

## Introduction

How does facial emotion influence memory? And does this influence change as we age?

Addressing these issues, Grady et al. (2007) had participants judge the emotional expression of faces (negative, positive, vs. neutral), not knowing that their memory of those faces would be tested later. After 15 minutes, participants were asked to discriminate between previously studied and non-studied faces (Old vs. New). The authors found no difference between positive and neutral expressions. **Younger adults showed better face recognition accuracy for negatively-valenced emotions (angry faces) than other emotions (happy and neutral). Older adults, however, showed no such memory enhancement.** One interpretation is that older adults are less sensitive to emotion due to the age-related decline in amygdala and ventromedial prefrontal cortex.

We wished to see whether this surprising finding can be replicated. We also wished to address an important limitation of Grady et al. (2007): the study and test faces were always identical, expressing the same emotion. In real-world settings, we need to be able to identify faces despite changes in viewing conditions and/or emotional expression (e.g. when eyewitnesses view mugshots showing neutral emotion after witnessing someone commit a crime with a negative emotional expression). In a study of younger adults, Herdener, Lien, Burros, Ruthruff, and Allen (under review) recently found enhanced memory of angry faces, relative to happy faces, only when the exact same face was repeated during the later recognition test. They concluded that memory enhancement applies only to the specific features shown in a specific image, not to general representations of identity.

## The Present Study

We assessed age-related differences in memory for face identity and how it is modulated by emotional expression.

## Experimental Design

Our study utilized an incidental learning task, similar to Grady et al. (2007), in that participants were not told that they needed to remember the faces. Each participant completed 3 consecutive phases: study, distraction, and then recognition.

**Study Phase:** Participants performed a gender identification task, quickly indicating the gender of a face (pressing the key labeled “M” for male and the key labeled “F” key for female). They were not informed that they would later be tested on the faces. A total of 100 different face images were used (50 female, 50 male), half angry and half happy.

**Distraction Phase:** Participants performed a simple matching-pairs game on an iPad for 20 min.

**Recognition Phase:** Participants viewed a face and pressed the key labeled “Y” if it was previously studied (“Old”) or the key labeled “N” if it was “New”. A total of 200 different face images (100 females, 100 males) were used; half were “new” and half were “old”.

## Sensitivity as an Index of Memory Facilitation

We used  $d'$  from signal detection theory (Green & Swets, 1966), as a measure of participants’ sensitivity to detect target presence, independent of any strategic differences in decision criterion (i.e., a predisposition to say ‘yes’ vs. ‘no’).

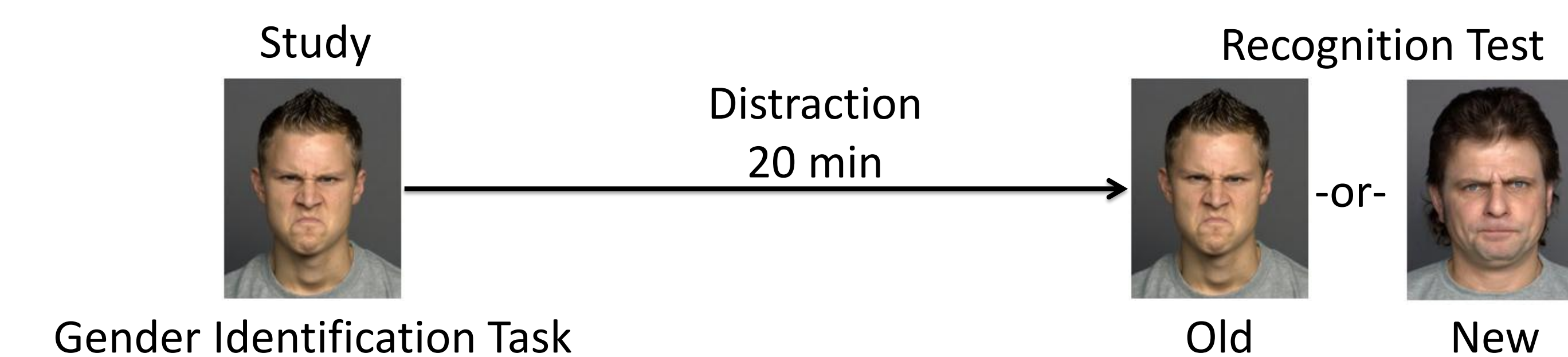
		Reality	
		Target Present	Target Absent
Response	Yes	Hit	False Alarm
	No	Miss	Correct Rejection

