Does perceptual integration efficiency predict face identification skills

Laurianne Côté, Pierre-Louis Audette, Caroline Blais, Francis Gingras, Justin Duncan & Daniel Fiset
Department of Psychoeducation and Psychology, Université du Québec en Outaouais

Context

- Classical theories of face perception propose that the ability to identify a face is not simply explained by an analysis of their constituent parts but rather by a holistic coding of the relationships between these parts[1].
- Using a method that explicitly measures perceptual integration efficiency for multiple facial features, it was shown that face identification is no better than what is predicted by efficiency for isolated parts[4]. Interestingly, face inversion still significantly decreased perceptual integration, which may suggest that expertise for upright faces comes from the ability to process multiple parts at once.
- The purpose of the present study was to test whether individual differences in face recognition is better explained by integrative processing, or simply by feature processing efficiency.

Method

Sixty-four (64) participants (35 women, M_{age}=22) were tested.

Perceptual integration task

- Participants were asked to memorize six (6) identities.
- Five (5) experimental conditions (see Figure 1).
- The Gold et al. (2012) paradigm[4] requires measuring the level of visual contrast needed to achieve a pre-specified performance (e.g. 75%) for each condition.

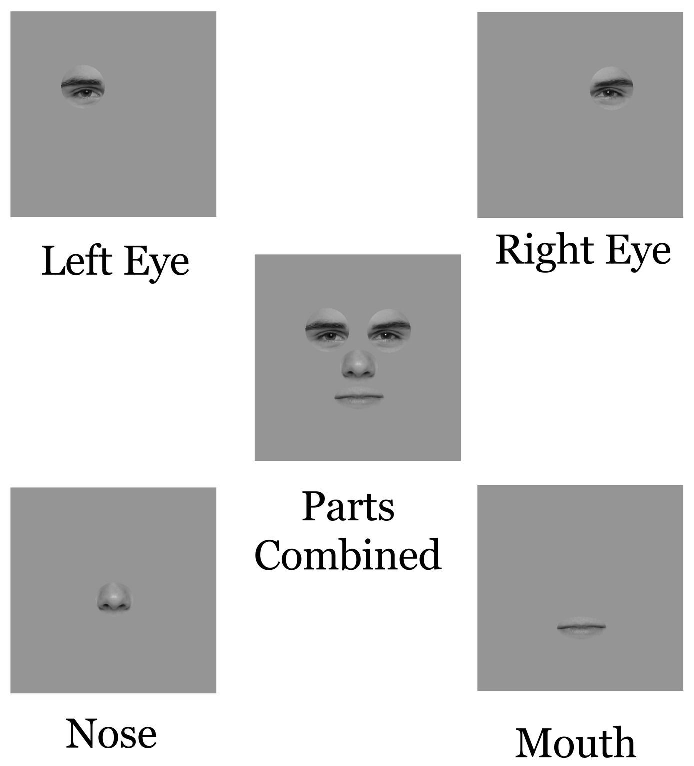

Figure 1 – Five (5) experimental conditions for one of the six learned identities.

