

USC Image Understanding Lab

# Lateral Occipital Cortex Represents Axis Structure

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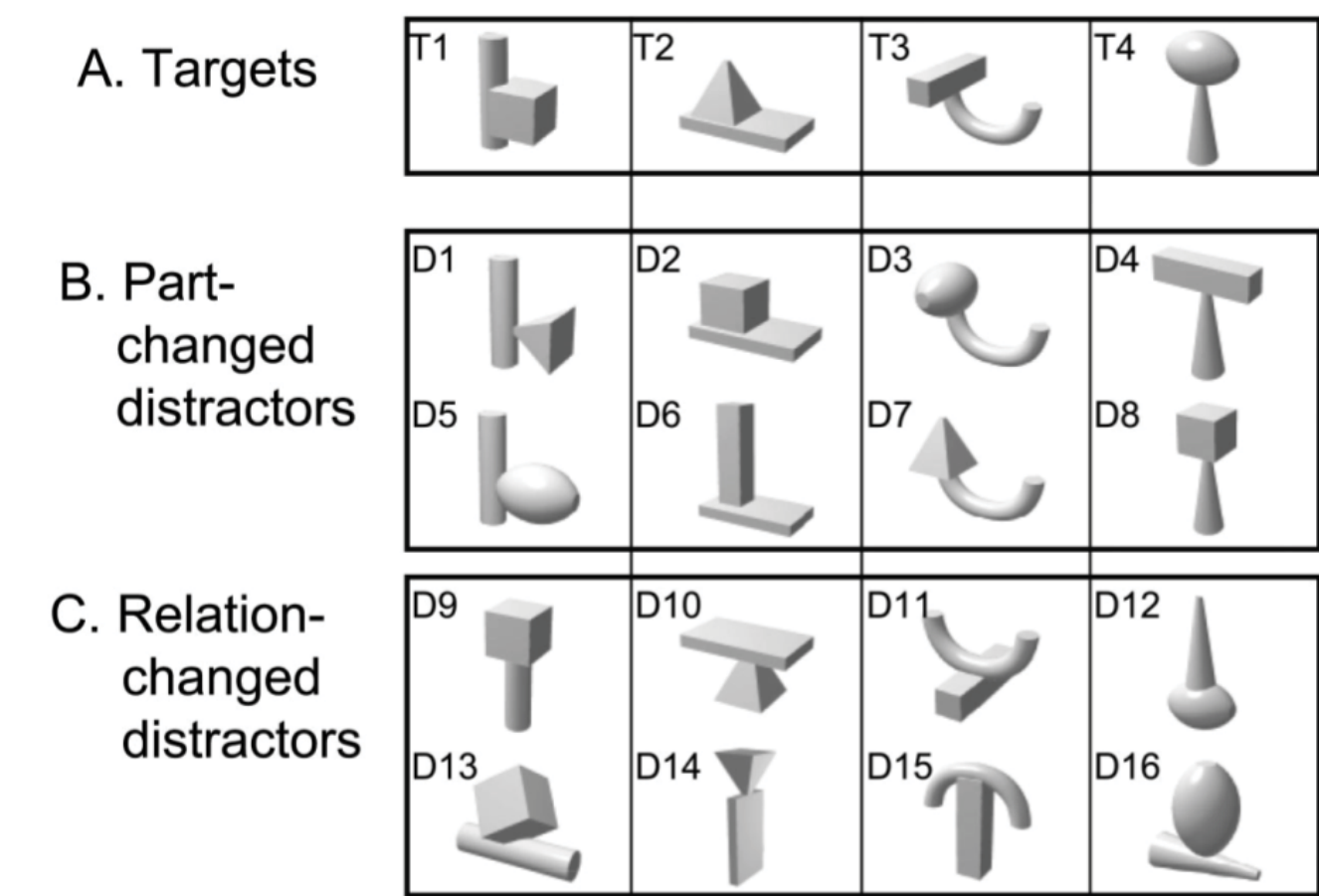
mark.lescroart@usc.edu  
http://geon.usc.edu/~mark



