Differential Mnemonic Discrimination of Faces: A Contributing Mechanism to the Other-Race Effect

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Background

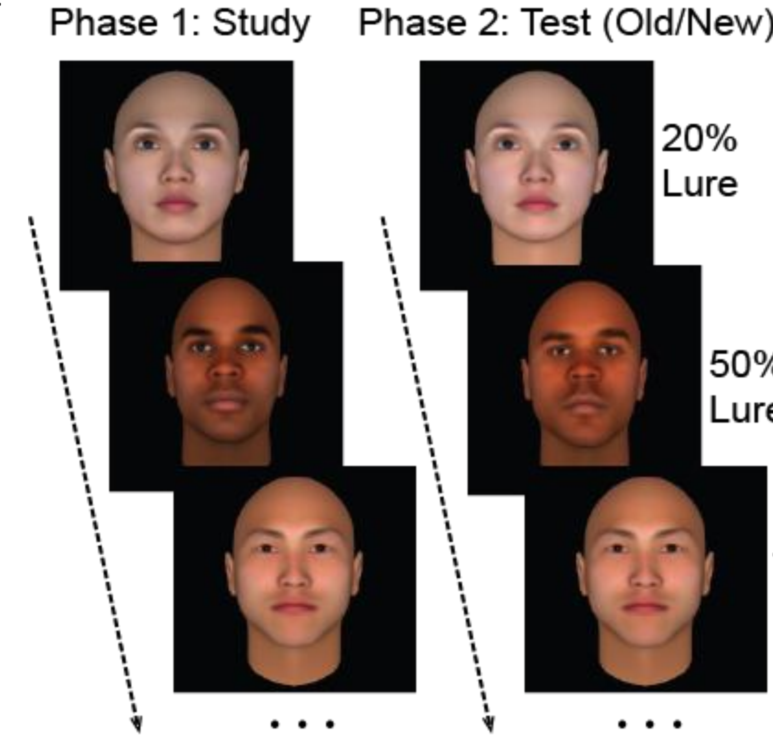
- The other-race effect (ORE) is the tendency to recognize and remember faces within one's own race more easily than those in other races.
- Prior work suggests differences in perceptual and attentional encoding contribute to the ORE in recognition memory[1]
- Considering the ORE is a memory effect, we set out to more thoroughly characterize the contributions of memory mechanisms in generating the ORE.
- To this end, we developed a task informed by computational models of medial temporal lobe (MTL) contributions to episodic memory[2-3] to test MTL involvement in traditional face recognition as well as mnemonic discrimination (MD) of faces. MD supports the ability to reject lure distractors in the presence of mnemonic interference from prior similar presentations.
- In addition to the fusiform face area, we characterize the involvement of MTL regions perirhinal cortex and hippocampus in the generation of this effect, during both encoding and retrieval.

Methods

Task Design

- Encoding phase for same-race (SR) and other-race (OR) faces followed by an old/new recognition test phase.
- 8 blocks in total. 22 faces shown per phase.
- Trial Types during Test/Retrieval Phase:
  - **Target Repeats (TR):** Exact repeat of encoded face. Correct answer 'Yes, seen before'
  - **Lure Distractor (LD)** Similar-looking to an encoded face. Correct answer 'No, not seen before'
- Lures varied in parametric similarity to encoded/1st presentation
  - Using FaceGen Randomness tool, lure distractors were generated to vary 20 – 50% in parametric similarity 20-50% from parent faces.
  - Presentation order was counterbalanced across study and test

Mnemonic Discrimination Task



MRI Methods

fMRI scan sample

Sample size: 21: 10 females, 11 Males
Demographics: 12 South-East Asian, 9 East-Asian

Localizer scan

- 2 run, block design
- counterbalanced blocks of:
  - Same-Race (SR) faces
  - Other-Race (OR) faces
  - Every-day objects
  - Phase-scrambled SR & OR faces

Experimental Scan

- 4 runs, even-related design
- Per run, 2 blocks of interleaved study/test phases of the Mnemonic Discrimination task.

