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# Encoding models of body stimuli reveal 2D key points like representation in extrastriate body area.

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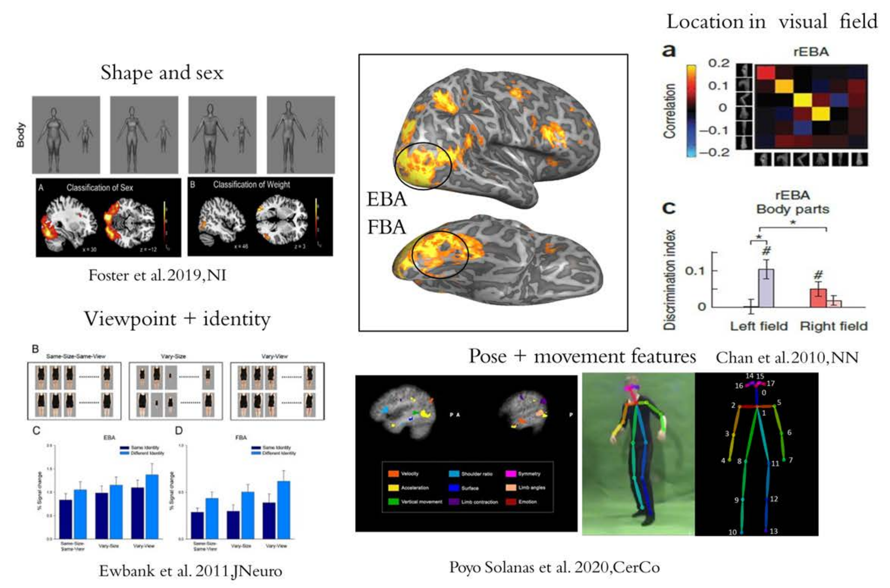
## Introduction

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. (Nishimoto et al. 2011).

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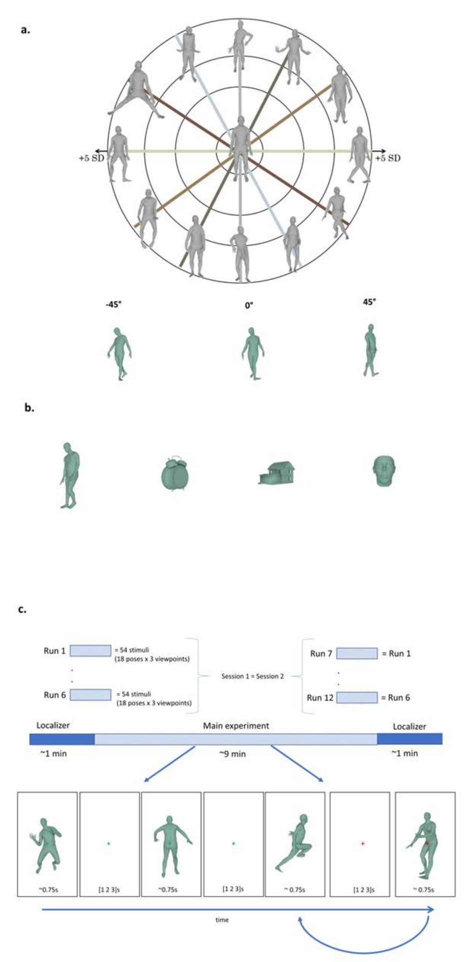


a. Example of std sampling for stimulus creation. (above) Examples of same pose from different viewpoints (below)

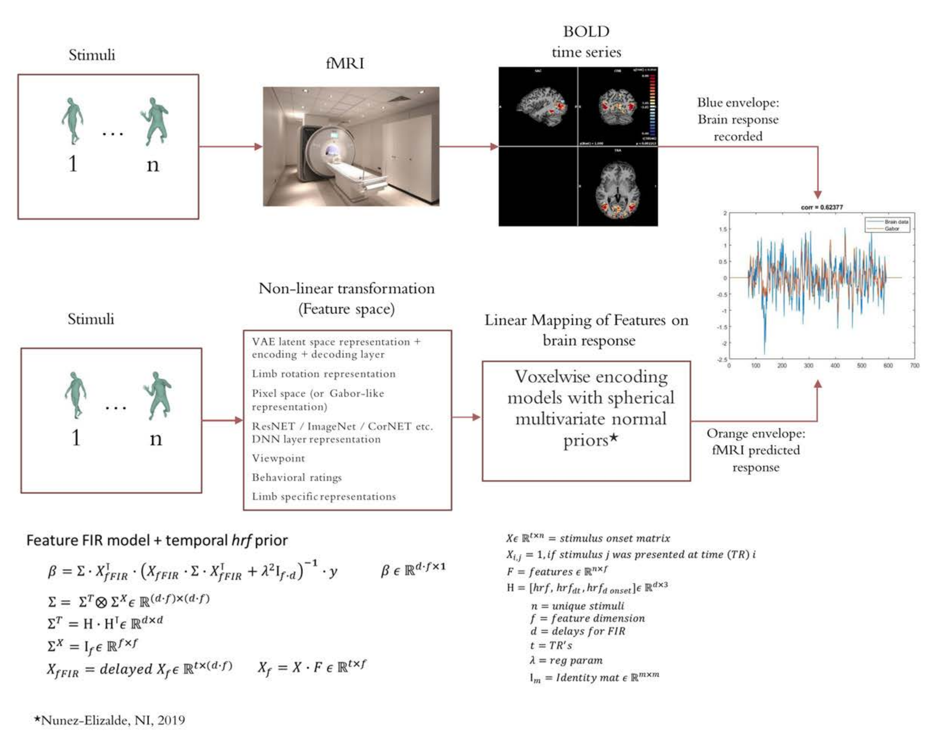
b. Object category used in the localizer (block design).