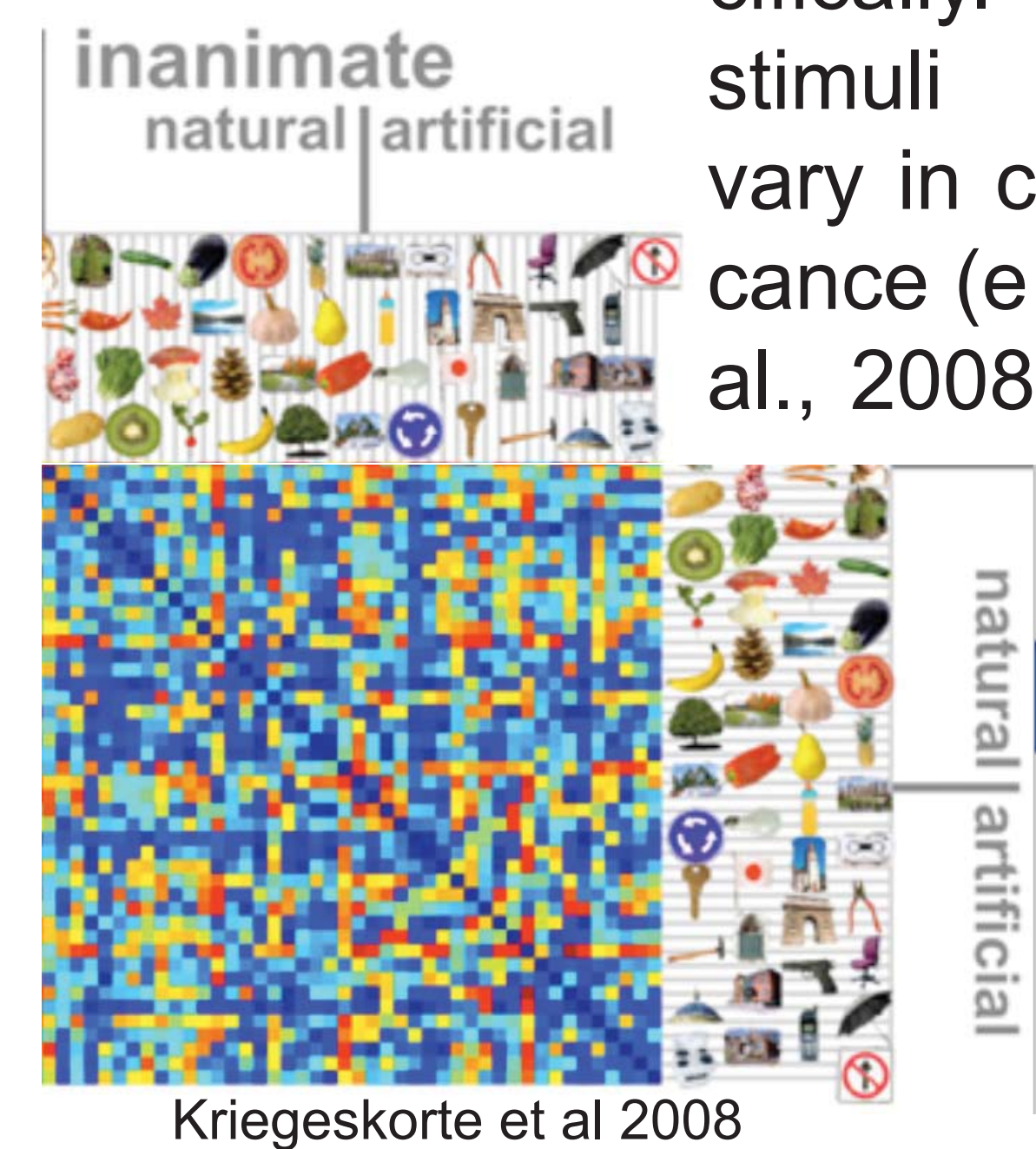
## Background

- Object structure can be defined by specifying the relationships between the medial axes of an object's parts.
- Lesions to the ventral stream can produce an agnosia for object structure but leave intact the perception of the shapes of the individual parts (Behrmann et al, 2006).

- Although there have been some human fMRI studies investigating object representations in ventral visual areas, these studies have not addressed object structure specifically.



