Morphing Angelina into Jessica reveals identity specific spatial frequency tuning for faces

Gabrielle Dugas[1], Isabelle Charbonneau[1], Jessica Royer[1], Caroline Blais[1], Benoît Brisson[2], Daniel Fiset[1]

(1) Departement of Psychologie, U. Québec en Outaouais (2) Université du Québec à Trois-Rivières ;

Theoretical Background

The dominant hypothesis in the face recognition domain is that we perceive faces as a whole (i.e. holistically) (Richler & Gauthier, 2014). It has been proposed that holistic face processing is based on the use of low spatial frequencies (SF) (Goffaux and Rossion, 2006). However, behavioral studies show that inversion, one way to disrupt holistic face processing, does not change spatial frequency utilization during face identification (e.g. Gaspar et al., 2008, Royer et al., 2017; Willenbockel et al. 2010).

Most studies use classical face recognition tasks, e.g. 10-AFC tasks, making it difficult to disentangle the impact of physical information from that of identity-specific information in an identity recognition task. We propose to use categorical perception to better target these two types of information (Rotshtein, 2005).

Method

Phase 1 : Selection of continua

- 20 participants classified stimuli from 40 continua of morph between pairs of famous actors.
- 16 continua reached our criteria of categorical perception

ID 1 – 100% ID 1 – 66% ID 1 – 33% ID 1 – 0%

Phase 2 : Behavioral data

- 14 participants performed a match-to-sample task where the response stimuli were sampled using the SF Bubbles method (Willenbockel et al., 2010).
- Trials where participants had to discriminate between two stimuli on the same side of the categorical barrier were called WIT trials (within identity) and the ones where the distractor was on the other side of the barrier were called BIT trials (between identity).

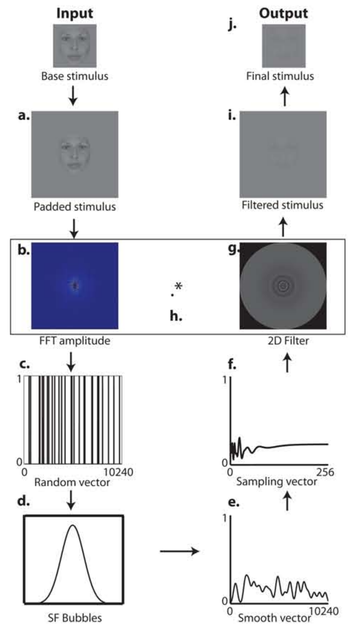

Figure 1. Example of a stimulus filtered with the Spatial Frequency Bubbles method.

Results and Analysis

Multiple regression analysis on the sampled SFs as an independent variable and reaction times (in milliseconds; the faster the better) as dependent variables were performed. Comparison of diagnostic SF for both types of trials (WIT and BIT) reveals a tuning of identity-specific SF for faces (Zcrit = 3.45, p <0.05, peak at 7.9 cpf for BIT, with a bandwidth of 2.8 octaves, and 10 cpf for WIT with a bandwidth of 1.7 octaves). The difference between BIT and WIT trials peaked at 4.2 cpf and was significant from 2.8 to 5.8 cpf.

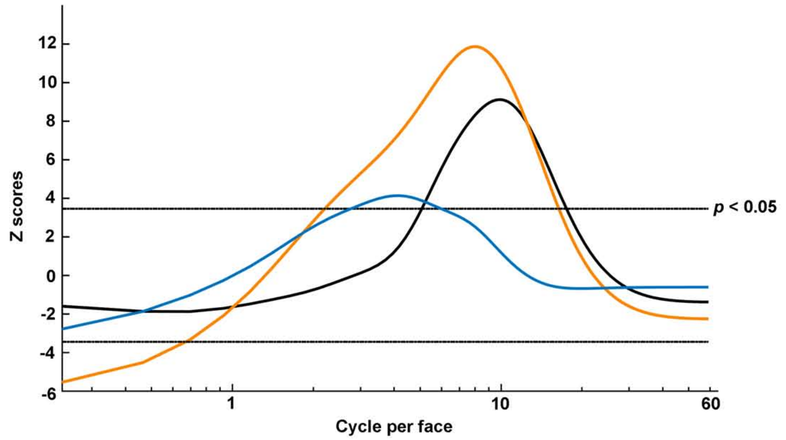

Figure 2. Graph representing the correlation between accuracy and SF utilization during WIT (black) and BIT (orange) trials.

Conclusion

Our results suggest that there is a difference between the SFs necessary for the visual discrimination between two faces and those necessary to specifically deal with the identity of a face. These data provide an interesting insight into the granularity of identity representations in visual memory. It will be interesting to verify if face inversion disrupts the diagnosticity of these low spatial frequencies for identity representation.

References

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