Task & Strategic Influences on the Eye-Movement based Memory Effect

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Abstract

Althoff & Cohen (1999) reported an eye-movement based memory effect (EMME) where differences in eye movements (# of fixations and constraint) differentiated famous and non-famous faces in an old/new recognition task. We compared eye-movements using two task types: A familiarity judgment task, and an exclude-recognition task. Contrary to previous predictions, data differed depending on task type: Familiarity judgments produced an EMME, while source judgments produced an opposite pattern. Recent reports suggest that visual processing of famous faces is highly efficient, implying that the EMME may represent this efficiency (Buttle & Raymond 2003). We were able to find a significant EMME using non-famous faces, but the degree of familiarity influenced whether the EMME was observed: Only well studied faces showed the effect. Number of fixations were more sensitive to this distinction than the constraint measure.

Introduction

Althoff & Cohen (1999) reported an **eye-movement based memory effect (EMME)** where participants used <u>more fixations and used a more constrained looking pattern for unfamiliar than famous faces</u>. However, in **exclude-recognition tasks (ERT)**, where "old" responses are made to only one of two familiar lists (e.g., Seymour et al. 2000; Seymour & Kerlin under review). Reaction time (RT) is greater for familiar rather than unfamiliar items. Because number of fixations and RT tend to be correlated in speeded tasks, we questioned whether the EMME would be observed in an exclude task, despite Althoff & Cohen's suggestion that it is independent of decision type. Also, some suggests that visual processing of famous faces is special (Buttle & Raymond, 2003) and thus it is not clear whether level of face familiarity can influence whether the EMME is observed.

Experiment 1 Goals

- Replicate Althoff & Cohen (1999).

- Buttle & Raymond (2003) suggest that visual processing of faces is highly efficient. This could mean that the EMME is restricted to certain stimuli. We use non-famous faces with 2 levels of study to determine if the EMME emerges without famous faces, and whether it is influenced by degree of familiarity?

Experiment 1 Method

Face Study Task

- Heavy Study (5 subtasks): Memorize 6 faces using feature description, mirror judgment, honesty judgment, age judgment, and attractiveness judgment tasks.

- Light Study (2 subtasks): Memorize 6 faces using feature description and mirror judgment tasks only.

Retention Interval (10 min)

Familiarity Judgment Task

- 3 trial blocks, each with 24 trials: random serial presentation of all 12 familiar faces and 12 new unfamiliar faces.

- Respond "Old" if familiar, "New" if unfamiliar.