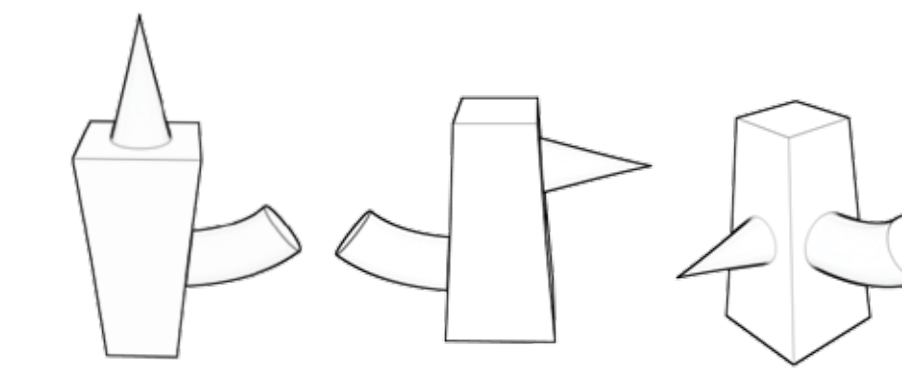
(Behrman et al, 2006)



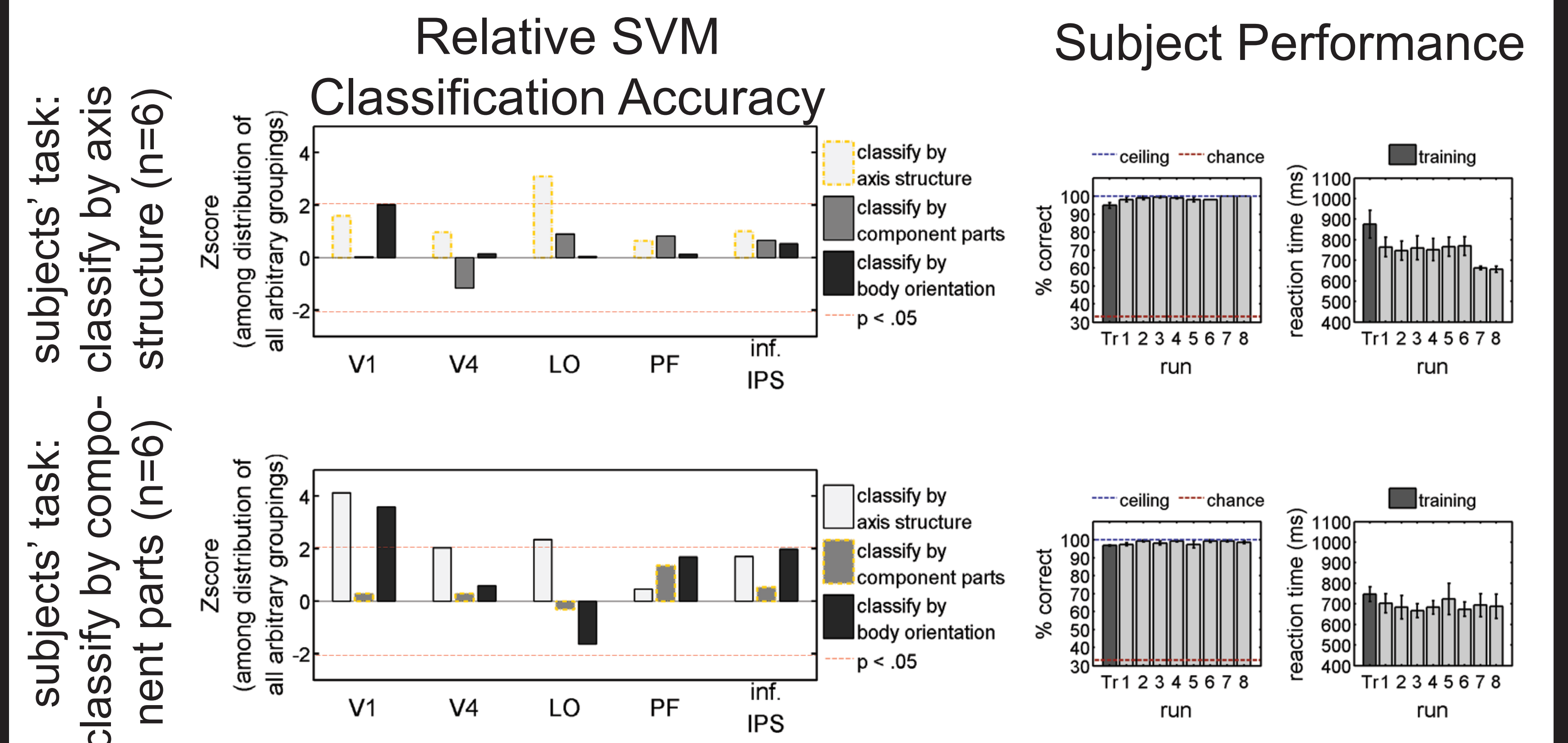
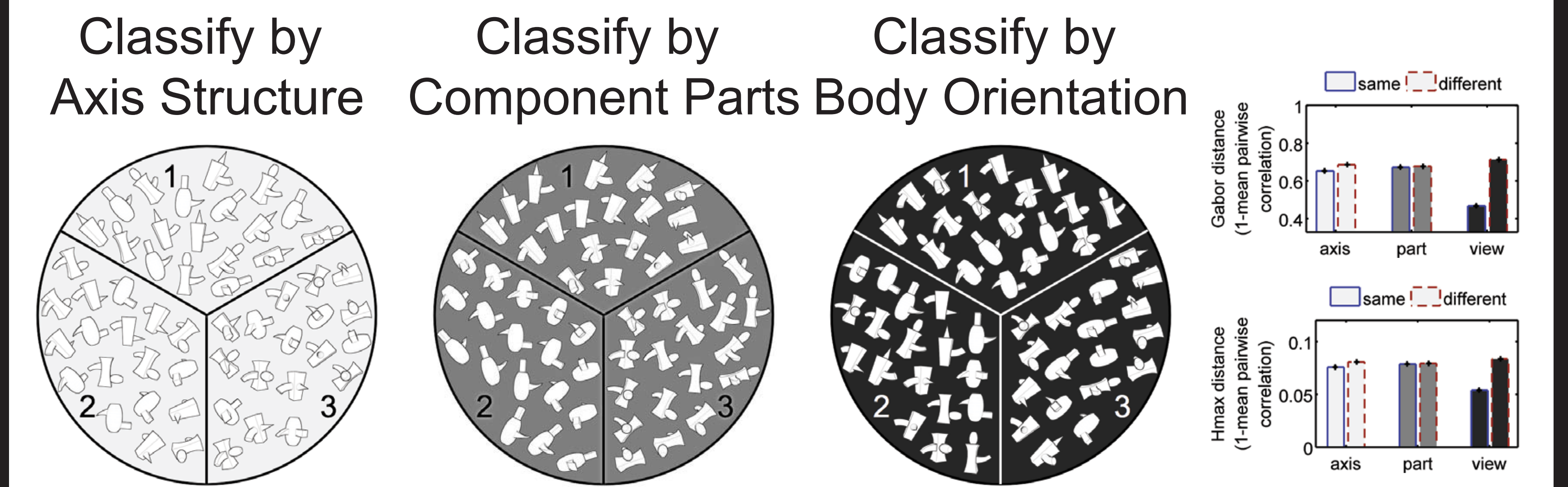
