Familiar Face Detection in 180ms

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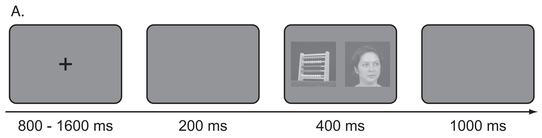
Introduction

- Ultra-fast saccades to a face can be initiated as fast as 100ms from stimulus onset [1].
- These saccades are likely driven by low-level visual features [2].
- Our lab previously found that personally familiar faces can be detected faster than unfamiliar faces even in the absence of awareness (using continuous flash suppression) [3].
- Learned features of a face might facilitate this detection.
- We investigated the saccadic reaction times (SRTs) using personally familiar faces, unfamiliar faces, and objects.
- We hypothesized that SRTs to personally familiar faces would not show a facilitation when presented with objects, as the ultra-fast saccades are driven by low-level features that are shared between familiar and unfamiliar faces.
- On the other hand, we reasoned that specific learned features of a familiar face should affect choice saccades between familiar and unfamiliar faces.

Methods



Target	Distractor
Familiar Face	Object
Object	Familiar Face
Unknown Face	Object
Object	Unknown Face
Familiar Face	Unknown Face
Unknown Face	Familiar Face

Table 1. Tasks of the experiment.

Fig 1. Paradigm of the experiment (A.) and example stimuli (B.)

- We adopted the paradigm from Crouzet et al. [1] (see Fig. 1): subjects were instructed to move their eyes to the target as fast as possible.
- Three stimulus categories: Personally Familiar Faces (pictures of subjects' friends), Unfamiliar Faces (pictures of students from the University of Vermont), and Objects.
- Six blocks with all possible combinations of target and distractor categories (see Table 1).
- Target equally present in the left and right hemifield.
- Each category had three identities (three personally familiar faces, three unfamiliar faces, three objects); faces were matched in gender and skin color. Each face and object identity was presented in three different orientations (left, central, right; see Fig. 1).
- For each block we presented all possible combinations of images in both hemifields: 162 trials per block (9 target images x 9 distractor images x 2 hemifields = 162).
- Stimuli were matched in average pixel intensity and contrast.

Analyses

- Linear Mixed-Effects Models for reaction times of correct trials.
- Logit Mixed-Effects Models for accuracy.
- Minimum reaction time defined as the first time-bin in which the number of correct trials was significantly greater than that of incorrect trials and the following four time-bins were significant as well [1].

Results

- Familiar Face vs. Unknown Face: minimum RT of 180ms, average RT of 191ms.
- Unknown Face vs. Familiar Face: subjects at chance level.
- Familiarity did not affect RTs or accuracies of saccades to objects or faces.

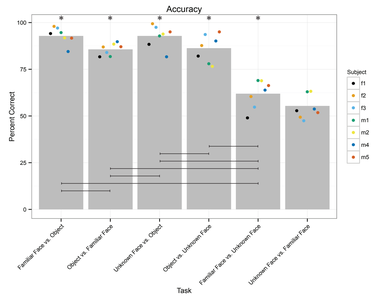


Fig. 2. Accuracy of each subject (colored points) in each task. The bar represents the average accuracy.

*: task significantly different from chance ($p < .05$)
Lines: tasks significantly different from each other ($p < .05$)

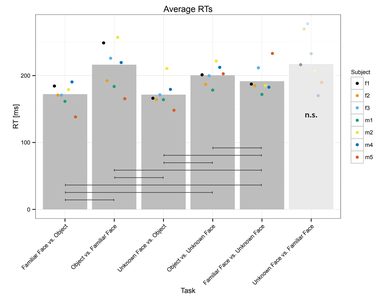


Fig. 3. Average RTs of each subject (colored points) in each task. The bar represents the average RT.

