Orientation sensitivity of face identification: A drift diffusion model analysis

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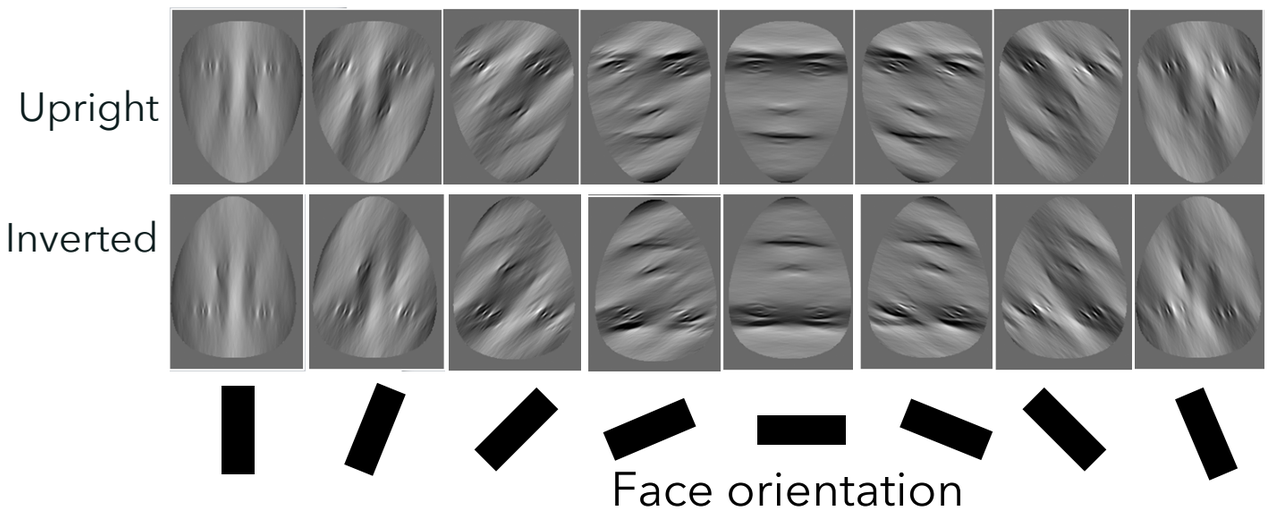
Background

- Human face identification is driven by horizontal information.
- Sensitivity to identity peaks for horizontally filtered faces and declines for oblique & vertically filtered faces.
- Face inversion results in a downward shift of the entire tuning curve as well as a reduction in the amplitude of the horizontal peak and a doubling in bandwidth.
- Previous studies employed a psychophysical approach focusing on accuracy rather than response time.

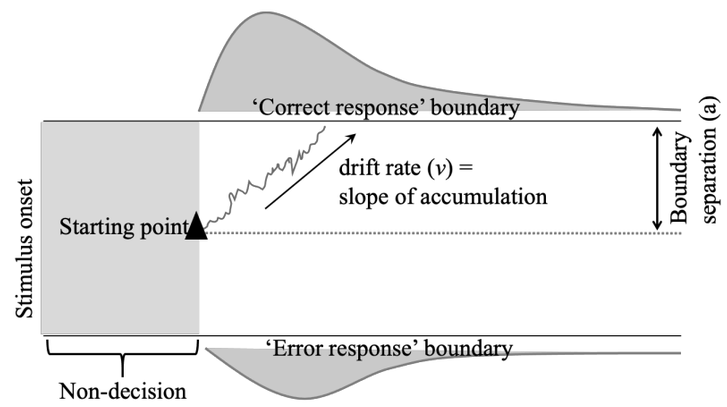
- **We introduce a drift diffusion modeling (DDM) approach to assess how filtering the orientation content of faces influences the various parameters of the perceptual decision process.**

Methods

- Data set of Goffaux & Greenwood (2016)[1].
- Face identification task: 33 participants performed a delayed match-to-sample task on identity.
- Eight different orientations (0, 22.5, 45, 67.5, 90, 112.5, 135, and 157.5°), and two picture plane orientations (upright, inverted) were used in the experiment.

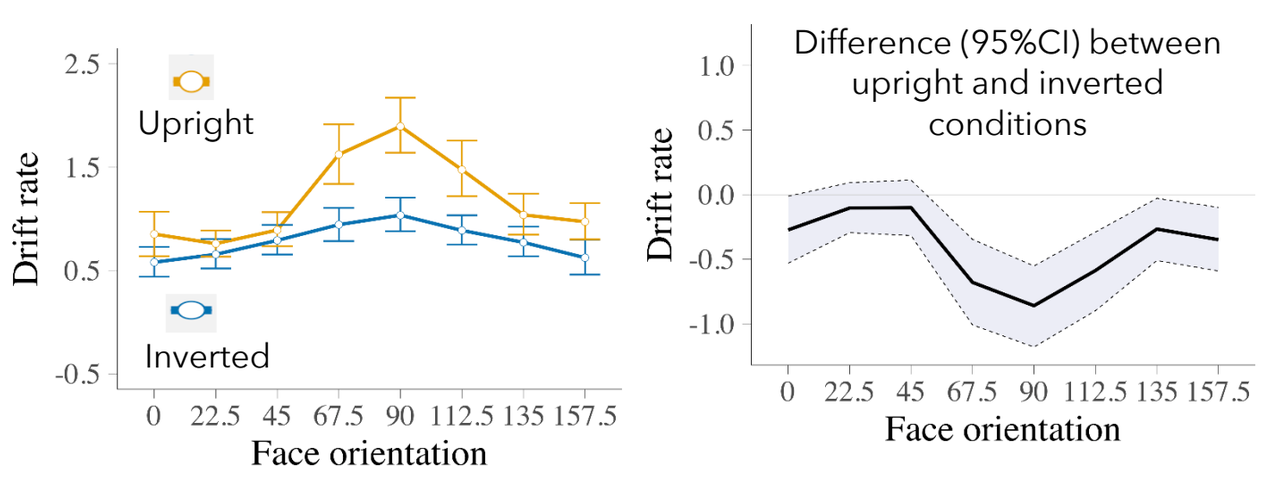


Our approach: Drift Diffusion Model (DDM)[2]