Preliminary Analysis

ROI Definition

- Subject-specific Fusiform Face area (FFA) ROI created with localizer scan, using contrast of: **Faces > Objects and Scrambled faces** thresholded at p =.0001
- Perirhinal Cortex (PrC) and Hippocampus (Hipp) created using in-house hand-drawn ROI template

Univariate Analysis

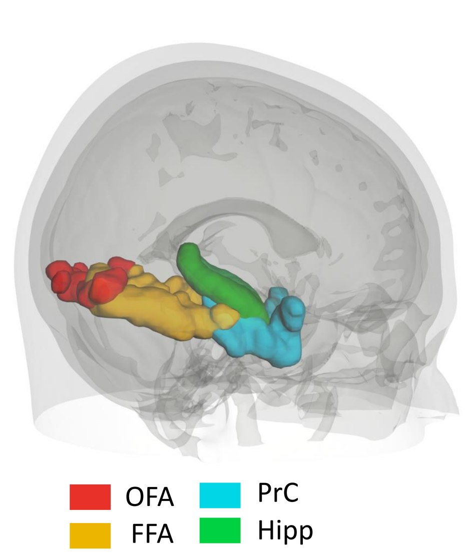
- Modeled 16 regressors of interest across
  - Task Phase (Encoding/Retrieval),
  - Trial Type (Target/Lure Pair)
  - Stimulus Race (SR or OR)
- Extracted beta estimates from left and right FFA, PrC, and Hipp

Legend

- Same Race Stimulus
- Other Race Stimulus
- ‡ Interaction
- † Main Effect
- †₵ Post-hoc Effect, after MC Correction
- ‡, †, †₵, Trending

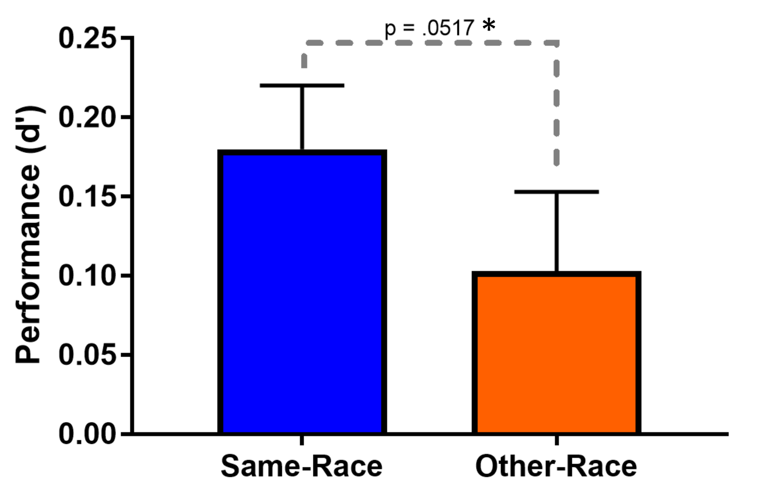
Figure Abbreviations

Enc.	Encoding
FFA	Fusiform Face Area
Hipp	Hippocampus
LCR	Lure-Distractor Correct Rejection
LFA	Lure-Distractor False Alarm
PrC	Perirhinal Cortex
Subs.	Subsequent
Stim.	Stimulus
TH	Target-Repeat Hit
TM	Target-Repeat Miss