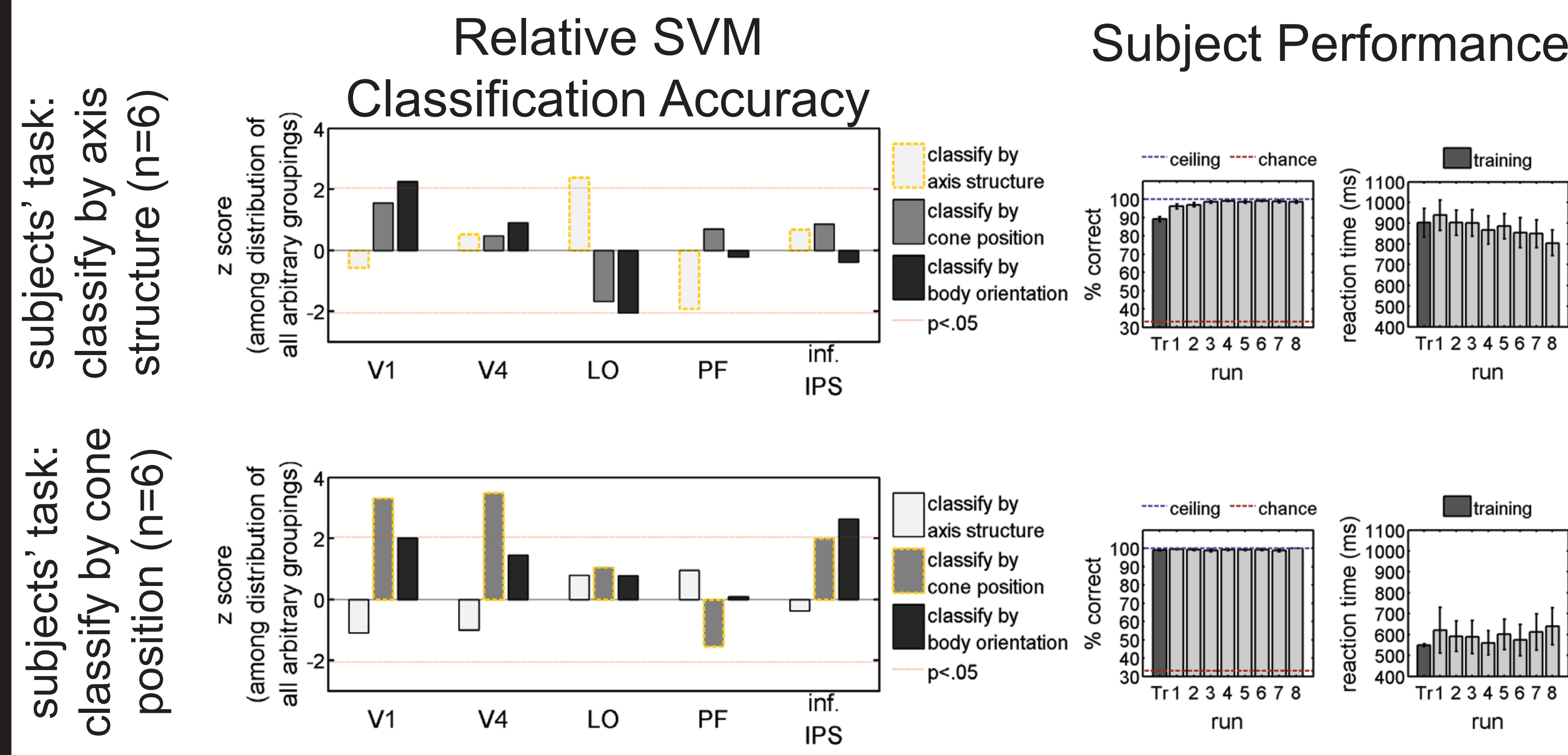
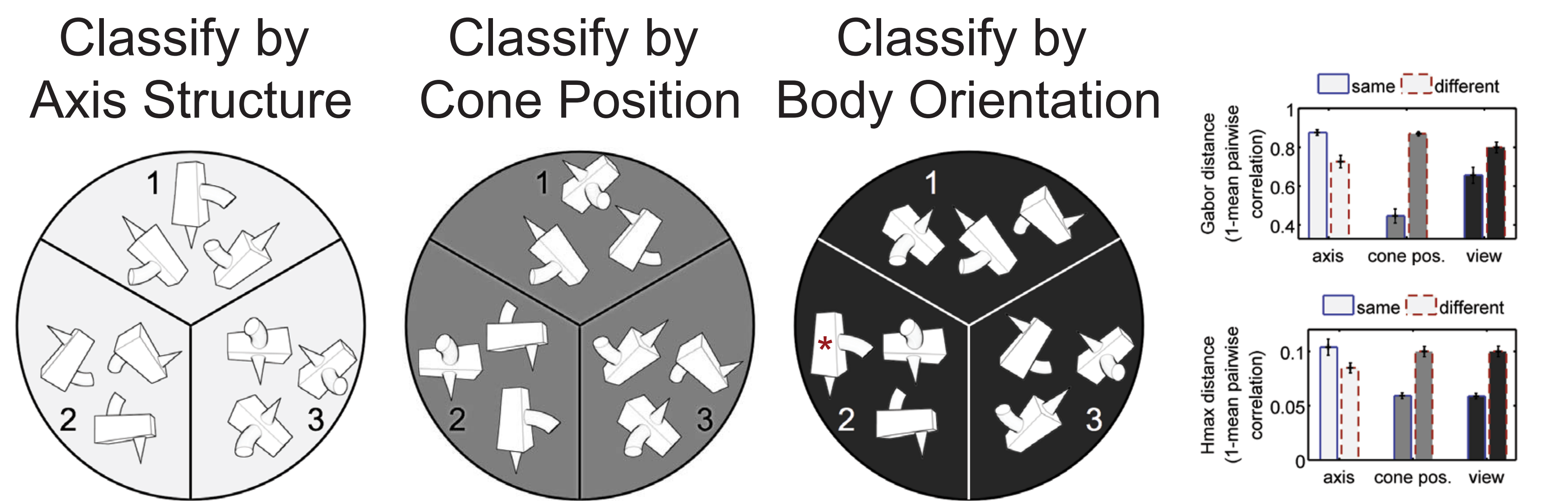
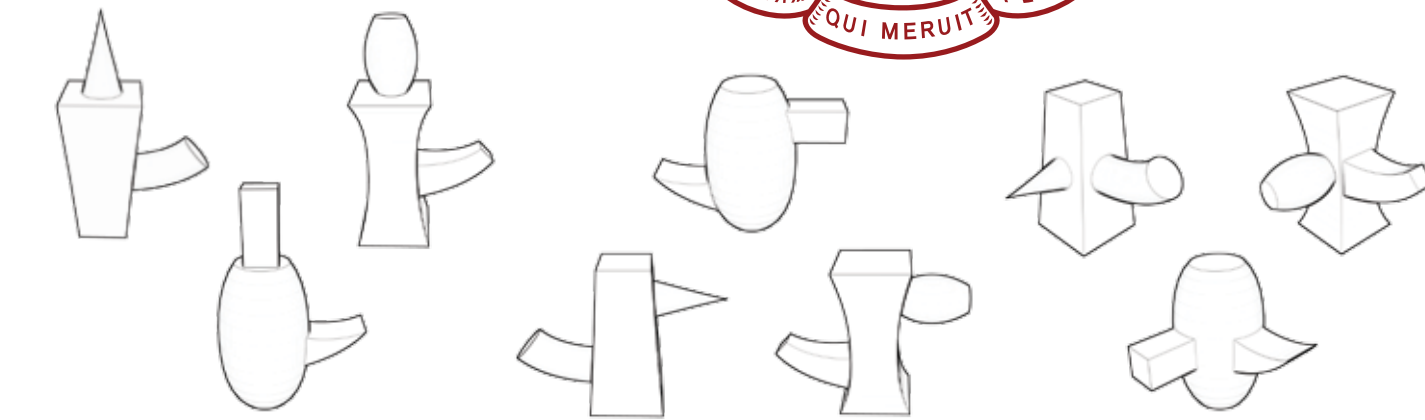
With stimuli that vary in color, texture, and evolutionary significance (e.g., Haxby et al, 2001; Kriegeskorte et al., 2008), one cannot make inferences about the role of object structure—or even object shape—in determining ventral stream response patterns.

