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Voxelwise encoding model reveals 2D key points like representation in extrastriate body area.

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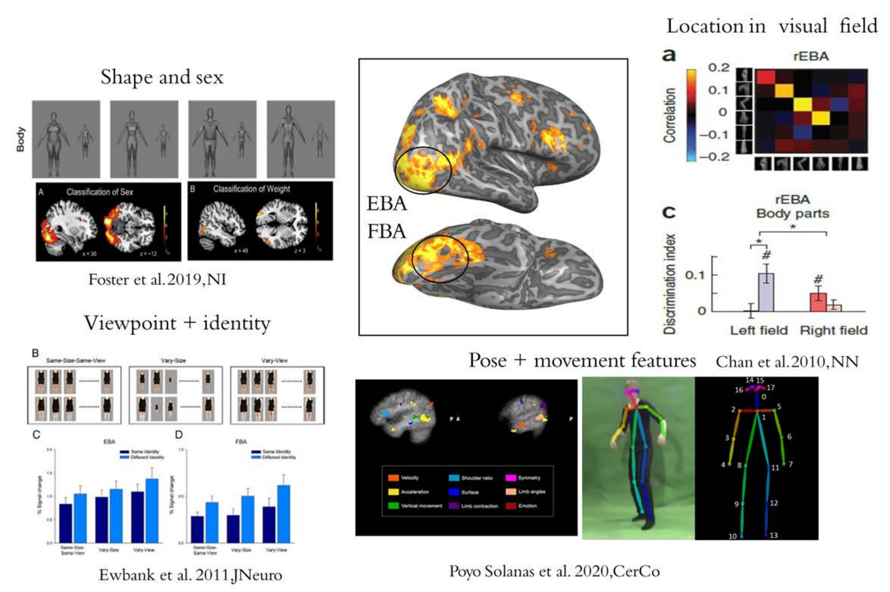
Introduction

The extrastriate body area (EBA) (Downing et al. 2001, Peelen and Downing, 2005) is currently considered to be a ventral cortex object category area, selective for still body stimuli. Despite the current view, several studies have shown how stimulus features or body attributes are encoded in EBA.



Objective

What is less clear is the role played by EBA in bridging the gap between low-level features of body stimuli (i.e. kinematics) and the high-level semantic information conveyed by the body (i.e. emotion, action).

Therefore, understanding how whole-body postures are encoded in EBA is crucial to disentangle its role in body perception.

In this fMRI study we used fully parametrized body stimuli and we tested several encoding models in order to determine which one could best predict fMRI BOLD responses in EBA.

Methods

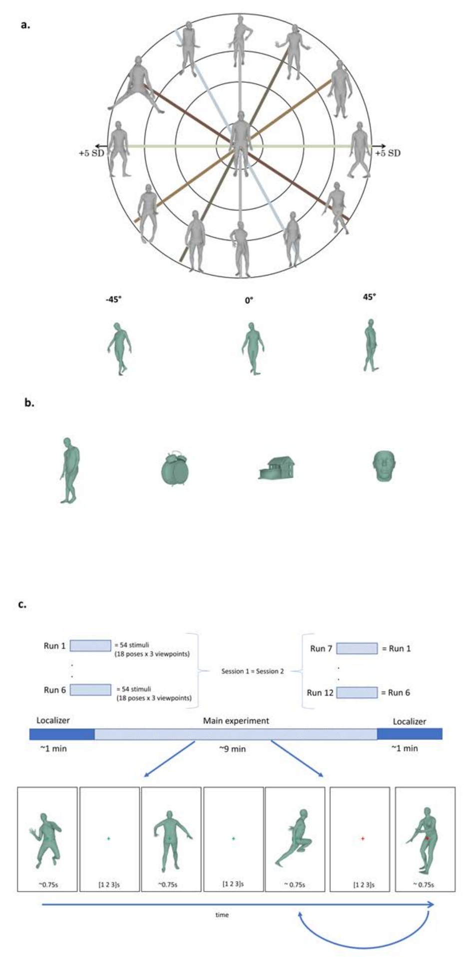
Stimuli: 324 images of body postures (108 unique poses from 3 viewpoints) generated using Vposer (Pavlakos et al. 2019).

Participants: 20 volunteers (9 males) right-handed.

