The relation between Horizontal Tuning for Faces and Face Processing Abilities

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Theoretical background

Recent studies have highlighted the important role of horizontal spatial information for many aspects of face processing, such as face detection (Balas, Schmidt & Saville, 2015), face identification (Goffaux & Dakin, 2010), and facial expression recognition (Huynh & Balas, 2014). One study has also reported an association between horizontal tuning for faces and face recognition ability (Pachai, Sekuler, & Bennett, 2013). However, these measures were obtained within the same task, which could have led to an overestimation of the true correlation. Therefore, in this study, the horizontal tuning for faces and face processing ability was measured with independent tasks.

Method

37 subjects took part in this experiment.

Face processing ability

Subjects completed the Cambridge Face Memory Test (CFMT; Duchaine & Nakayama, 2006; Russell, Duchaine, & Nakayama, 2009), the Cambridge Face Perception Test (CFPT; Duchaine, Germine, & Nakayama, 2007), and the Glasgow Face Matching Test–short version (GFMT; Burton, White, & McNeill, 2010).

Orientation Bubbles task

Subjects completed 600 trials of a 10-IFC face identification task in which they were asked to identify face stimuli randomly filtered with orientation bubbles (Fig.1).

Subjects also completed a car recognition task with orientation bubbles, and the Horse Memory Test (HMT; Duchaine & Nakayama, 2005).

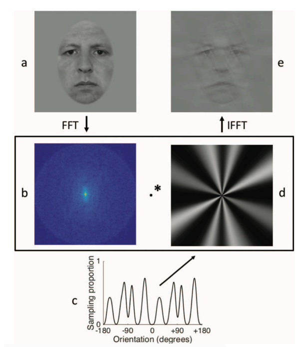

Figure 1. Orientation Bubbles procedure and stimulus example. The orientation bubbles mask (d) is applied to the base image Fourier amplitude (b) of the face stimulus (a), and the orientation-filtered Fourier amplitude is converted to the image domain with inverse FFT (e).

Analyses and results

A face ability score was extracted based on performance in the three face processing measures, using principal component analysis.

Orientation profiles were extracted on a subject basis by computing a weighted sum of orientation filters across trials, using standardized accuracies as weights. Horizontal tuning was then calculated as the weighted sum of orientation profile vectors dot-multiplied with a Von Mises distribution (FWHM = 42 deg) centered on the -90 deg horizontal axis.

We then measured the association between horizontal tuning for faces and face processing ability scores, and observed a significant positive correlation, r = 0.4, CI 95%= [0.13; 0.64], p<0.05 (Fig. 3). Importantly, this relation could not be explained by factors such as horizontal tuning for cars, object-processing ability, or low-level sensitivity to horizontal gratings, $r_{Partial} = 0.39$, 95% CI = [0.08, 0.64], p<.05.

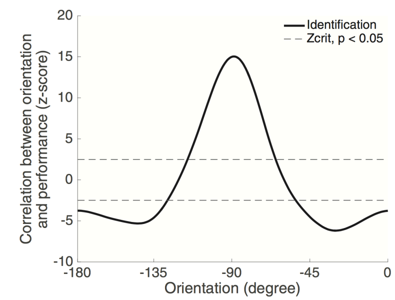

Figure 2. Group classification vector. Information around the horizontal axis was positively correlated with face identification (*Zmax* 15.07).

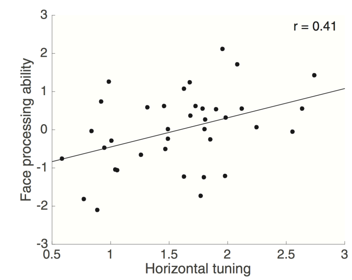

Figure 3. Group classification vector. Information around the horizontal axis was positively correlated with face identification (*Zmax* 15.07).

Conclusion

Our results further reinforce the hypothesis according to which horizontal spatial structure is crucial for face processing.

References

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