$d'$  takes both **hit** rate (saying the target present when it really was there) and **false alarm** rate (saying the target was present when it was not there) into account. It is calculated as:

$$d' = Z(\text{Hit Rate}) - Z(\text{False Alarm Rate})$$

## Experiment 1 (36 younger; 36 older)

Experiment 1 replicated Grady et al.’s (2007) study but used  $d'$  as a measure of memory facilitation. Both study and recognition test sessions contained angry and happy faces; the emotion of a face at test always matched the emotion at study. Half of the faces in the recognition test were previously studied (same identity, same emotion; [Old]) whereas the other half were not (different identity; [New]).

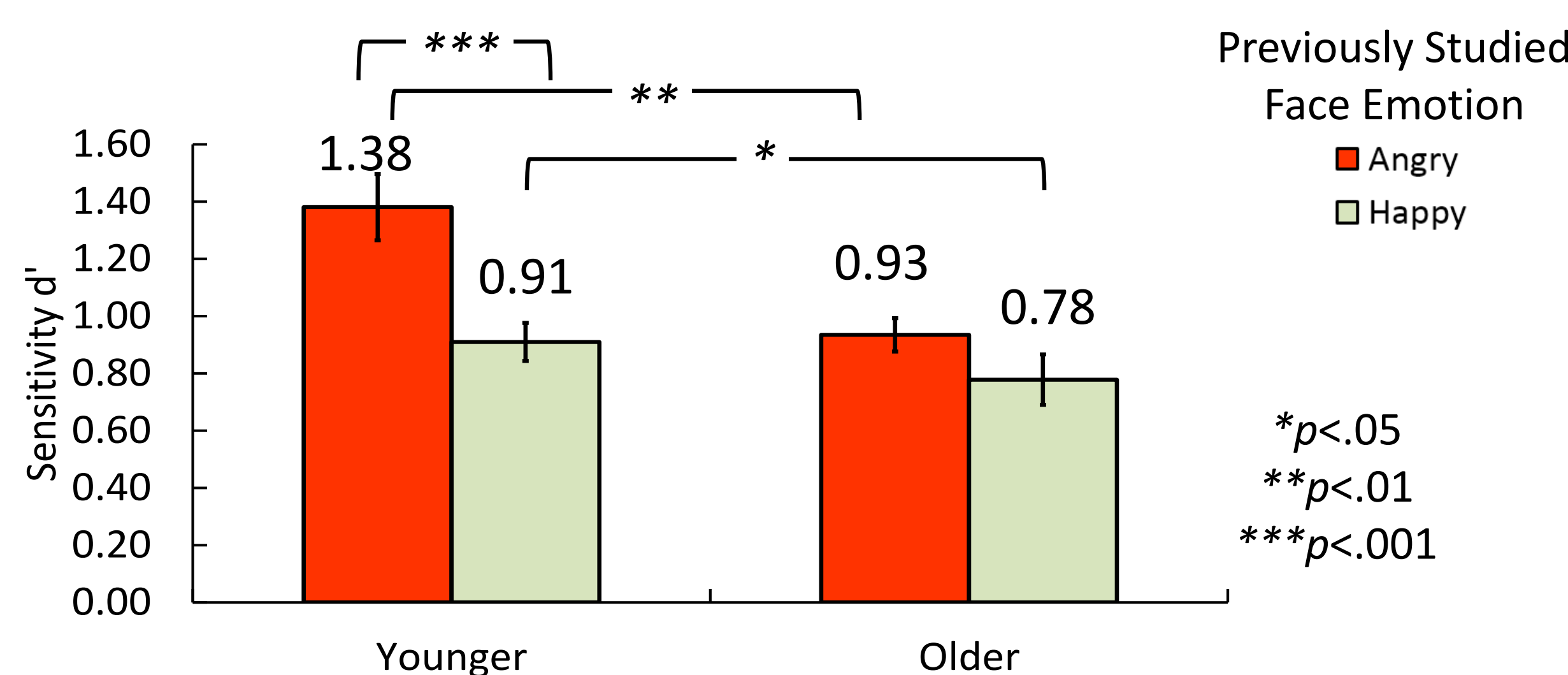


**Hit:** correctly identifying a previously studied face as “old.”

**False alarm:** incorrectly identified a new face as “old”.

Following Grady et al. (2007), we expected higher  $d'$  for angry faces than happy faces for younger adults, but no difference for older adults.