Lines: tasks significantly different from each other ($p < .05$)

Note: the task Unknown Face vs. Familiar Face was not statistically different from chance

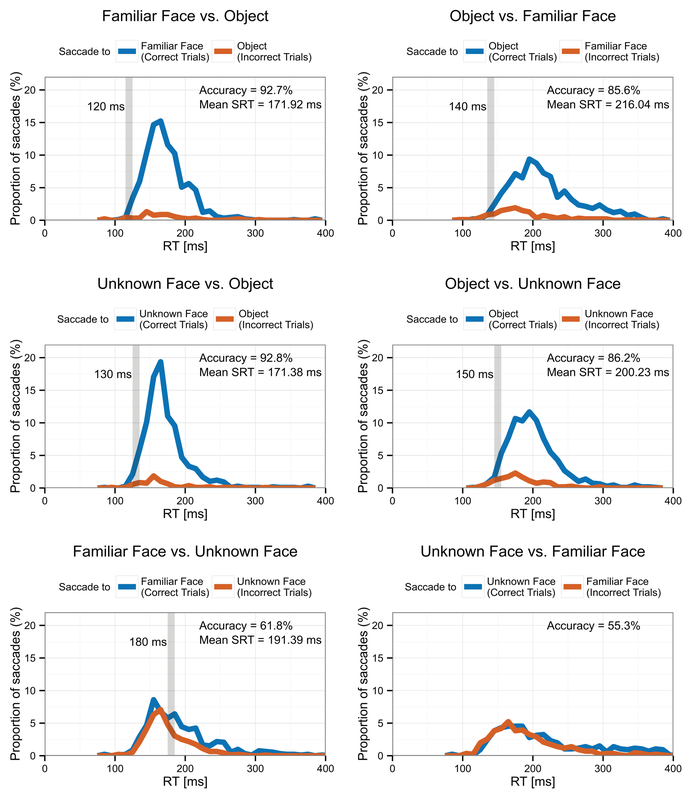


Fig. 4. Proportion of correct (blue) and incorrect (red) saccades for each task. Gray vertical bar represents minimum SRT. Average SRTs are reported only for tasks significantly different from chance.

Discussion

- The minimum SRT for Familiar vs. Unfamiliar Faces was in 175-184ms.
- This behavioral response occurs earlier than the earliest known neural response modulated by familiarity.
  - The N170/M170 in EEG/MEG is modulated inconsistently by familiarity (e.g., no modulation: [5]; larger N170 for familiar faces: [6]; smaller N170 for familiar faces: [7]).
  - Evoked responses modulated by familiarity occur at around 210-250ms [8], 30-70ms after the latency we report here.
- Thus, it seems likely that these very rapid saccades precede identification of the face (activation of person knowledge).
- Identification and recognition of a face (detecting a familiar face) seem to be dissociated: detection without awareness of familiar faces is faster than for unfamiliar ones [3].
- Learned features of a face, such as the shape of the mouth or the distance between the eyes, might accelerate break-through speed and drive these rapid saccades; indeed, subjects could not move accurately their eyes to an unfamiliar face when a familiar one was presented as a distractor.
- Social cues (eye-gaze position and head orientation) are processed faster in familiar faces than unfamiliar ones [9], showing that overlearning of facial features enhances their processing.
- On the other hand, familiarity did not affect saccades to faces when objects were distractors, or to objects when faces were distractors.
  - Low-level visual features drive these ultra-rapid saccades [2].
  - Familiar and Unfamiliar Faces cannot be discriminated based on low-level visual features.

Conclusions

- The very rapid saccades to familiar faces that we report here cannot be attributed to known neural responses that distinguish familiar from unfamiliar faces.
- We propose that detectors for visual features specific to overlearned familiar faces facilitate their rapid detection, before these features are integrated into an explicit representation that is view-invariant and linked to the face's identity.
- These identity-specific detectors might be a subset of general detectors for facial features, such as the distance between the eyes or the height of the forehead [10].
- Thus, potentials evoked by the activation of detectors for familiar-identity-specific features might not be distinguishable from the potentials evoked by the general-purpose detectors for non-identity-specific features.

References

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