- PROBLEM:** Could the BOLD signal in ventral visual areas distinguish groups of objects that differed *only* in their axis structures?

Results: 3 Objects x 3 Views

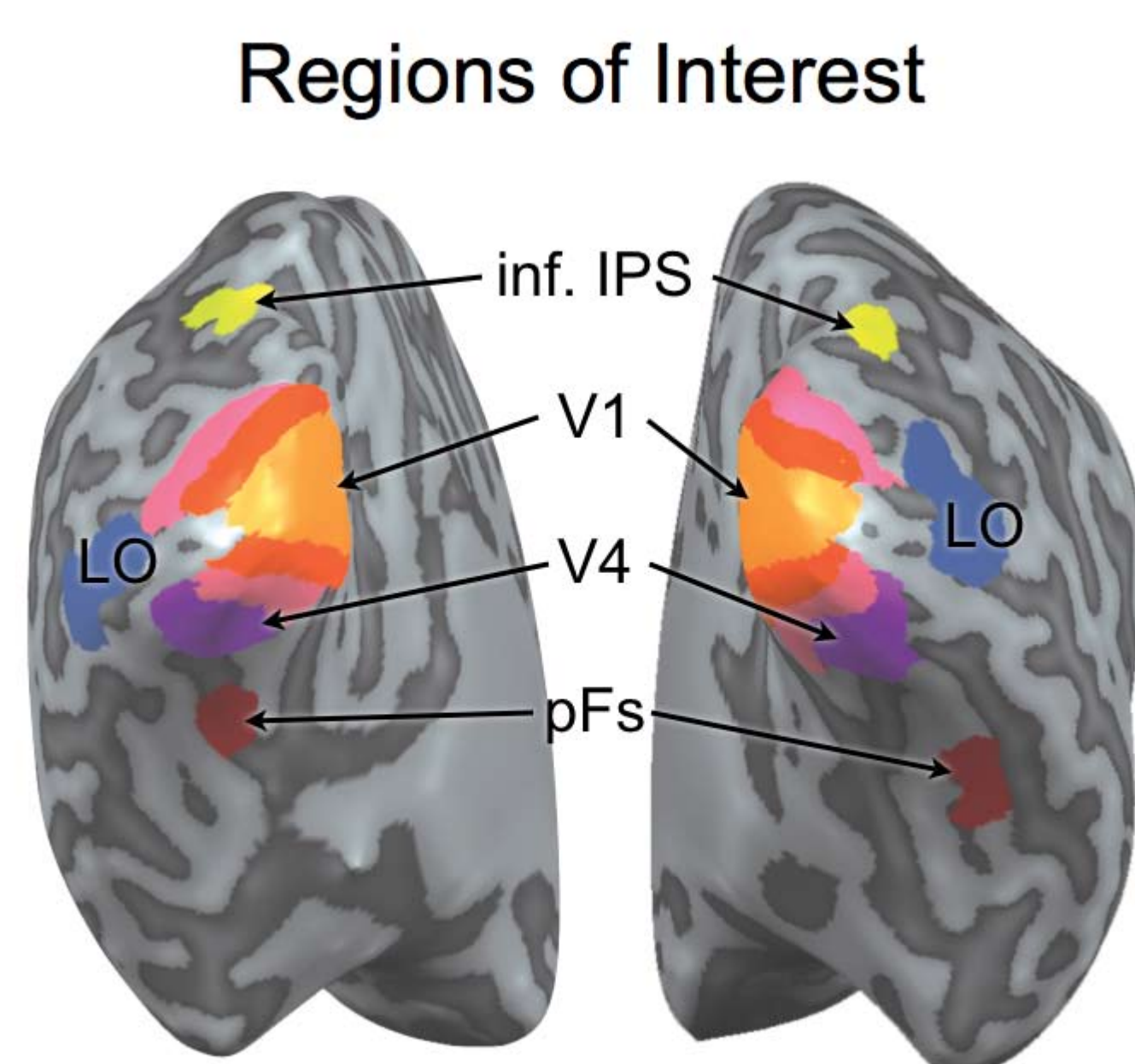


Results: 9 Objects x 6 Views