A. Behavioral Results

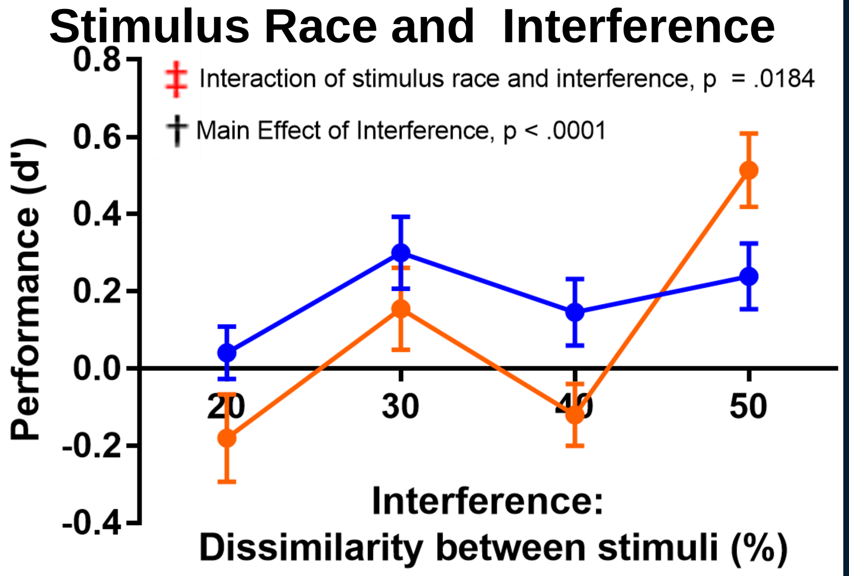
Face Recognition Performance Differences Across Race



$d' = Z(\text{hit rate}) - Z(\text{false alarm rate})$

* Current sample only 78% powered to detect the above effect, based on a priori power analysis of our previously published results, where p<.0001[4].

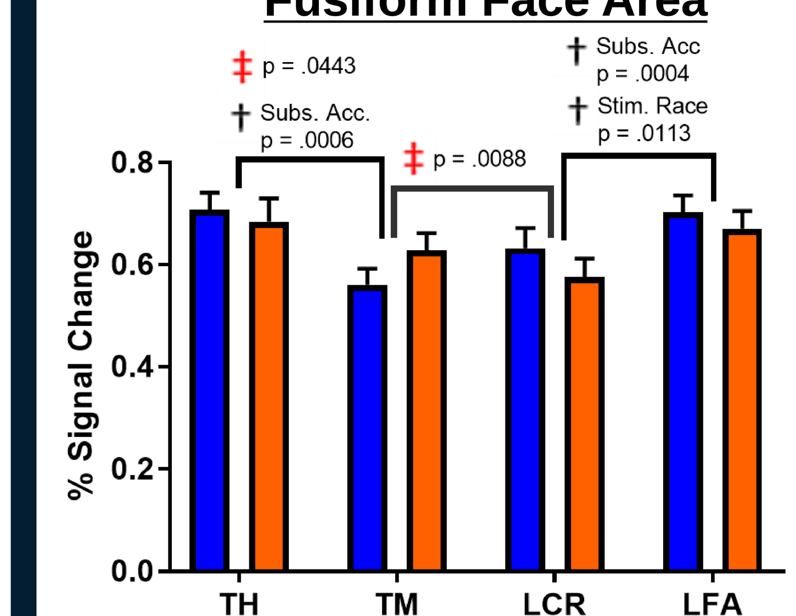
Performance as a function of Stimulus Race and Interference



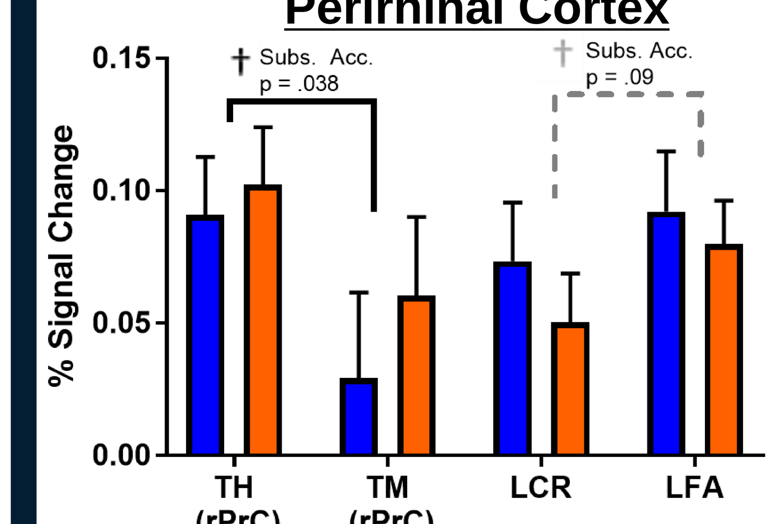
SR recognition is trending higher overall. **Performance is further modulated by race and interference**, where performance is better for SR faces at high and intermediate levels of interference (20 – 40 %) and is better for OR faces at the lowest interference level (50%).