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.

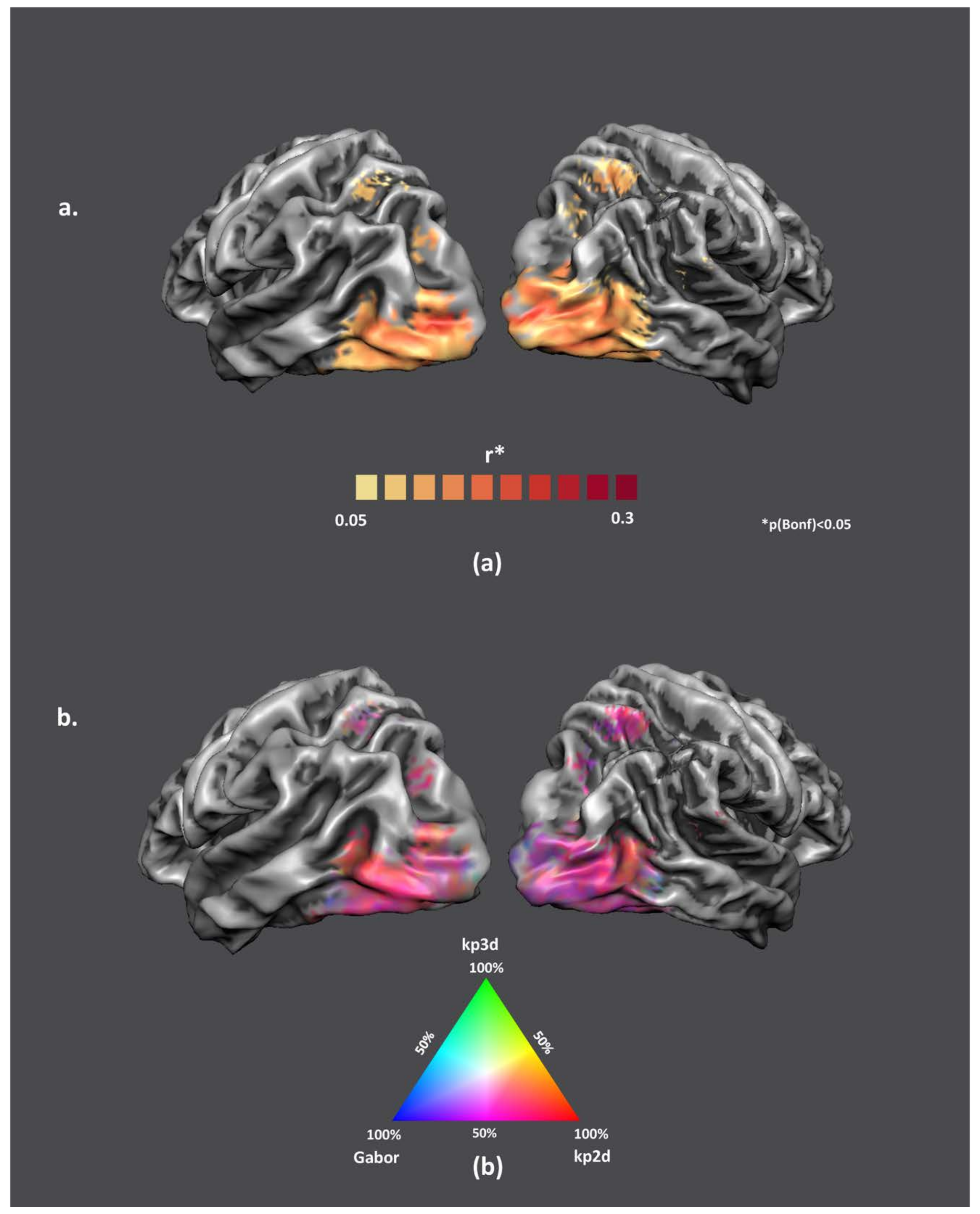
**Models' assessment:** Pearson's correlation between predictions obtained by each model separately and left-out testing data.