Eye Tracking

Equipment: Table mounted monocular eye-tracker (chin rest) recording at 60 Hz (Arrington Research 2003).
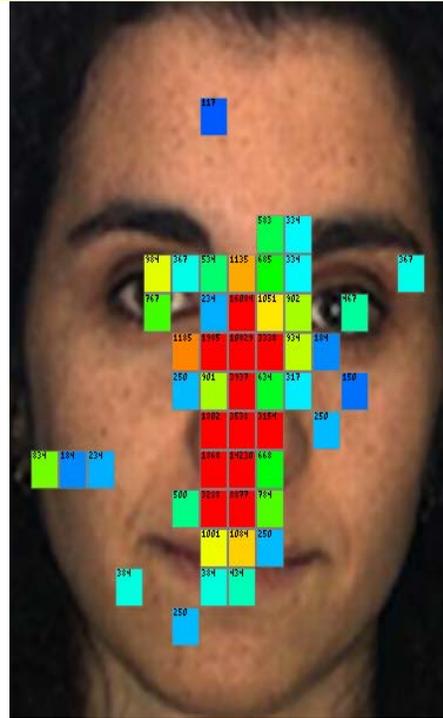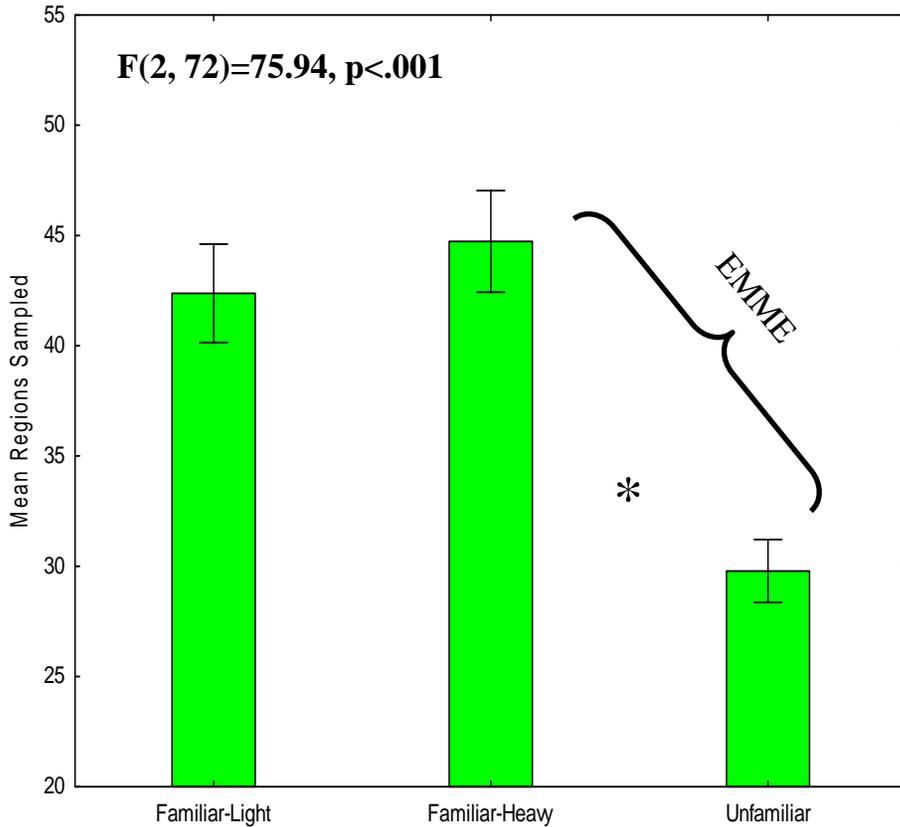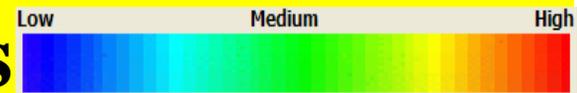
Relevant Measures: Eye position, # of fixations, and view duration.
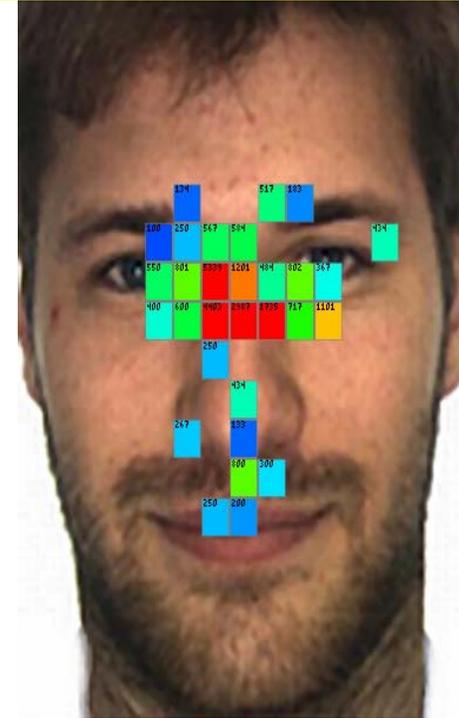