B. Encoding Activity Associated with Subsequent Performance

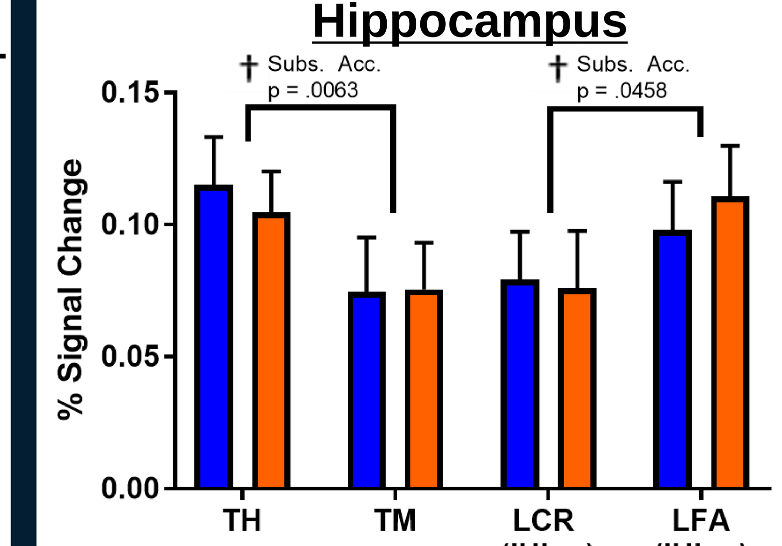
Fusiform Face Area



Perirhinal Cortex



Hippocampus



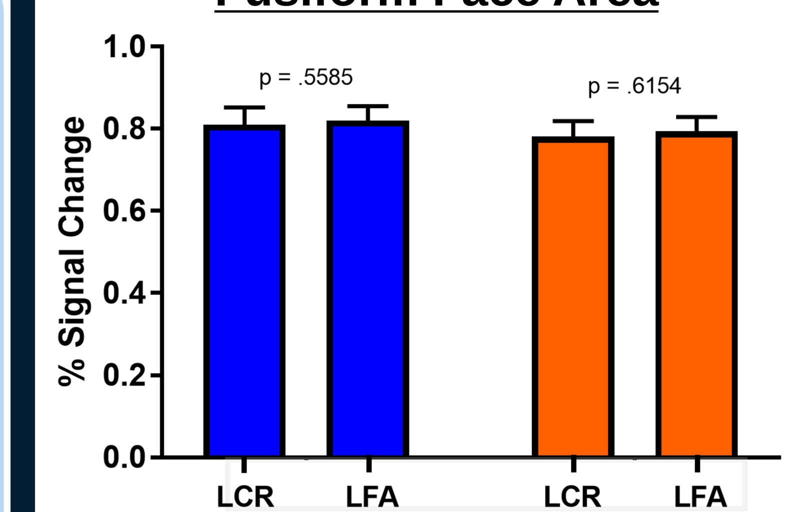
Trials Sorted by Subsequent Performance

Encoding activity across ROIs demonstrates a **strong subsequent memory effect**; Higher activity to faces during encoding is associated with subsequent memories/'Yes, seen this face before' response types, **independent of accuracy**. Higher encoding activity therefore affords subjects an accuracy advantage for target repeats, and a disadvantage for lure distractors.