Experimental design: Two 7T fMRI (12 experimental runs in total) mixed block/fast event-related design (localizer: block design; main experiment fast event-related design)

Encoding models:

- **kp2d**: 2D key points (joints coordinates) extracted during stimulus creation.
- **kp3d**: 3D key points (joints coordinate)
- **Gabor**: pixel space representation.



a. Example of std sampling for stimulus creation. (above) Examples of same pose from different viewpoints (below)

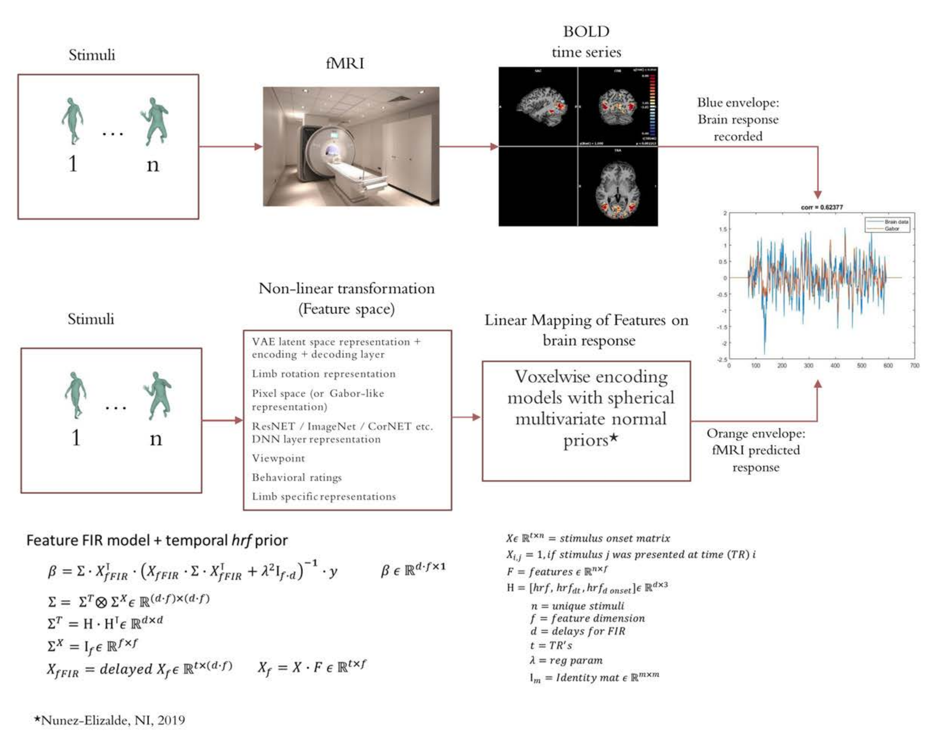
b. Object category used in the localizer (block design).

c. Main experiment following a fast event-related paradigm with one-back task to control attention

ROI definition: EBA was defined using the localizer contrast: Body> [Houses + Tools];

Models fitting: Banded ridge regression (Nunez-Elizalde et al. 2019; Dupré La Tour et al. 2022) in which the regularization parameters are learnt in crossvalidation.