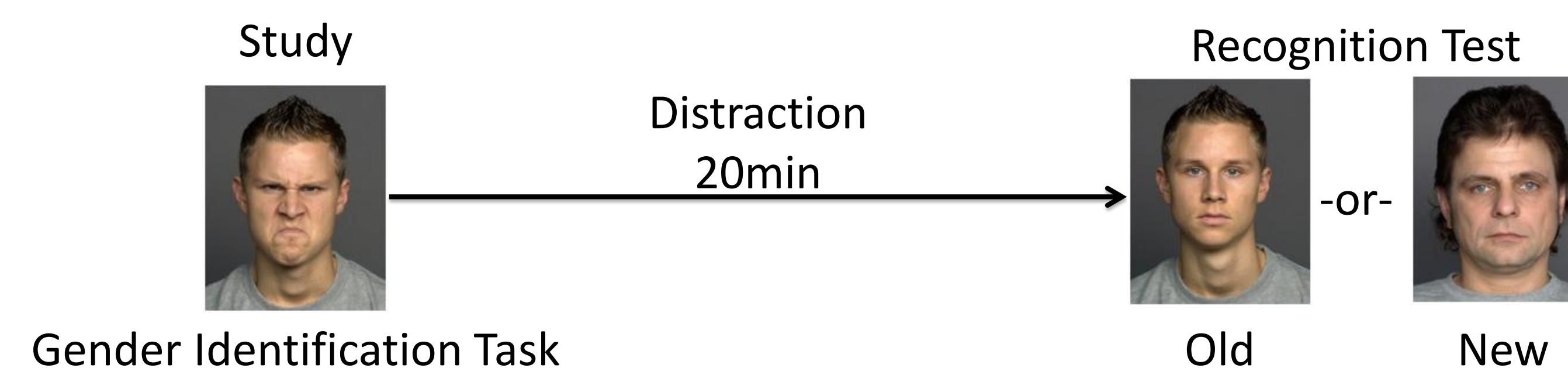
## Results and Discussion



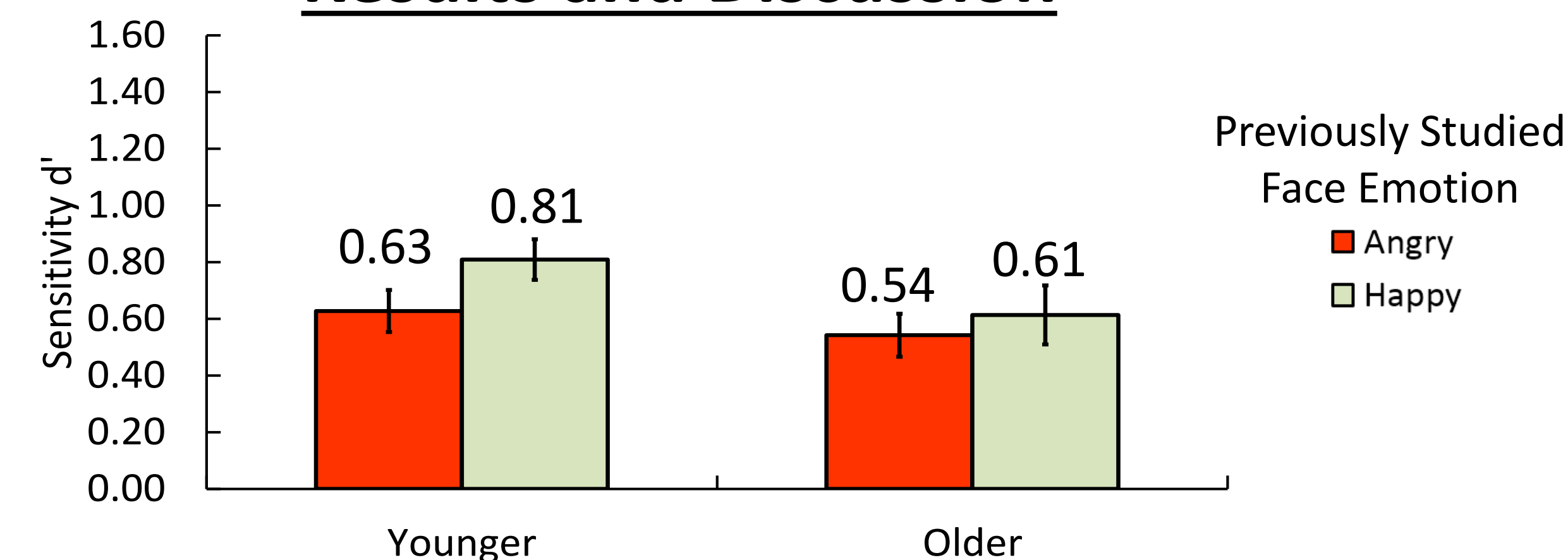
Overall,  $d'$  was significantly higher for previously studied angry faces than happy faces,  $F(1,70)=6.97$ ,  $p < .05$ , confirming Grady et al.’s (2007) finding of memory facilitation by negative emotions. The interaction between emotion and age group was not significant,  $F(1,70)=2.73$ ,  $p = 0.10$ . However, whereas younger adults showed significant memory facilitation for angry faces ( $d'=1.38$ ) than happy faces ( $d'=0.91$ ),  $t(35)=3.62$ ,  $p < .001$ , older adults did not ( $d'=0.93$  vs.  $d'=0.78$ , respectively),  $t(35)=1.62$ ,  $p = .11$ , replicating Grady et al.

## Experiment 2 (29 younger; 15 older)

Experiment 2 examined whether memory facilitation for angry faces reflects a generally improved memory for that person’s identity, or whether it is specific to the features of the picture viewed. Thus, only neutral faces were used in the recognition task.



## Results and Discussion



In contrast to Experiment 1,  $d'$  was not significantly higher for previously studied angry faces than happy faces,  $F(1,42) < 1.08$ ,  $p = .31$ . Replicating Herdener et al.’s (under review) findings, younger adults showed no memory facilitation for negative emotion,  $t(28) < -1.57$ ,  $p = .13$ . Likewise, older adults showed no memory facilitation for negative emotion,  $t < 1$ .

## General Discussion

For younger adults, we found memory facilitation by angry faces, relative to happy faces, when the exact same face picture – showing the same emotion – was used at both study and test (Experiment 1), but not when neutral faces were used at test (Experiment 2). This finding suggests that negative emotional expressions improve memory for the specific features of that specific image, without improving general memory for that person’s identity. For older adults, however, we found no memory facilitation by angry faces in both experiments.

The memory enhancement triggered by negative emotional expressions is not preserved in old age.

## References

- Green, D.M., Swets J.A. (1966) *Signal Detection Theory and Psychophysics*. New York: Wiley.  
 Grady, C. L, Hongwanishkul, D., Keightley, M., Lee, W., & Hasher, L. (2007). The effect of age on memory for emotional faces. *Neuropsychology*, 21, 371-380.  
 Herdener, N., Lien, M.-C., Burros, A., Ruthruff, E., & Allen, P. A. (under review). Show me the emotion: The effect of emotional valence on memory for face identity. *Memory & Cognition*.