Does the Radial Bias influence fast saccades towards Faces in the Periphery ?

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Introduction

- Saccadic choice studies have demonstrated that faces are more rapidly and accurately fixated in the periphery than other stimuli, such as animals, objects and scenes[1,2,3]
- Such ultra fast saccades towards faces are typically measured with lateral stimulus presentation, i.e., stimulus placed along the horizontal meridian [4,5,6]
- Face recognition preferentially relies on horizontally-oriented visual cues (Fig. 1)[7]
- Roux-Sibilon et al. (2023) recently found that face-selective mechanisms are more engaged along the horizontal meridian compared to the vertical meridian[10] likely due to the combined influence of the radial biases[8,9] and the horizontal tuning of face recognition (Fig. 2)

Does the combined influence of peripheral radial bias and foveal horizontal tuning contribute to the ultra fast saccades towards faces along the horizontal meridian ?

Fig. 1

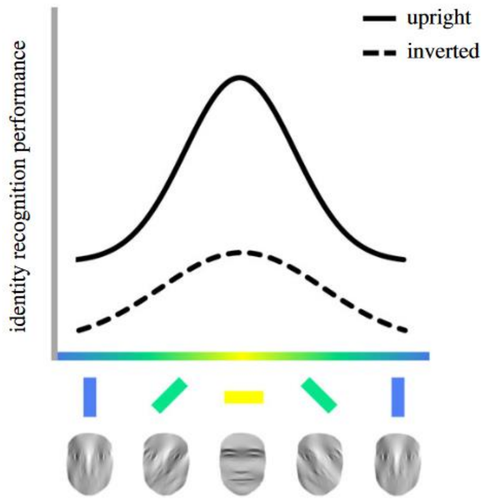
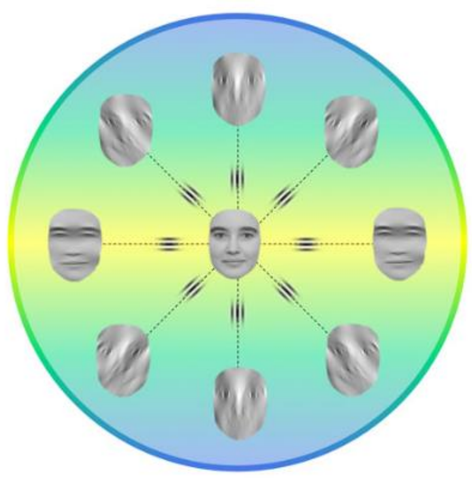


Fig. 2



Methods

Sample:

Fifty healthy adults participated in the study (Mean age = 21.1 (+/- 2.9); 44 right-handed; 40 women).

Saccadic choice task (n = 50):

Follows established saccadic-choice procedures[1,2,3,4], with the primary difference being that stimuli are presented at 15° eccentricity along either the vertical (VM) or horizontal meridian (HM).

Stimuli: 240 images of human faces and vehicles[2] , 8° of visual angle, varied in size and perspective.

Task: saccade towards a predefined target category (faces or vehicles).

Foveal horizontal tuning task (n = 35):

Task: Foveal same-different delayed identity matching paradigm.

Stimuli: Greyscale images of familiar white male actors[11], presented upright or inverted, with full spectrum, horizontal (90°), or vertical orientation content (0°)[12].

Peripheral radial bias task (n = 39):

Peripheral four-alternative forced-choice (4AFC) detection task

Task: indicate where a target appeared in their visual field.

Stimuli: Horizontal and vertical Gabor patches, subtending 6° of visual angle, placed at 15° eccentricity along the vertical or horizontal meridian.

Difficulty adjusted by dynamically varying stimulus contrast using a staircase method.

Bayesian hierarchical models :

Saccadic choice task:

*SRT ~ 1 + target * meridian + (1 + target * meridian|subject)*

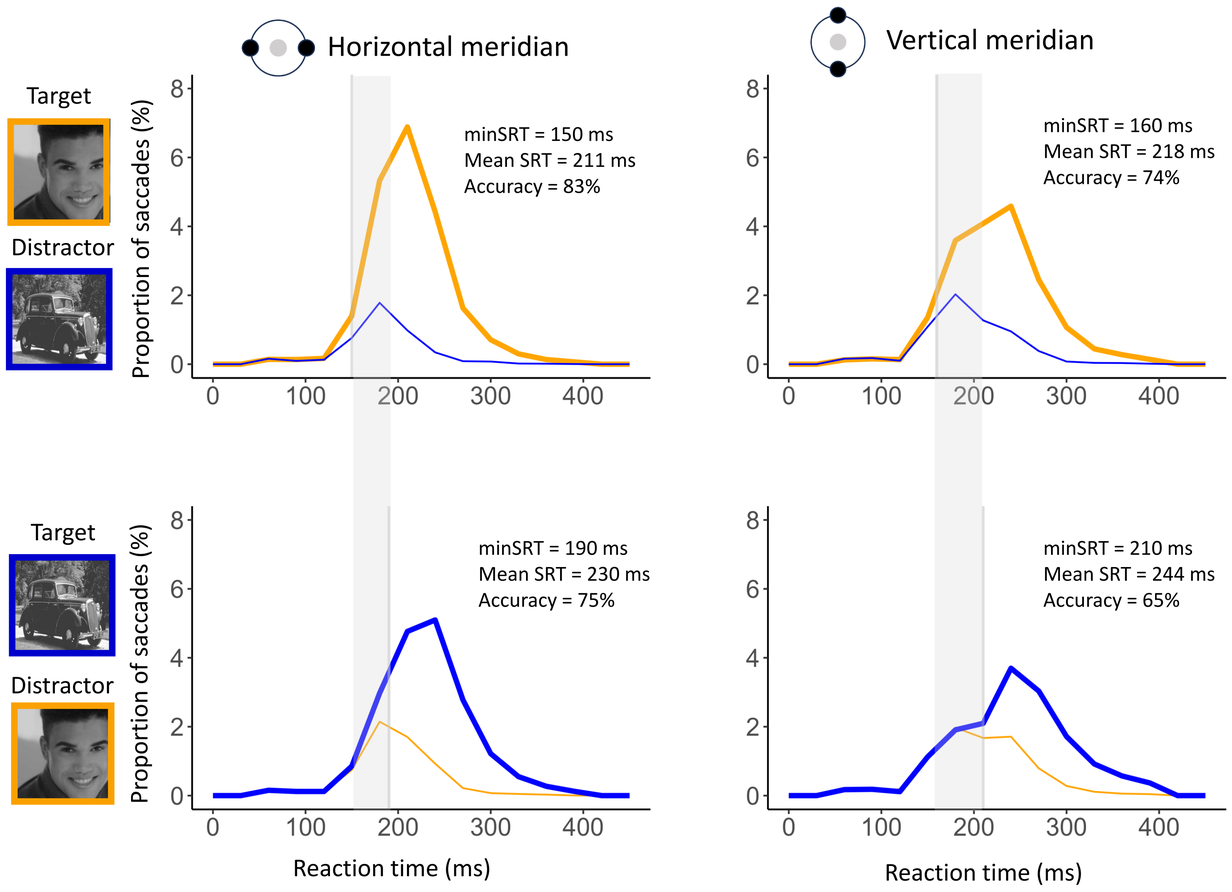
Foveal horizontal tuning task:

*Standardized D' ~ 1 + condition * filter + (1 + condition * filter|subject)*

Peripheral radial bias task:

Threshold ~ 1 + radiality meridian + (1 + radiality * meridian|subject)*

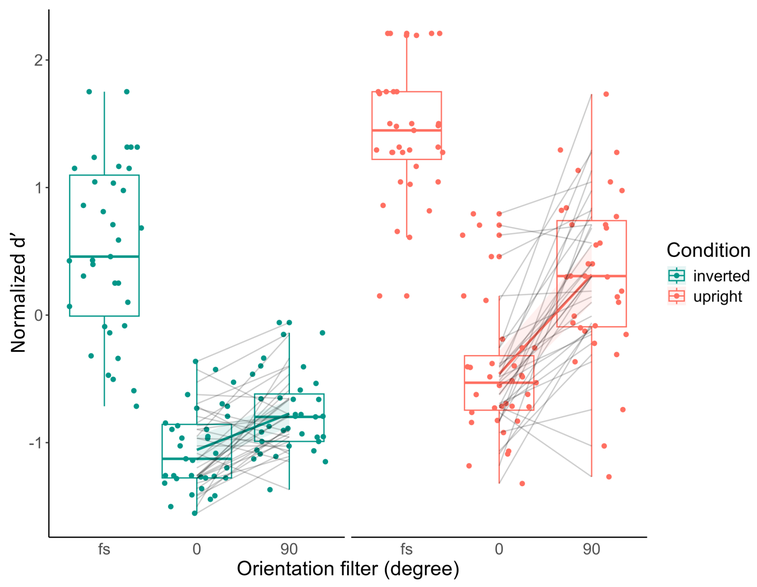
Saccadic reaction times (SRT)



- **Minimum saccadic reaction time (minSRT)** was determined by dividing the latency distribution into 10-ms bins. If five consecutive bins showed significantly more correct than incorrect responses (χ^2 test, $p < .05$), the first was considered the minSRT.
- **Bootstrapped minSRT (n = 5000):** no significant difference in face advantage (vehicle-face) between horizontal (M=39.5, CI=[20,50]) and vertical (M=56.7, CI=[40,70]) meridians.
- Main effect of target, i.e, faster saccades towards faces than vehicles Main effect of meridian, i.e., faster saccades along the horizontal meridian overall but no significant interaction.

