Reducing the perceptual field of view does not cause the face inversion effect

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Introduction

The face inversion effect (FIE) is defined as a disproportionate drop in recognition performance when faces are inverted in the picture plane. Recently, the FIE has been attributed to a shrinking perceptual field of view (PFV; i.e., the visual field area in which features can be processed in parallel and integrated in a perceptual whole) as a direct result of inversion[1]. This offers an elegant and testable explanation to the FIE, since shrinking the PFV by inverting faces would limit face processing to only a few (or even one) features, instead of the whole face, as is normally the case when faces are upright. Recent research has shown inversion also reduces the efficiency with which horizontal spatial information is processed[2], though spatial frequency use appears unaffected[3-4]. The goal of this study was thus to compare the effects of FIE and PFV shrinking on spatial orientation and spatial frequency uses.

Methodology

To test whether PVF shrinking could explain the FIE, we compare 3 conditions: upright, inverted and window-constraint. In the latter, we simulated PFV shrinking by revealing faces through a small gaze-contingent window (see *figure 1*). We then measured face processing strategies for upright, inverted, and windowed stimuli using spatial frequency[3,4] and orientation[5] bubbles (520 trials per condition, per tuning). The size of the Gaussian window was determined on a subject-specific basis to produce an accuracy loss comparable to the FIE (in a preliminary task; 240 trials).

The conditions were organized in alternating blocks of 40 trials. We controlled performance by adding white noise to the stimuli to maintain an 85% accuracy level in the upright condition. Noise was then kept constant in subsequent inverted and window-constraint blocks. Window size was continuously monitored to maintain equivalence between FIE and PFV shrinking.

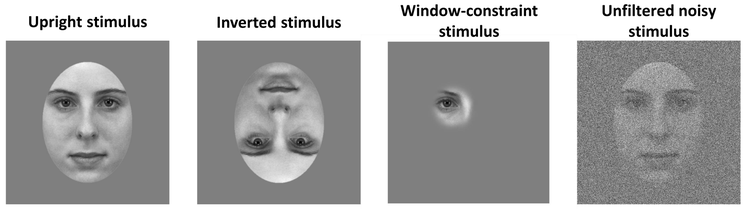

Figure 1. Examples of unfiltered stimuli in the three conditions.

Results

For inverted vs. upright faces (i.e., FIE) there was a reduction in horizontal spatial information processing efficiency, replicating previous findings.

For windowed vs. upright faces (i.e., PFV shrinking simulation), there was a reduction in horizontal processing efficiency, but it was not commensurate with the FIE (*Figure 2*).

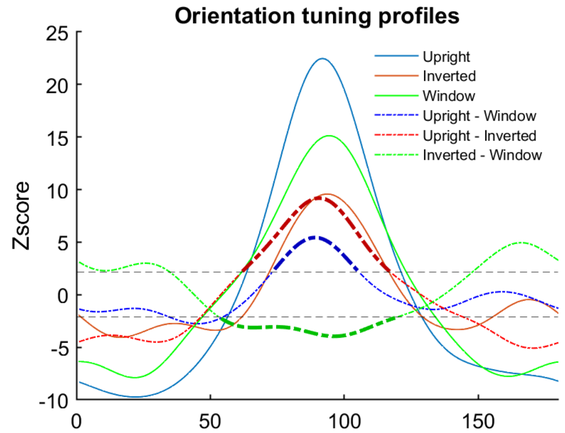

Figure 2. Global orientation profiles and computed differences between conditions.

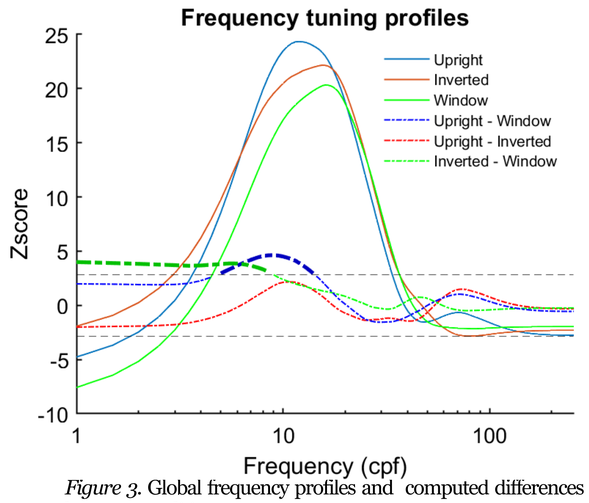

Figure 3. Global frequency profiles and computed differences between conditions.

For inverted vs. upright faces (i.e., FIE) spatial frequency tuning profiles did not significantly differ, replicating previous studies (*Figure 3*).

However, PFV shrinking significantly reduced the diagnostic importance of lower spatial frequencies when compared to both upright (between 5 and 14 cpf) and inverted conditions (under 8.5 cpf).

Conclusion

For a similar drop in performance in inverted and window-constraint conditions, our psychophysical findings showed distinct patterns of visual information use. While the inversion effect caused no change in spatial frequency use, the shrinking of the PVF significantly decreased the importance of low spatial frequencies. Interestingly, these two experimental conditions decreased the importance of horizontal information, although the magnitude of this effect was stronger for inversion. These results are thus incompatible with a shrinking of the perceptual field of view as an explanation for the face inversion effect.

References

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