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## Introduction

It has been suggested that people are innately biased to attend to negatively valenced faces (e.g., angry faces; Shaw, Lien, Ruthruff, & Allen, 2011). The bias toward negative emotion may increase our chance of survival by alerting us to hazards in the environment.

Some studies have even found that negative emotions enhance memory. In Johansson, Mecklinger, and Treese (2004), for instance, participants made gender judgments of faces showing negative, positive, and neutral emotions. Later, they were asked to discriminate between previously studied and nonstudied faces (Old vs. New). The key finding was that face recognition accuracy was higher for negatively valenced emotions (angry faces) than other emotions (happy and neutral).

In Johansson et al.'s (2004) study, however, 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 emotional expression (e.g. when eyewitnesses view mugshots showing neutral emotion after witnessing someone commit a crime with a negative emotional expression).

## The Present Study

In the present study, we aimed to determine whether memory facilitation by negative emotion is specific to the angry emotion pictured, or whether it is more general, applying to identification of any picture of that person.

## Experimental Design

Our present study utilized an incidental learning task, similar to Johansson et al. (2004), in that participants were not told that they needed to remember the faces. Each participant received 3 sessions in order – study, distraction, and then recognition test.

**Study Session:** Participants performed a gender identification task, quickly indicating the gender of a face. They pressed the “z” key for male and the “m” key for female, as quickly and accurately as possible. They were not informed that they would later be tested on the faces. A total of 100 different face images were used (50 females, 50 males) – half of them expressing angry emotion and the other half expressing happy emotion.

**Distraction Session:** Participants performed a simple matching pairs game on an iPad for 20 min. This distraction between study and test ensured that participants would use long-term rather than short-term memory and that they would not rehearse the faces.

**Recognition Test Session:** Participants viewed an image of a face that was either seen in the gender task session (“old”) or had not been seen before (“new”). They pressed the “x” key for “Old” and the “n” key for “New”. A total of 200 different face images (100 females, 100 males) were used – half of them were the same identity as those shown in the study session and the other half were different identities.

## Sensitivity as an Index of Memory Facilitation

We used  $d'$ , derived from signal detection theory (Green & Swets, 1966), as a measure of one's sensitivity to detect target presence, independent of any strategic influences on decision criterion (participants' predisposition to say 'yes' vs. 'no').

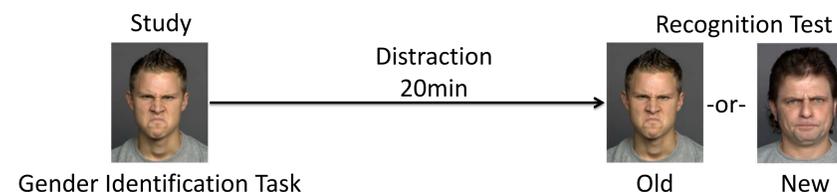
		Reality	
		Target Present	Target Absent
Response	Yes	Hit	False Alarm
	No	Miss	Correct Rejection

$d'$  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:

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

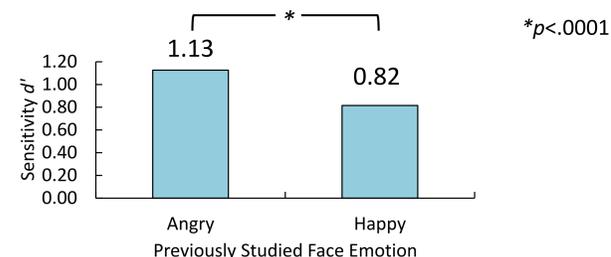
## Experiment 1 (N=95)

Experiment 1 aimed to replicate Johansson et al.'s (2004) study using  $d'$  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 rates** were measured when participants correctly identified the previously studied faces. **False alarm rates** were measured when participants incorrectly identified the new faces as the previously studied faces. Followed Johansson et al. (2004), we expected that angry faces would produce higher  $d'$  comparing to happy faces.

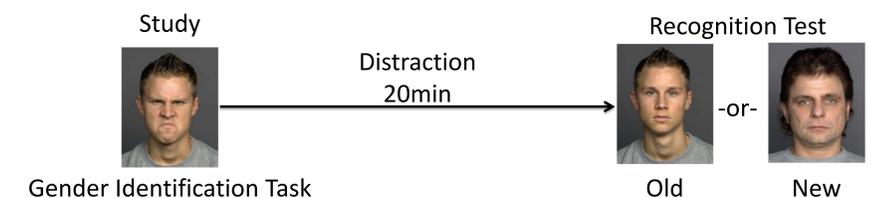
## Results and Discussion



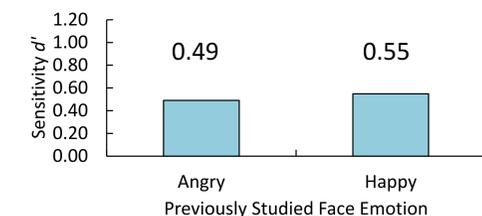
The  $d'$  was significantly higher for previously studied angry faces than happy faces,  $F(1,95)=13.27, p<.0001$ , confirming Johansson et al.'s (2004) finding of memory facilitation by negative emotions. We further divided the participants into a Low sensitivity group and a High sensitivity group based off a median split of overall  $d'$ . The High sensitivity group showed memory facilitation for angry faces ( $d'=1.48$ ) than happy faces ( $d'=1.01$ ),  $F(1,47)=11.29, p<.01$ . The Low sensitivity group showed a relatively small and non-significant facilitation ( $d'=0.79$  vs.  $d'=0.62$ , respectively),  $F(1,48)=2.62, p=.11$ .

## Experiment 2 (N=31)

Experiment 2 examined whether negative emotion leads to a generally improved memory for that person's identity, or whether it is specific to the picture viewed. Thus, only neutral faces were used in the recognition task – half of the faces were in the same identity as the previously studied faces (Old) and half were different identities (New).



## Results and Discussion



In contrast to Experiment 1,  $d'$  was not significantly higher for previously studied angry faces than happy faces,  $F<1.0$ . A median split on overall  $d'$  into a Low sensitivity group and a High sensitivity group showed no memory facilitation for either group,  $F_s<1.0$ . The  $d'$  was 0.77 and 0.82 for angry and happy faces, respectively, for the High sensitivity group. The  $d'$  was 0.23 and 0.29 for angry and happy faces, respectively, for the Low sensitivity group.

## General Discussion

We found memory facilitation by angry faces, relative to happy faces, when the exact same face picture – showing the same emotion – was used in 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 a specific image, without improving general memory for that identity. One implication is that negative emotion during a crime is not necessarily a positive indicator of future memory when viewing mugshots, which have neutral expressions.

## References

- Green, D.M., Swets J.A. (1966) *Signal Detection Theory and Psychophysics*. New York: Wiley.  
 Johansson, M., Mecklinger, A., & Treese A-C. (2004). Recognition memory for emotional and neutral faces: An event-related potential study. *Journal of Cognitive Neuroscience*, 16, 1840-1853.