Fixation & RT Results
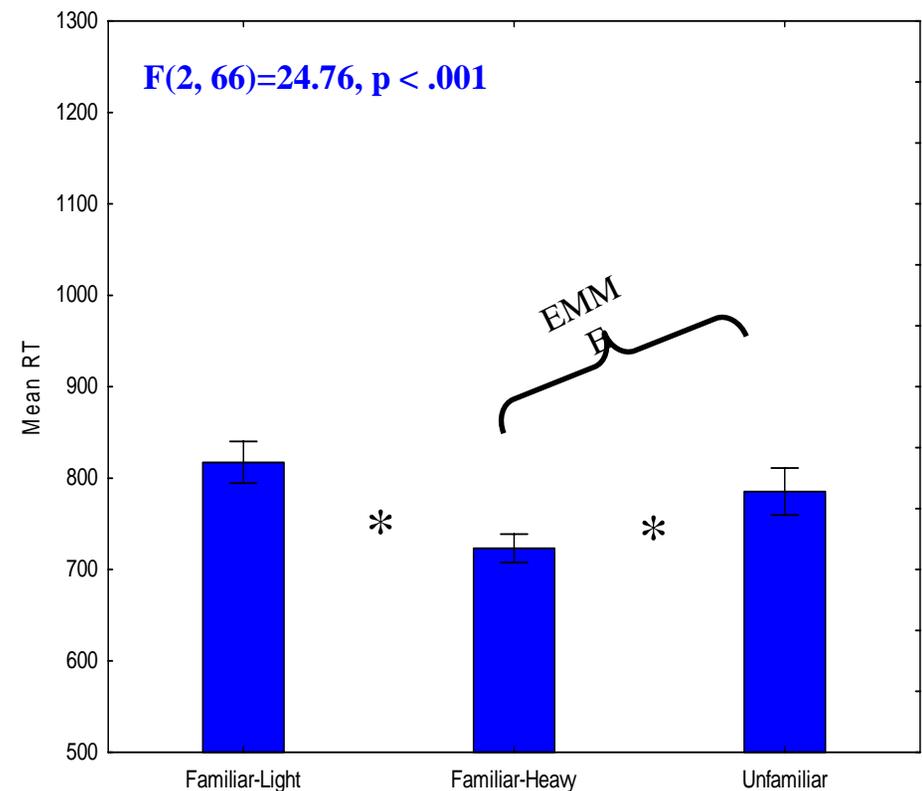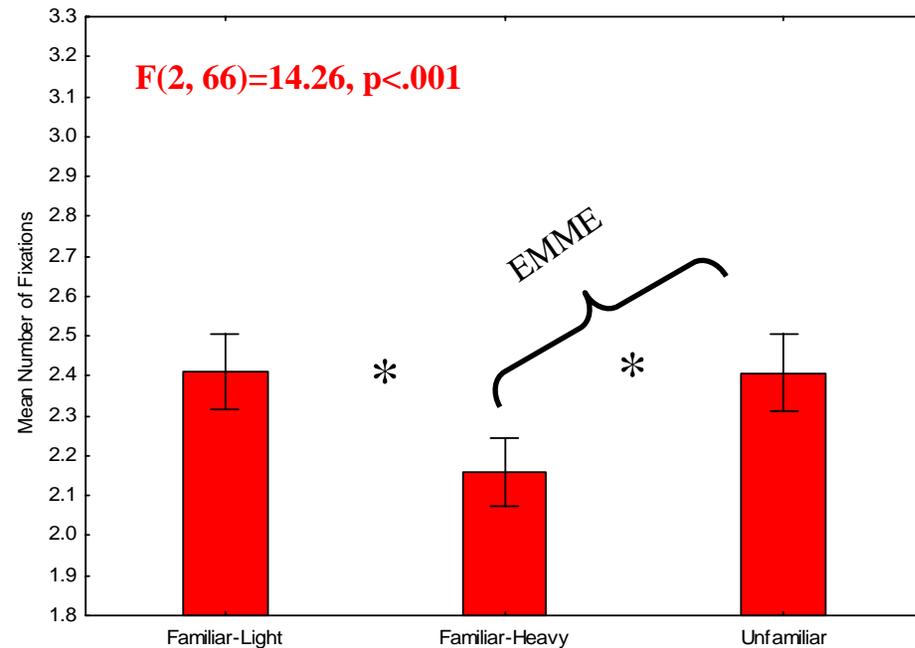
Consistent with an EMME, fixations, $p < .001$ were greater for unfamiliar faces. However, only well learned familiar faces were different than unfamiliar faces (both measures, $p < .001$). Light study produces no EMME on fixations.

