

# Cortical distance between category-selective visual areas

# determines the representation of multi-category scenes



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### Background

- A hallmark of high-level visual cortex is its functional organization of category-selective regions that reside in adjacent locations. What is the functional significance of this organization?
- It has been recently shown that the fMRI representation of pairs of multicategory stimuli in category-selective areas are biased towards the preferred category [1,2]. This bias is formed by a normalization mechanism [3] acting locally in an area with homogeneous category-selective neurons [1,2].
- We hypothesized that cortical proximity between category-selective areas determines the relative contribution of each category to the representation of multi-category scenes:
- In category-selective areas that reside in distant locations, the preferred category dominates the representation of the multi-category scene.



 $Scene = \beta_0 + \beta_{Face} \cdot Face + \beta_{Body} \cdot Body + \beta_{Room} \cdot Room + \beta_{Chair} \cdot Chair + \varepsilon$ 

- To assess the contribution of each of the isolated categories to the representation of the scene, we fitted a linear model predicting the response to the scene based on the responses to the isolated categories.
- Each feature of the model is the PSC of a single voxel.
- The betas of the model are a measure for the contribution of each isolated stimulus to the scene representation.
- We performed a searchlight analysis within each category-selective area of each individual subject.

#### **Functional localizer**



- Independent data was used to asses category selectivity and define category-selective areas.
- The distance between voxels selective to different categories was measured to define to types of areas:
- <u>Border areas</u>: Category-selective voxels that reside in adjacent locations to voxels selective to a different category – *border voxels*.

- In category-selective areas that reside in adjacent locations, both preferred categories contribute to the representation of the multi-category scene
- For each region of interest, we calculated the mean betas within the area for each subject, and later performed group statistics across subjects (N=15).
- <u>Category-selective areas:</u> contained only voxels that were distant from other categoryselective voxels by excluding border voxels.

A Distant area: The Parahippocampal Place Area (PPA) The representation of the multi-category scene is dominated by the room



- The parahippocampal placeselective area resides in a distant location from other categoryselective areas.
- The room dominates the representation of the multicategory scene, while other categories are decluttered.



#### Proximal areas: Ventral face-and body-selective areas

#### The contribution of the face and body to the representation of the multi-category scene is determined by the distance between the face and body areas



 Both the face and the body contribute to the representation of the multi-category scene in the area where they border

- The preferred category determines the representation in areas that are farther from the border, decluttering non-preferred stimuli.
- The border area may declutter non-person stimuli and therefore practically serve as a person selective region but still enable the flexibility to bias the representation to either the face or the body.

\*p<0.05 \*\*p<0.01 \*\*\*p<0.001 corrected for multiple comparisons within each region of interest

Proximal areas: Lateral body- and place-selective areas – The contribution of the body and room to the representation of the multi-category scene is determined by the distance between the body and place areas

Extrastriate **Body** Area (EBA)

EBA and OPA border area

Occipital *Place* Area (OPA)

# Conclusions

The functional organization of category-selective



\*p<0.05 \*\*p<0.01 \*\*\*p<0.001 corrected for multiple comparisons within each region of interest

- Lateral-occipital body- and place-selective areas are relatively large with a joint border between them.
- In the border between them, both the body and the room contributes to the scene representation.
- Within category-selective areas, regions that are distant from the border between these areas show a dominance for the preferred category in the scene representation decluttering the non-preferred stimuli.

areas enables the generation of a flexible representation of complex multi-category scenes where different categories dominate the representations in different regions of categoryselective cortex as a function of their relative distance

These findings provide for the first time a functional account for the well-established organization of category-selective areas on the representation of multi-category visual scenes.

<u>References:</u> [1] Kliger & Yovel 2019; [2] Bao & Tsao (2018); [3] Reynolds & Heeger, 2009.