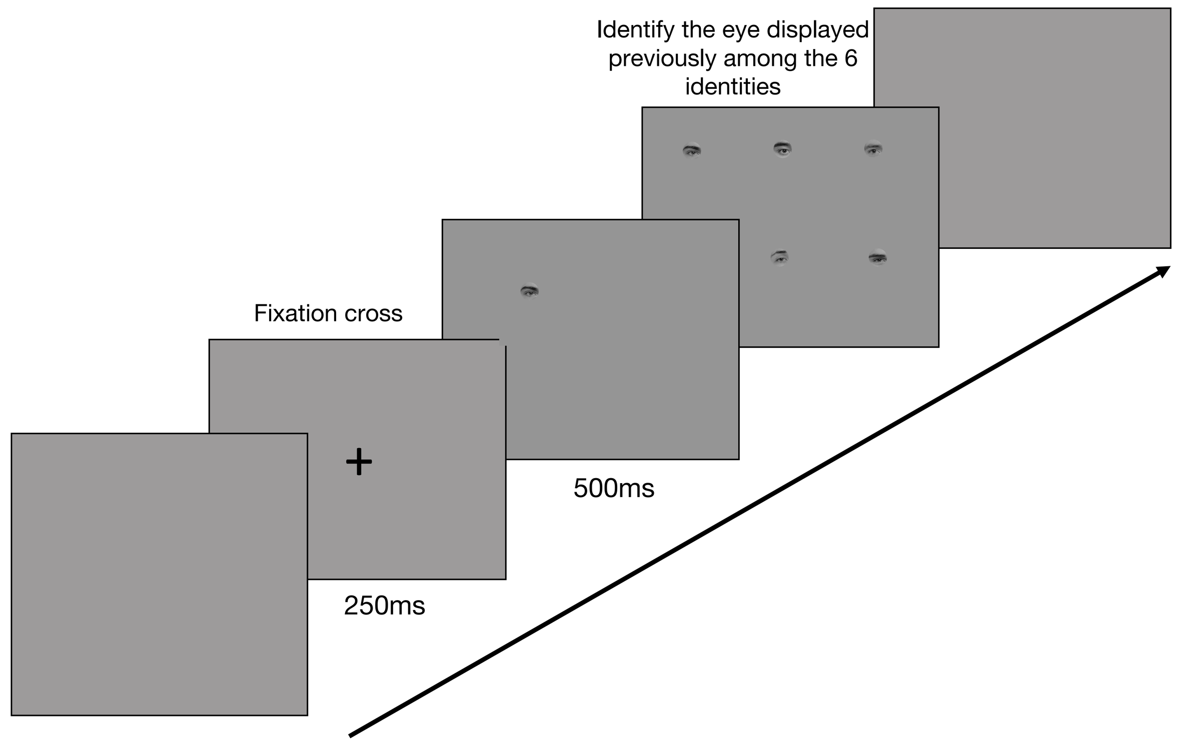

Figure 2 – Sequence of a trial of the integration task.

Face and object recognition tasks

- Cambridge Face Memory Test (CFMT)[3]
- Cambridge Face Perception Test (CFPT)[2]
- Glasgow Face Matching Test 2 (GFMT2)[8]
- Vanderbilt Expertise Test (8 categories of objects ; VET)[5]

Analysis and Results

1) An integration index (Φ) is calculated:

$$\Phi = \frac{S^2 \text{ parts combined}}{S^2 \text{ left eye} + S^2 \text{ right eye} + S^2 \text{ nose} + S^2 \text{ mouth}}$$

Figure 3 – Formula for the integration index. S is the contrast sensitivity, which is the reciprocal of the contrast level needed to achieve 75% performance (S = 1/contrast level).

2) Three principal component analyses were performed:

- **Face processing** abilities (CFMT, CFPT, GFMT2).
- **Isolated face parts recognition** abilities (sensitivity thresholds : $M_{righteye}$ = 0.005, $M_{lefteye}$ = 0.006, M_{nose} = 0.035, M_{mouth} = 0.03).
- **Object recognition** abilities (VET).

3) A three-predictor multiple linear regression model predicts a significant proportion of the variance in face identification skills, **R = 0.629 (R^2 = 0.396)**. The largest part of the variance was explained by face part recognition abilities **(β_{parts} = -0.523, p < 0.001)**. The integration index and object recognition skills were not significantly associated with face identification abilities **($\beta_{integration}$ = 0.128, p = 0.210; β_{object} = 0.139, p = 0.255)**.