Constraint is defined here as unique number of arbitrary face regions fixated. Consistent with an EMME, viewing of unfamiliar faces was considerably more constrained than familiar faces, $p's < .001$. Constraint was not sensitive to level of familiarity. Image above shows typical difference between familiar and unfamiliar faces.

Experiment 2 Goals & Method

Goals

- Repeat Experiment 1 using exclusion instructions.

- If data follow typical RT results, they will be opposite the EMME, suggesting that it is limited to old/new recognition tasks. If data follow EMME pattern in Experiment 1, disconnect between eye-movements and reaction time will be implied.

Procedure

- Same as Experiment 1 except:
  - Respond "Yes" **only** to faces from second (Light) list.
  - Respond "No" to faces from first (Heavy) list.
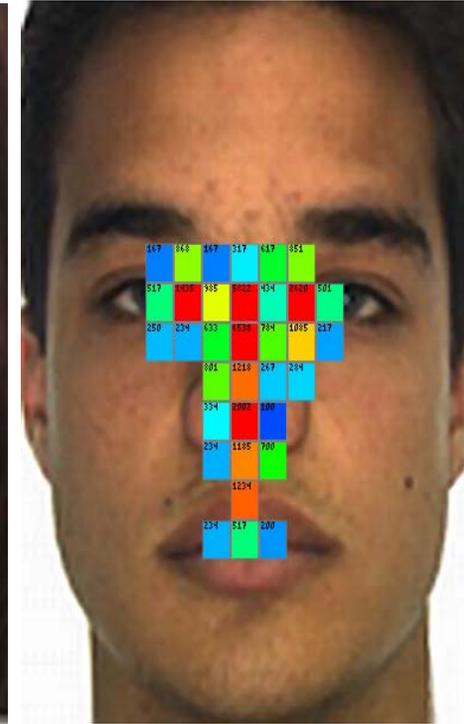
Fixation & RT Results
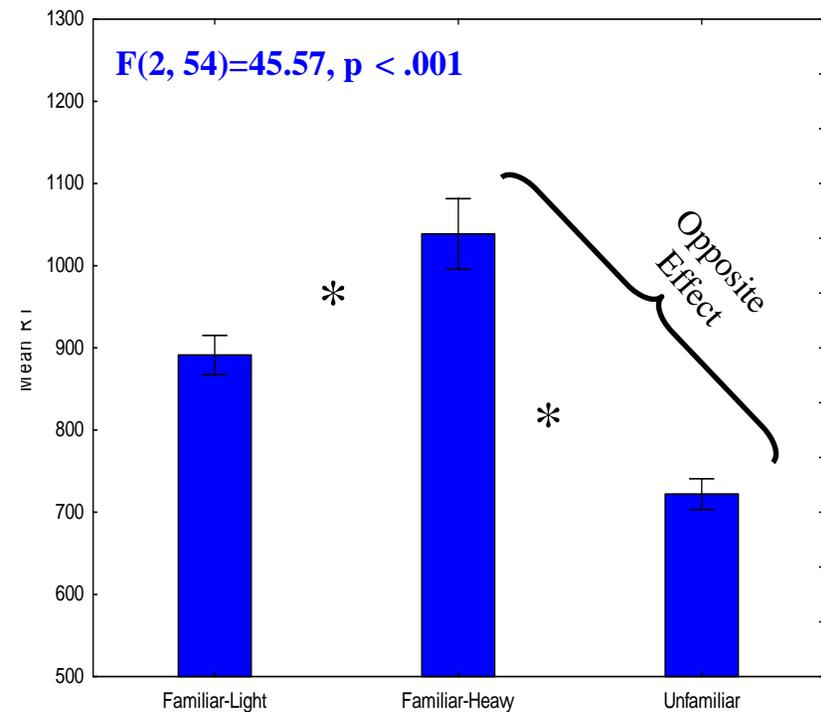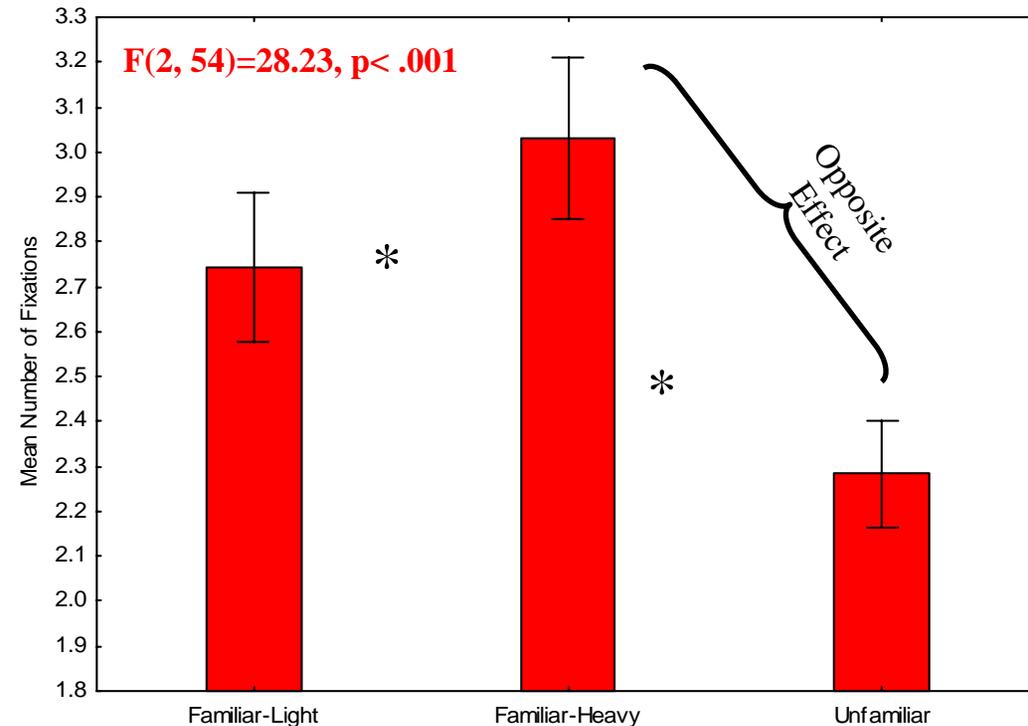
As before, both measures are highly correlated, however a pattern **opposite** to Experiment 1 was found: fixations and RT were greater for familiar than unfamiliar faces, $F(2,120) = 42.03$, $p < .001$. Although this held for both Light and Heavy study lists, degree of familiarity modulated the effect.
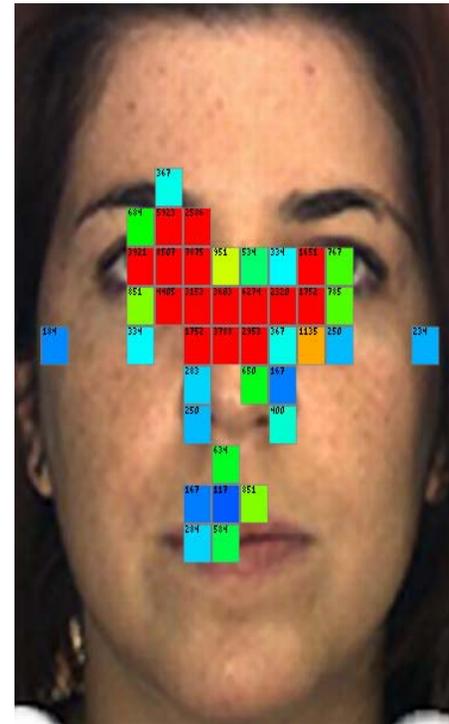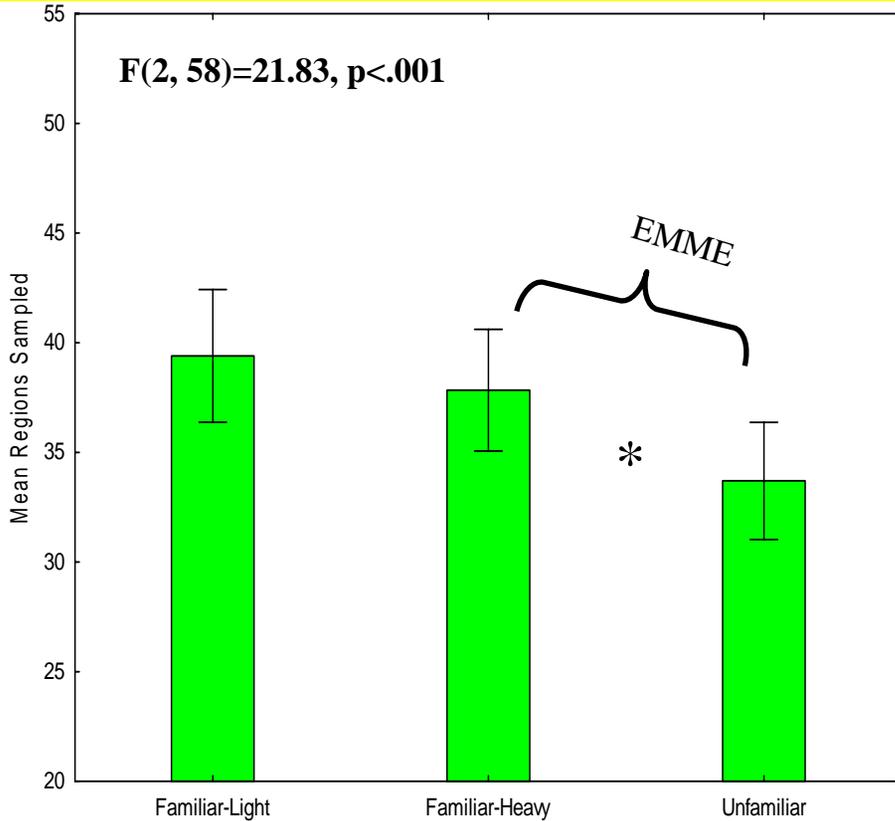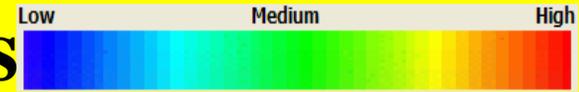
Familiar-Heavy   Unfamiliar