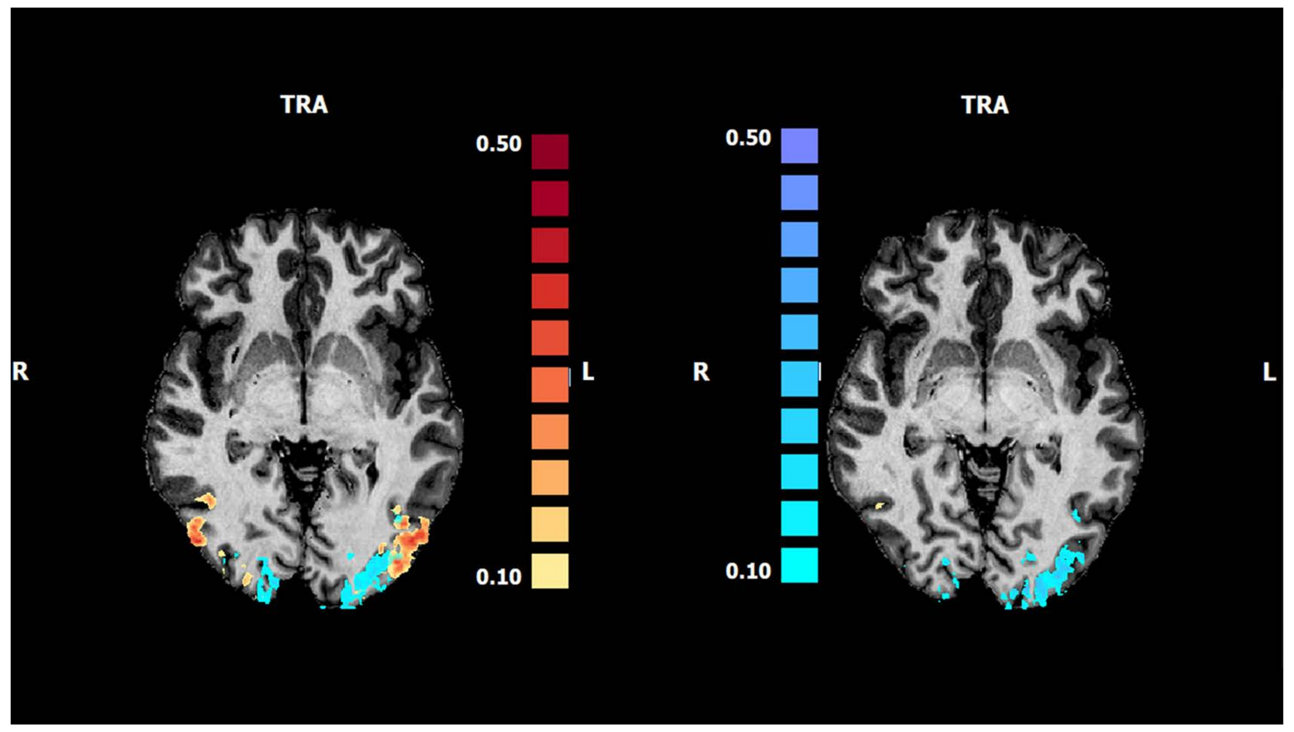
Models' assessment: Pearson's correlation between predictions obtained by each model separately and left-out testing data.



Results

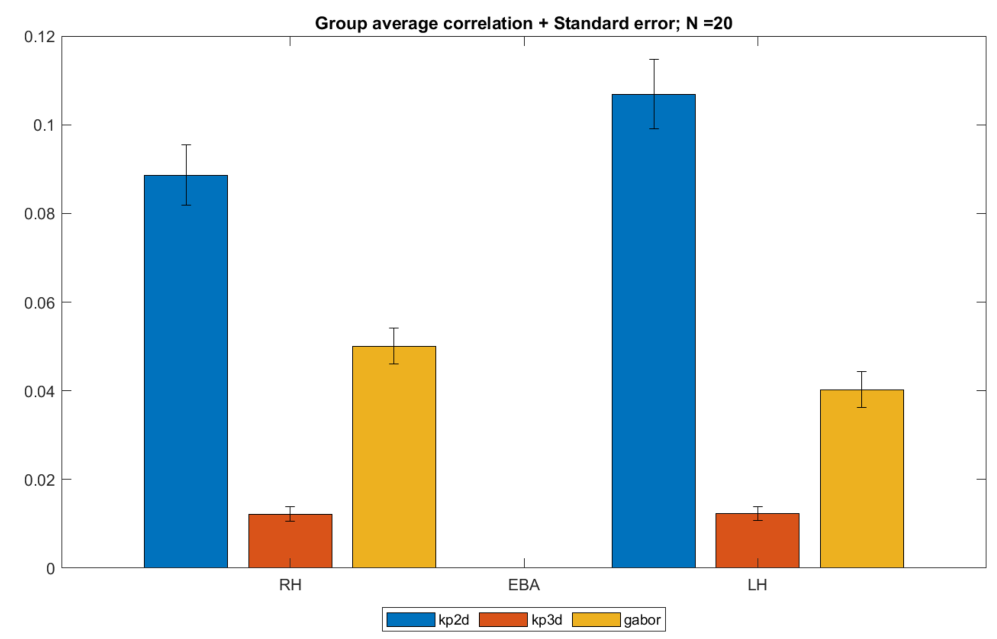
Whole-brain analysis:

- **Gabor** model outperforms **kp2d** and **kp3d** in early occipital areas.
- **Kp2d** shows higher prediction accuracy in high-level visual cortex.