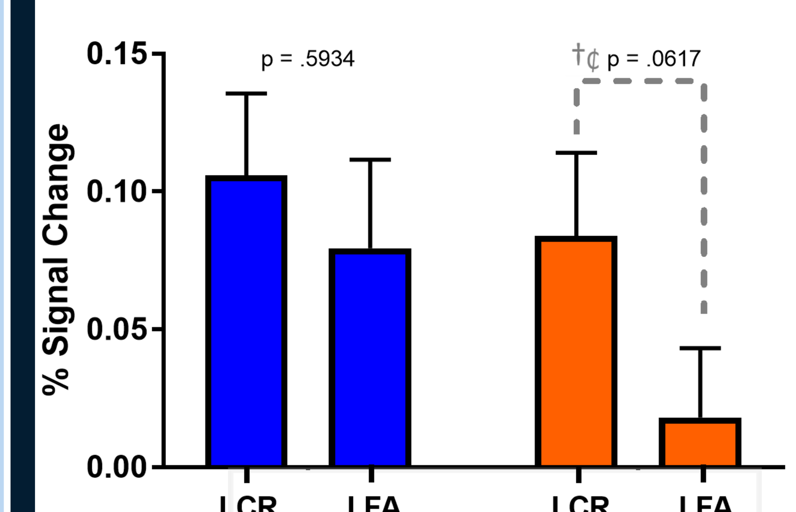
In addition, FFA demonstrates **interactions between the race of face stimuli and subsequent accuracy**. Encoding activity leading to accurate responses (TH and LCR) is higher in magnitude for SR relative to OR faces, while encoding activity leading to forgetting (TM) is higher for OR relative to SR faces.

