The two-faces of recognition ability: better face recognizers extract different physical content from left and right sides of face stimuli

Faghel-Soubeyrand, S[1,2,3]., Alink, A[4]., Bamps, E[2,3]., Gervais, R[1] ., Gosselin, F[1]., Charest, I[2,3].
1.Département de Psychologie, U. de Montréal // 2. School of Psychology, U.of Birmingham // 3.Center for Human Brain Health, U.of Birmingham
// 4. UMC Hamburg-Eppendorf, U.of Hamburg

Introduction

Face recognition ability varies in the neurotypical population [1].

The field has only begun understanding the perceptual mechanisms behind these variations (i.e use of horizontal information, [2]; and use of eye regions, [3]).

To better understand this link, we devised an experiment using a novel psychophysics paradigm, diagnostic feature mapping [4].

First, we measured 120 participants' use of 3 core physical parameters of the visual system (orientation, spatial-frequency, position) during 2 face recognition tasks (gender, emotion).

Second, we assessed how individual use of this information predicts face-recognition ability.

And third, we revealed the temporal unfolding of category-specific information arising from these perceptual mechanisms using EEG and decoding algorithms [10].

Methods

N = 120 Neurotypicals
(576 000 total trials)

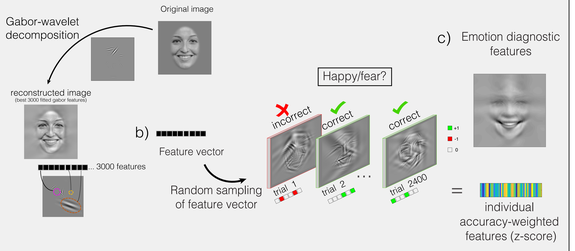
2 tasks: face-gender and face-emotion recognition

Orientation
(10 to 180 degree in 18 steps)

Spatial-frequency
(2 to 80 cpi in 20 steps)

Position
(3000 x-y positions)

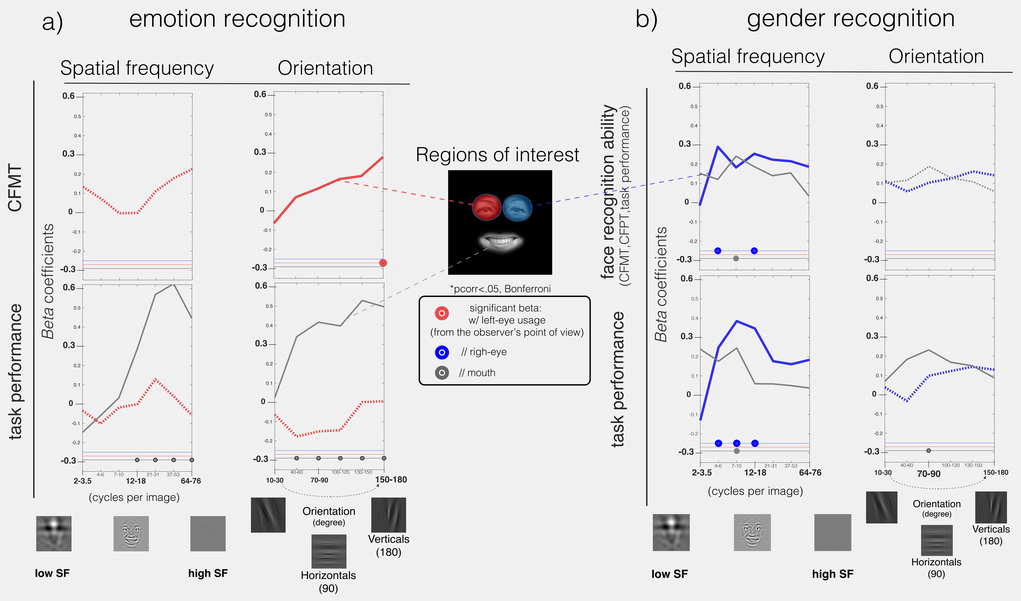
Individual **face recognition ability scores** were collected with the Cambridge Face Memory Test [1] and the Cambridge Face Perception Test [5].



a) an original image was first decomposed in 3000 Gabor grids called features. b) image features were randomly sampled on every trial (2400 per participant per task). Task performance was controlled with an adaptive staircase (number of visual features required to maintain 75% accuracy in the gender or emotion tasks). c) features were weighted with trial accuracy scores.

Results

Correlation between face-representation differences & face-recognition ability



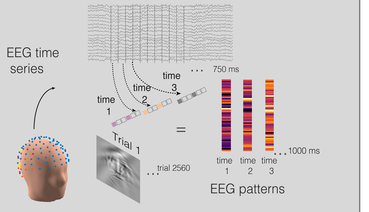
Electroencephalography (MVPA)

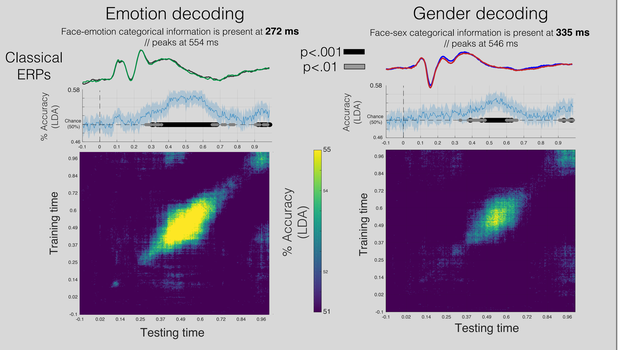
We used a linear discriminant analysis (LDA) to classify raw EEG signal (each time-point separately; 5-fold cross-validation, repeated 5 times) [see 6, 7].

-high-density, **128 electrodes** EEG

- 3 participants
2560 trials per participant, per task

- Filtered .01-30hz





Category-specific information about faces is present relatively late (~300-650ms), compared to traditional face/attentional processing steps (e.g. N170, P2).

Face-emotion information precedes face-sex information by about 70ms.

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highlights & discussion

The best face recognition strategy is not "one-size-fits-all". For skilled face-recognition, observers should extract different physical information from left vs. right side of face stimuli, depending on the task :

1. face-gender discrimination: mid-low spatial-frequency content from the right eye of face stimuli from the observer's viewpoint.

2. face-expression discrimination: vertical orientation information from the left eye of face stimuli from the observer's viewpoint [9].

Decoding of EEG patterns shows that the culmination of face-processing steps (the accumulation of category-specific facial information) unfolds ~300-650ms post-stimulus.

The temporal organization of face-information (extraction-steps, evidence accumulation and diffusion) may offer new insights in individual differences related to face recognition ability.