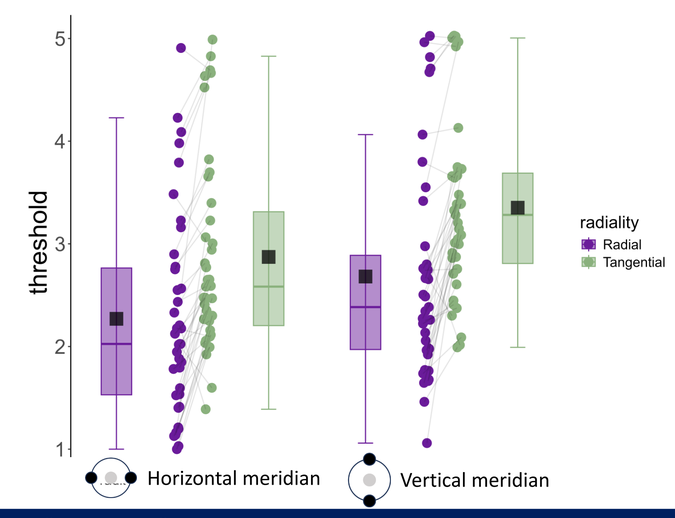
Horizontal tuning of foveal face recognition

Main effects of filter, condition, and their interaction. Full spectrum (fs) led to best performance overall. The advantage of horizontally filtered (90°) faces over vertically filtered (0°) faces was more pronounced in the upright than the inverted condition



Peripheral radial bias

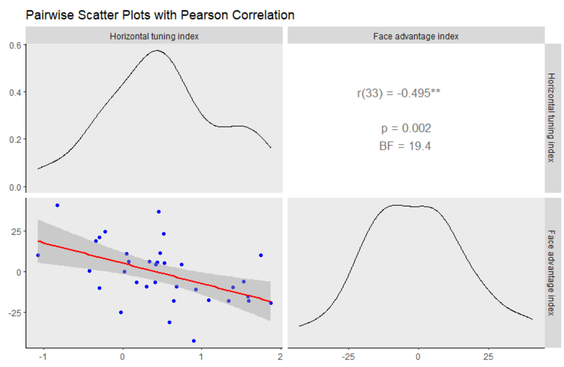
Main effects of radiality and meridian, i.e, better performance for radial than tangential stimuli and along the horizontal than vertical meridian (horizontal – vertical anisotropy).



Is the saccadic behavior related to radial bias and/or horizontal tuning ?

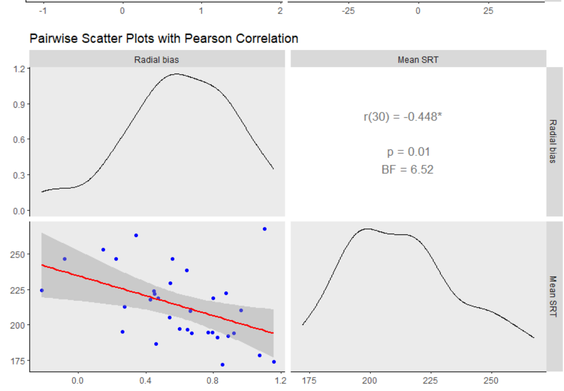
Face saccadic advantage per meridian
[Vehicle-Face]HM - [Vehicle-Face]VM
Horizontal tuning index
[Upright-Inverted]90° - [Upright-Inverted]0°

The more the foveal face-specialized identity processing is horizontally-tuned, the stronger the saccadic advantage for faces along the vertical meridian.



Mean SRT
[Saccades towards faces]HM
Radial bias
[Tangential – Radial]HM

The stronger the radial bias along the horizontal meridian, the faster the saccades towards faces horizontally.



Discussion

- Saccades were faster and more accurate towards faces than vehicles overall.
- Vertical meridian setup mostly disturbed the latency of the saccades toward vehicles.
- Saccades towards faces were relatively immune to vertical meridian setup, suggesting the robustness of face-specialized peripheral detection.
- The robustness of the saccadic face advantage along the vertical meridian is linked to the participant's reliance on horizontal cues for face-specialized identity recognition at fovea.
- Along the horizontal meridian, the latency of the saccades towards faces is explained by the strength of the radial bias.

→ **Peripheral face detection is functionally linked to orientation dependence of face-specialized recognition mechanisms at the fovea.**

→ **Detection of faces in the periphery is linked with the intensity of the radial bias along the horizontal meridian.**

→ **Peripheral radial bias and foveal horizontal tuning separately contribute to the ultra fast saccades towards faces in the periphery.**

References

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