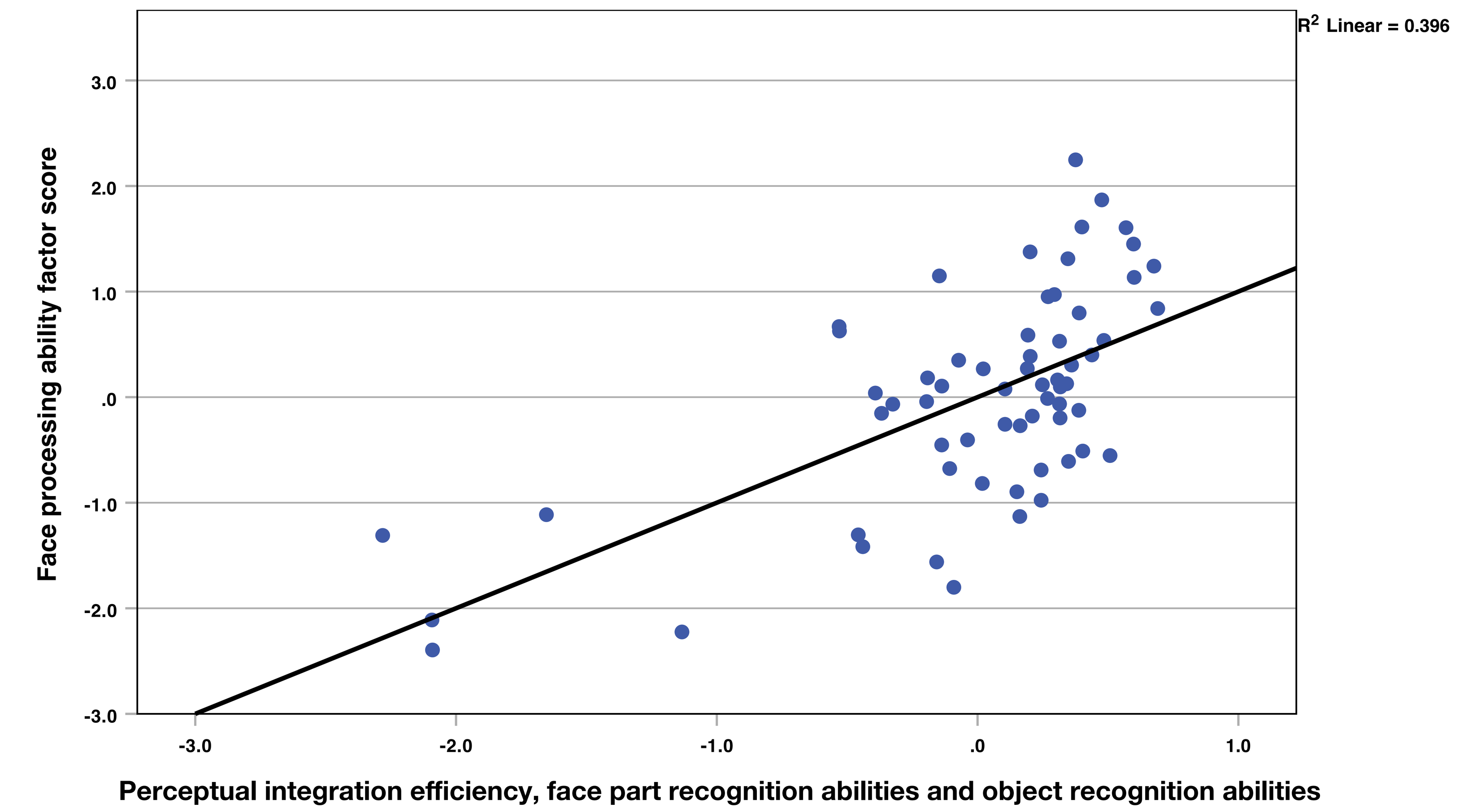

Figure 4 – Face identification ability predicted by perceptual integration efficiency, face part recognition abilities and object recognition abilities in a multiple linear regression model.

Discussion and Conclusion

Our results suggest that individual differences in face processing abilities are mostly explained by differences in abilities for processing isolated parts of faces. In contrast with classical theories of face perception, these results suggest that part-based face processing, not holistic face processing, is the main factor underlying individual differences in face processing abilities.

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