Even during the exclude-recognition task, the constraint measure shows a reliable EMME. However, it is considerably smaller than for the old/new judgment task,. Unlike number of fixations, constraint is not sensitive to level of familiarity. $F(2,130) = 21.82$, $p < .0001$. Image above shows typical difference between familiar and unfamiliar faces.

Conclusions

If famous faces allow especially efficient visual processing, different eye movements for famous and non-famous faces may merely reflect this facilitation, limiting the implications of the EMME. Instead, we found the effect using newly learned faces, suggesting that the EMME is not restricted to famous faces. However, the effect only appeared with heavily studied faces. Lightly studied familiar faces led to fixation data similar to unfamiliar faces. A constraint measure was not influenced by level of familiarity. Previous work suggests that the EMME is not dependent on the type of judgment being made. However, we found a large EMME on number of fixations and constraint in the old/new recognition task, but using an exclude recognition task led to a much smaller EMME on constraint and a large but reversed pattern on number of fixations.

The EMME has been previously attributed to stimulus re-processing efficiency. However, the effect seems influenced by type of judgment and level of familiarity, and may thus index task strategy as well. This may have implications for the detection of concealed knowledge. Seymour et al. (2000) reported that slower "new" responses to familiar stimuli can be used to detect familiarity despite participants' attempt to conceal their knowledge. Experiment 2 suggests that similar detection may be possible using fixation data. As previously reported (Seymour et al. 2000) , RT distinguishes well between familiar and unfamiliar items (hr = .90; fa = 0), but other ocular measures such as pupil size (hr = .87; fa = 0), and number of fixations (hr .85; fa=.05) are also promising. Peak blink amplitude did poorly (hr=.77; fa=.88). Detection using eye-based measures related to the EMME may be preferable if they allow for covert recording.

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