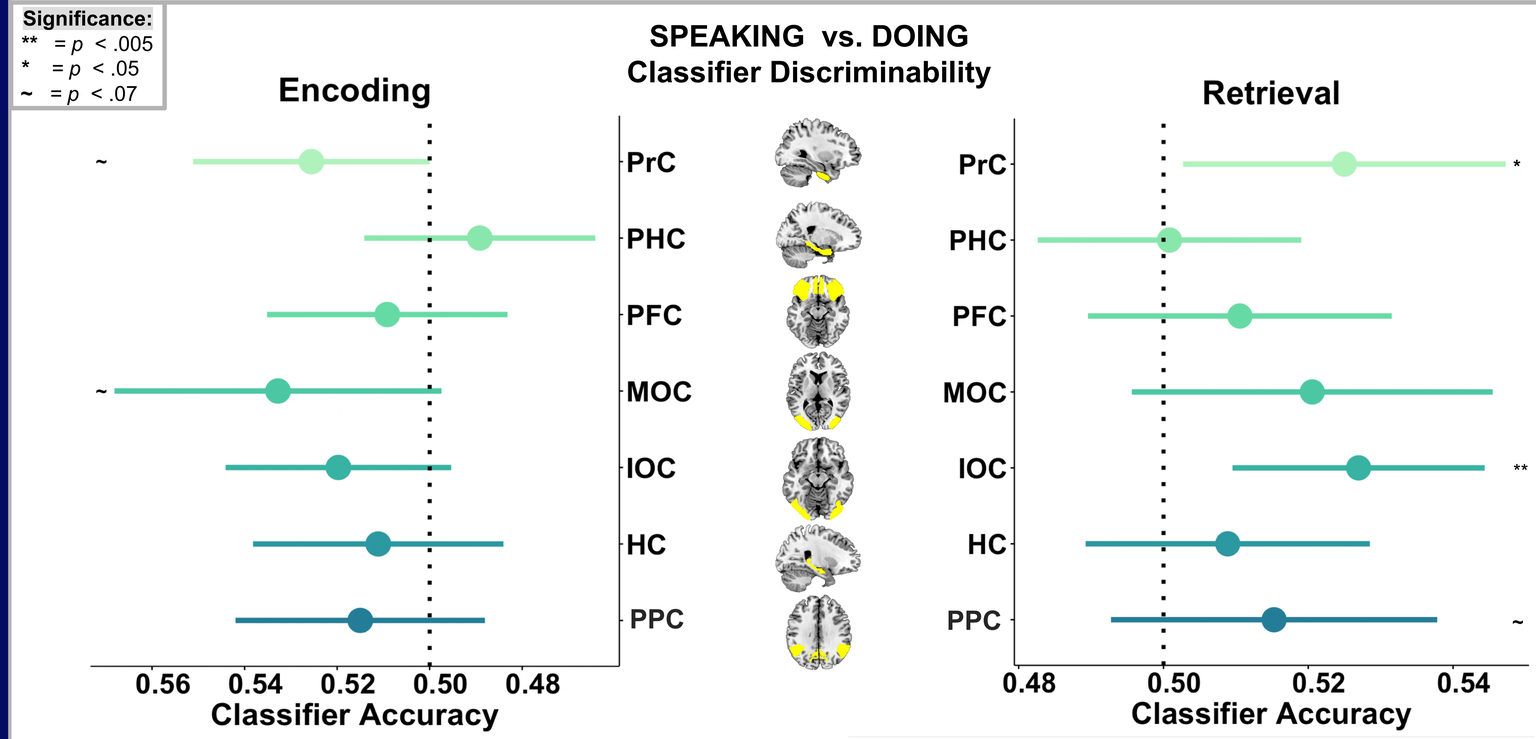
1. PrC = Perirhinal Cortex mask (Devlin & Price, 2007)
2. PHC = Parahippocampal Cortex: defined by region label
3. PFC = Prefrontal Cortex: BA 8-14, 24, 25, 32, 44-47
4. MOC = Middle Occipital Cortex: BA 19
5. IOC = Inferior Occipital Cortex: BA 17&18
6. HC = Hippocampus: defined by region label
7. PPC = Posterior parietal cortex (Angular gyrus, BA5/7)

Demographics

- N = 25 (M_{age} = 22.36, SD_{age} = 3.03)

Results

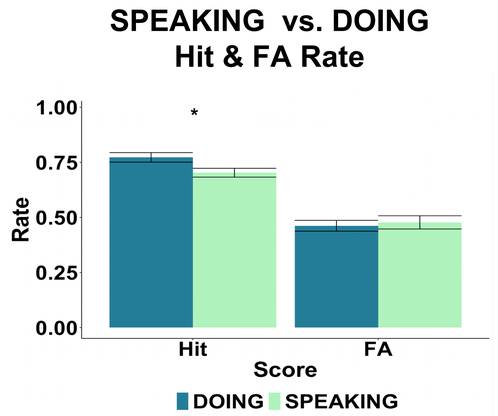
Significance:
** = p < .005
* = p < .05
~ = p < .07



Multivariate Results

Encoding:
- No significant findings at p < .05
- The classifier was marginally able to distinguish between encoding conditions in the PrC.

Retrieval:
- Retrieval associated with specific encoding strategies were significantly distinguishable in the IOC and PrC
- Marginal effects were observed in the PPC



Behavioral Results:
- Significantly higher hit rate in the DOING (M_{hit} = .77) compared to SPEAKING (M_{hit} = .70) condition.
- No difference in false alarm rate (M_{DOING} = .46; $M_{SPEAKING}$ = .48).

Classifier accuracy and behavior

Relationship with behavior:
- Classifier accuracy cannot significantly predict hit rate, nor are classifier accuracy and hit rate significantly correlated.

Conclusions & Future Directions

Behavior
- Higher hit rate in the DOING compared to the SPEAKING condition suggests that promoting unitization at encoding benefits subsequent associative memory.

Multivariate
- The fact that neural patterns were discriminable in IOC at retrieval, when the display was identical across conditions suggests that retrieval of the differential encoding conditions was influential to the retrieval of the associative pair
- The PrC is known to support item processing, while the IOC support associative processing[8,9]. Significant discriminability in these regions suggests induction of unitization within the DOING condition, and associative binding for the SPEAKING condition.

Future Directions
- Add single item condition to the paradigm to examine whether neural patterns at retrieval are discriminable between unitized and single-item memory conditions.

References & Acknowledgements

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