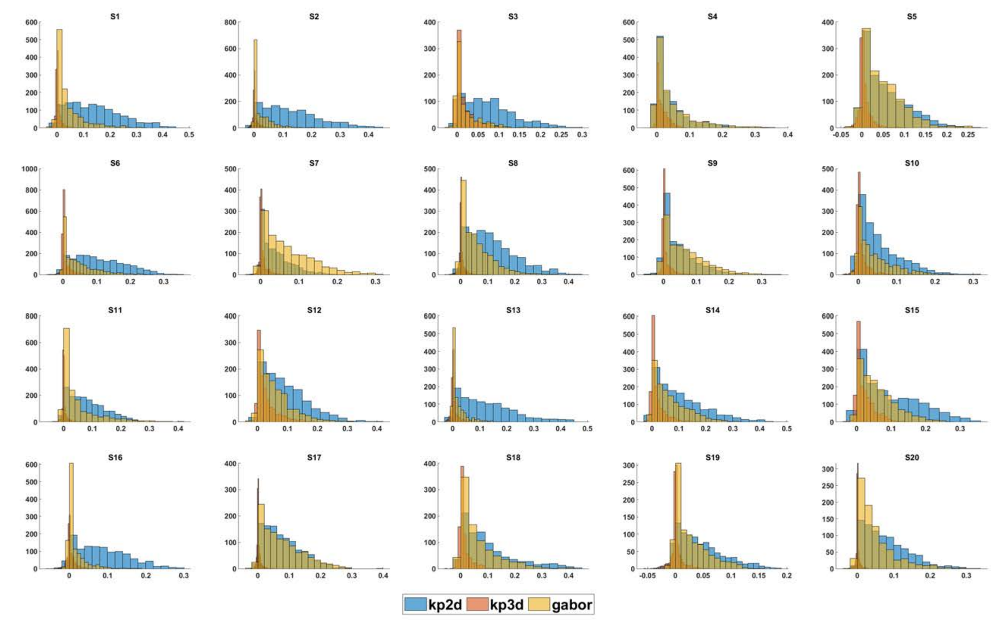


Left: Comparison between kp2d (yellow/red) and Gabor (cyan). Color bar represents Pearson's correlation value.
Right: Comparison between kp3d (yellow) and Gabor (cyan).

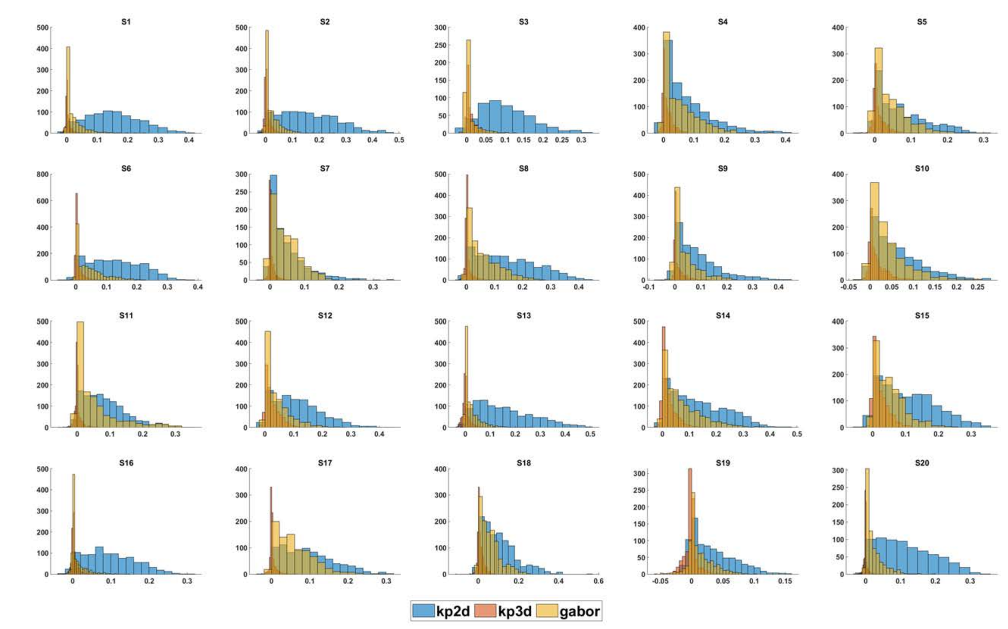
ROI analysis:
Analysis performed on bilateral **EBA** (defined on independent data). The average accuracies across 20 subjects reveals that **kp2d** outperforms **kp3d** and **gabor** in EBA. (These results have not yet been statistically assessed).



Mean of predictions' accuracies across 20 subjects in right and left EBA



Right hemisphere



Left hemisphere

Subject-level accuracies 'distributions in Pearson's correlation value.

Conclusion

These results suggest that bodies may be represented in **EBA** as key points, namely **the relative distance between the joints** is driving the response. This representation is bidimensional and thus **viewpoint specific**.

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