## Results

**Whole-brain analysis:**

- **Gabor** model explains more variance than **kp2d** and **kp3d** in early occipital areas.
- **Kp2d** explains more variance in high-level visual cortex.




**(a)**: Group Prediction accuracy in terms of Pearson's correlation (r) for the joint model (kp2d, kp3d, gabor) between predicted and brain responses.

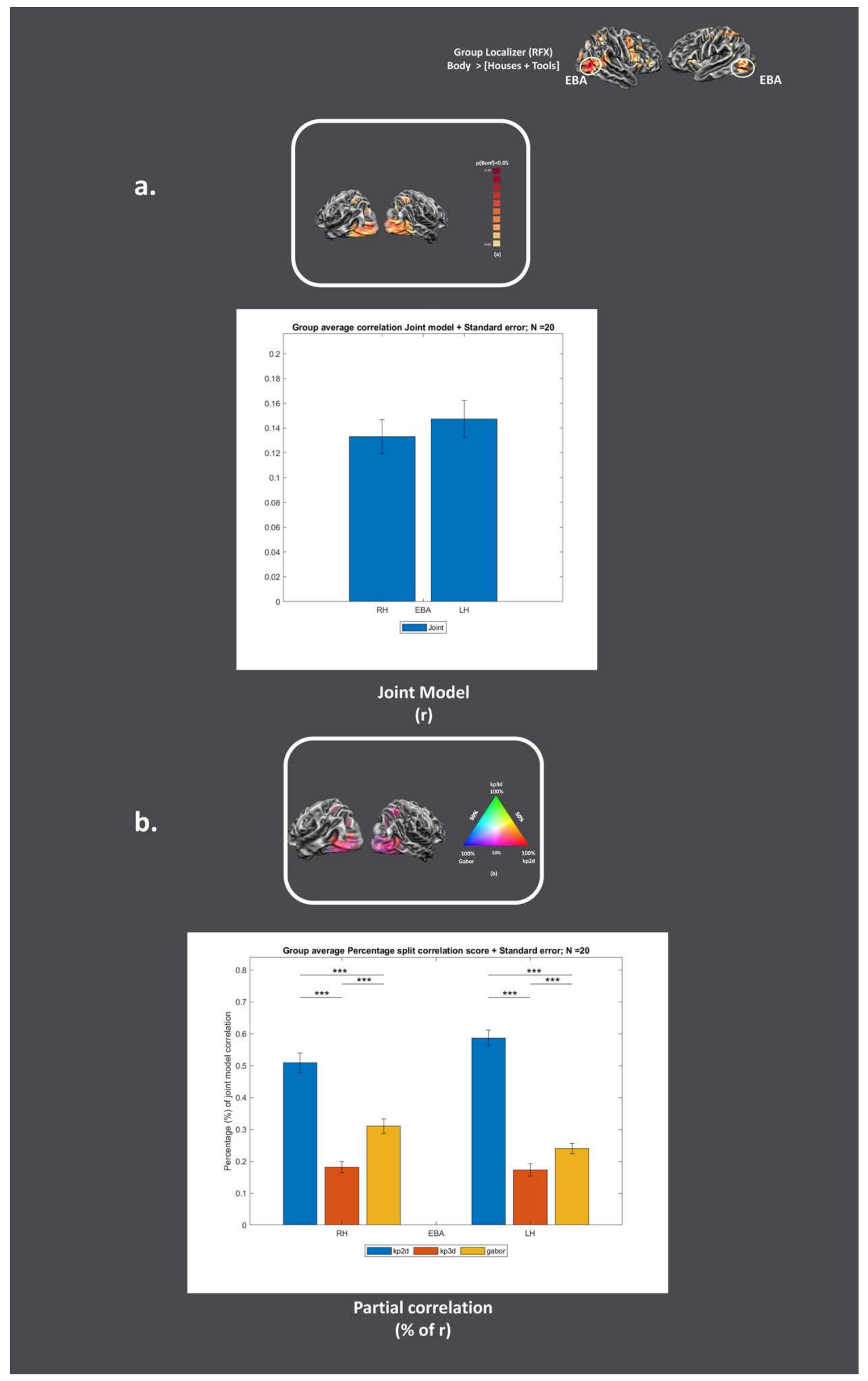
**(b)**: RGB map in which each vertex colour is coded according to the relative contribution of each model, **R=kp2d, B= Gabor, G = kp3d.**

**ROI analysis:**

Analysis performed on bilateral **EBA** (defined on independent data). The average percentage of correlation explained across 20 subjects reveals that **kp2d** is responsible for approximately **50% of the variance in EBA**. (see next column).

## 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**.




**(a)**: The first bar plot depicts the group correlation coefficient between the joint model predictions and brain response to novel stimuli (test stimuli) across participants in bilateral EBA.

**(b):** The second bar plot shows how the information contained in the joint model predictions which significantly correlates with BOLD activity in EBA is split across models. *** $p<0.0001$

## References

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