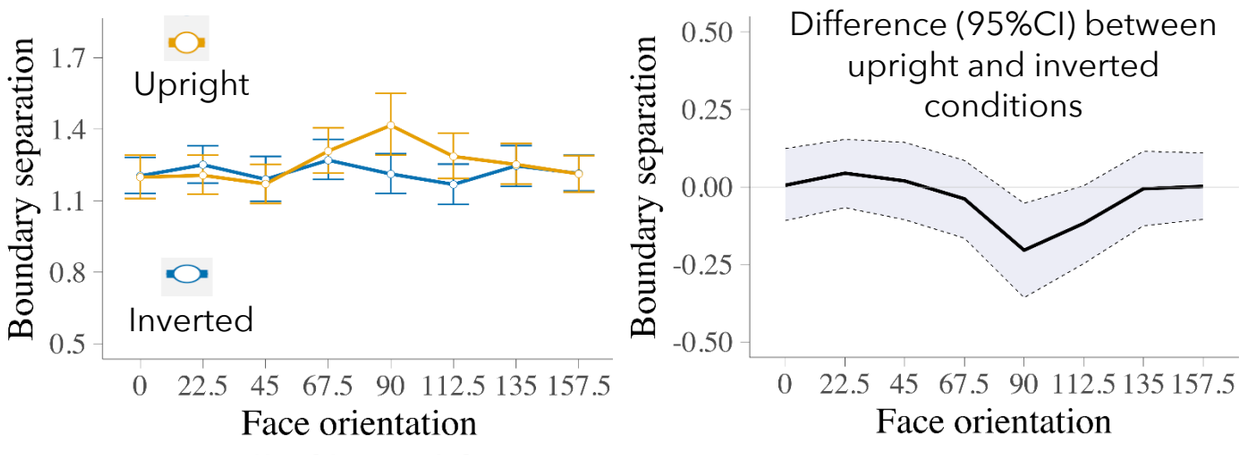
- Drift rate (v): the rate of evidence accumulation.
- Boundary separation (a): determines the speed–accuracy trade–off.
- Non-decision time (t0): nonspecific components (i.e. response preparation and motor execution).

Results: Drift rate



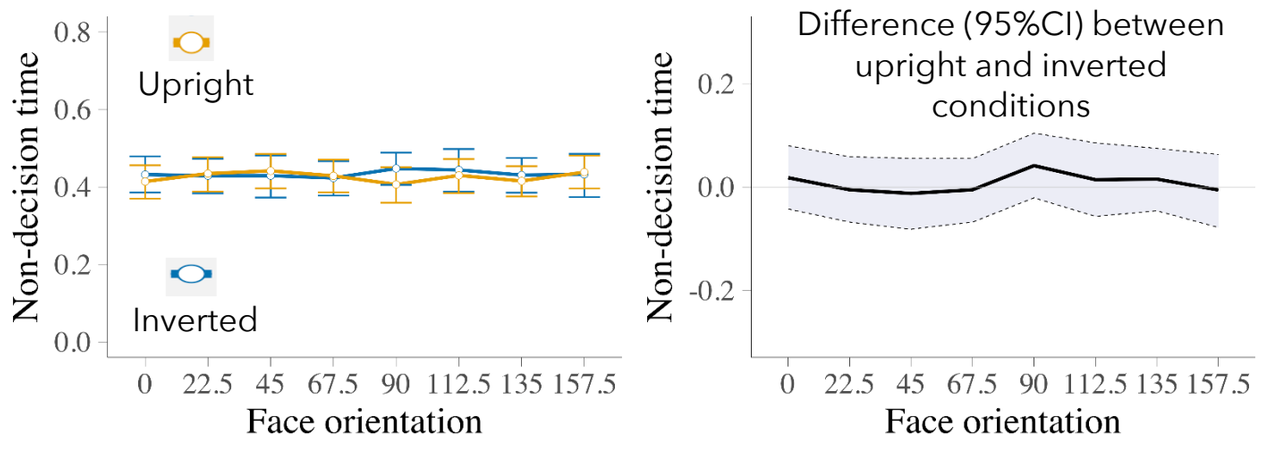
- Information accumulates faster for upright faces in the horizontal range.
- Face inversion effect is strongest in the horizontal range.

Results: Boundary separation



- Horizontally filtered faces resulted in larger boundary separation for upright compared to inverted faces, suggesting subjects were more cautions when processing horizontal information in upright than inverted faces.

Results: Non decision time



- The duration of the encoding and response output process is similar across face and filter orientations.

Discussion

- We observed that drift rates peaked in the horizontal range for upright faces, and progressively decreased when moving away from the horizontal range. The orientation profile of sensory evidence accumulation (i.e., drift rate) is very similar to the orientation profile of identification accuracy (or d').

- In the horizontal range, perceptual decisions are made with more caution in upright compared to inverted faces, possibly because more face information is available in this range.

- Our results indicate that filtering face orientation content influences the drift rate and evidence accumulation is most efficient in the horizontal range of face information.

References

1. Goffaux, V., & Greenwood, J. A. (2016). *Scientific reports*, *6*, 34204.
2. Ratcliff, R., & McKoon, G. (2008). *Neural computation*, *20*(4), 873-922.

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