C. Retrieval Activity – Potential Regional Differences

Fusiform Face Area



Perirhinal Cortex

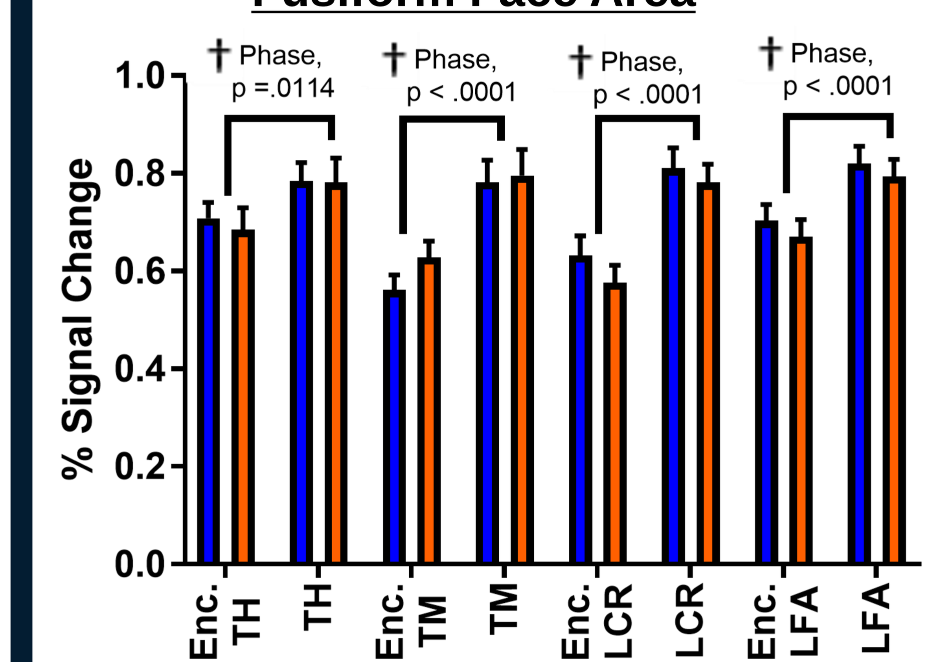


Accuracy of Response to Lure Distractors

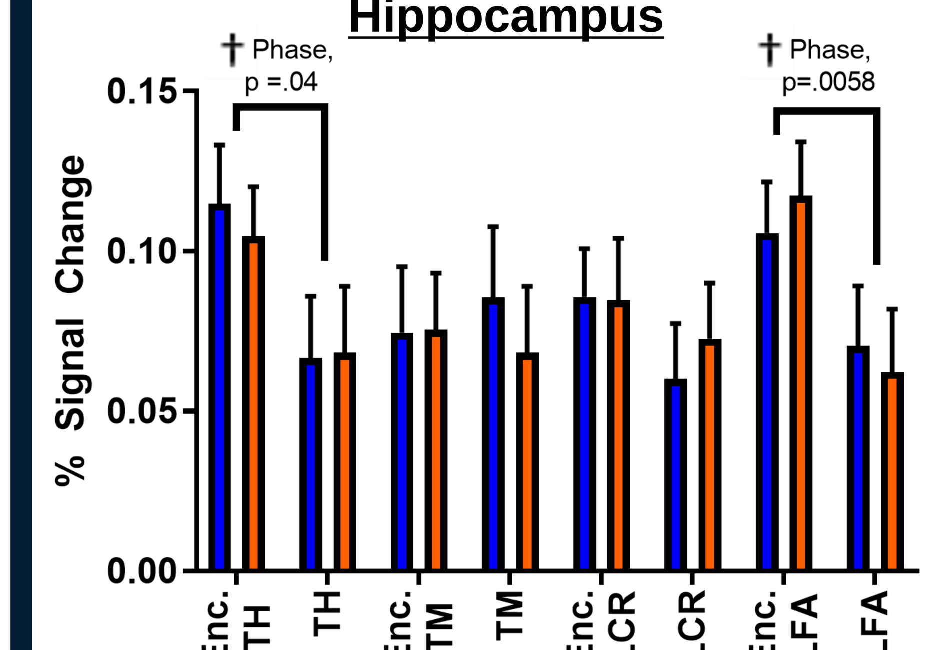
During retrieval, **FFA activity is indiscriminate across trials.**. In the PrC, there is a trending decrement in activity specific to OR faces associated with false memories/ incorrect lure responses.

D. Encoding-Retrieval Facilitation and Suppression

Fusiform Face Area



Hippocampus



Corresponding Encoding- and Retrieval-Trial Face Pairings

During memory retrieval, **FFA** demonstrates non-specific/agnostic **exposure-related facilitation**, i.e., increased retrieval activity to all trial types.
Hippocampus demonstrates **exposure-related suppression** (decreased retrieval activity) specific to trials that subjects believe they saw before, independent of accuracy (TH and LFA).

Take-Home Messages

- A commonly reported link between high encoding activity and successful subsequent memory, may in some cases be more appropriately considered a link between high activity and memory – independent of actual truth or accuracy. **An association between high encoding activity and subsequent false alarms may have implications for mistaken eye-witness testimony.**
- **Non-traditional face regions may be recruited to support successful face recognition**, and a network of regional differences (rather than localized ones) may contribute to behavioral deficits in other-race face recognition.
- **Future steps: Network-based and representational analysis may illuminate differences in SR/OR recognition** that traditional univariate analysis is not sensitive to

References

1. Hugenberg K., Young S.G., Bernstein M.J., & Sacco D.F. Psychological Review, 117(4), 1168–1187. (2010). 2. Leutgeb J.K., Leutgeb S., Moser M.B., Moser E.I. Science. 315(5814), 961-966; (2007). 3. Yassa M. A., & Stark C.E.L. Trends in Neurosciences, 34(10), 515–525. (2011). 4. Yaros JL, et al. Sci Rep. 2019 ;9(1):19399. (2019)

Acknowledgments

A. Chang for conceptualizing a previous version of this task; R. Jirsaraie for development of the scanner protocol; M. Hollearn, J. Adams, M. Sathiskumar, A. Mikhail, and H Chehabi for data collection. J. Yaros is funded by the University of Irvine's Provost PhD Fellowship and Diversity Recruitment Fellowship. M. Yassa is funded by US NIH grants R01MH1023921 and R01AG053555.

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