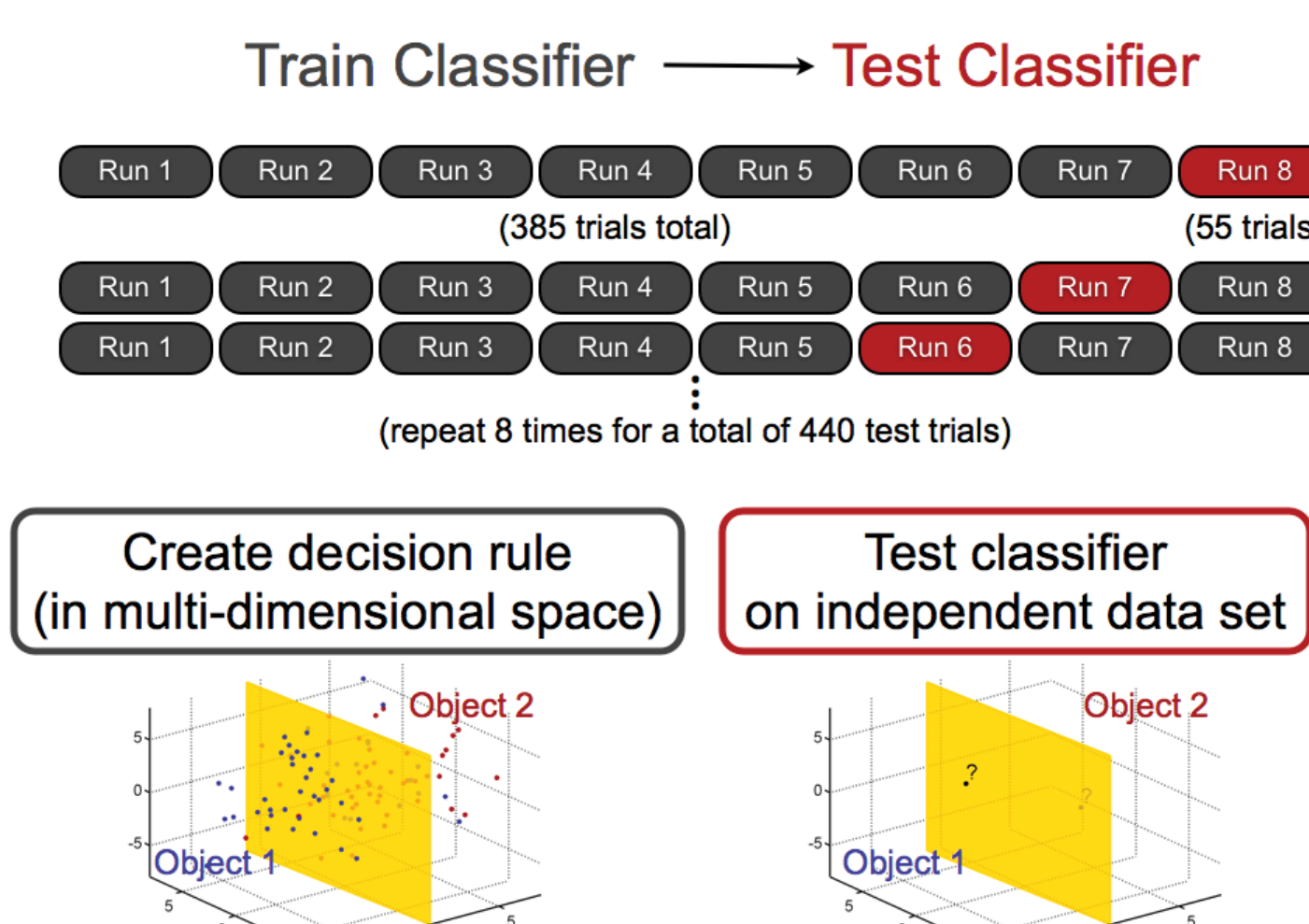


## Methods

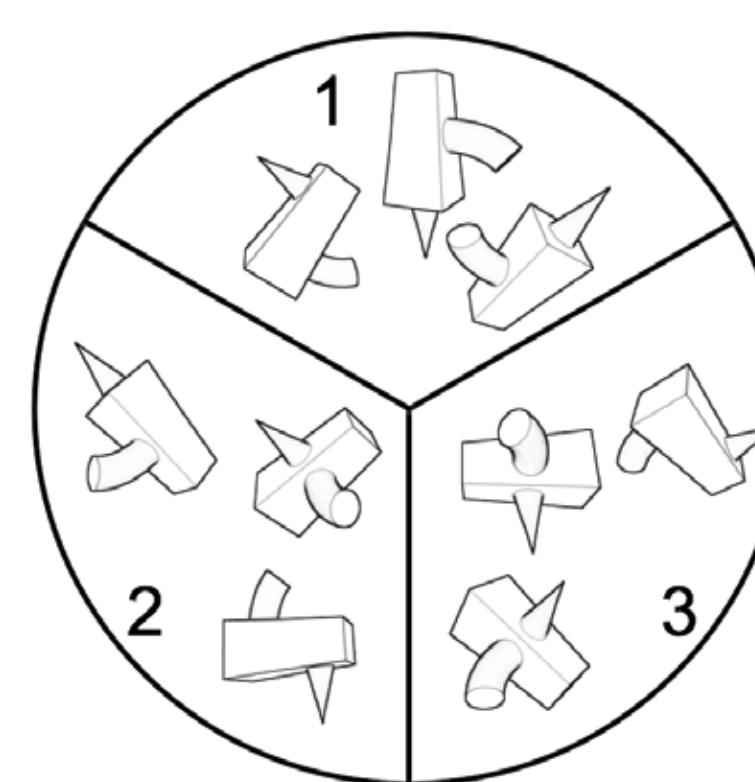
- Stimuli were nine (3 objects x 3 views) or fifty-four (9 objects x 6 views) images of novel objects (see above).
- Images appeared for 750 ms (3 object experiment) or 200 ms (9 object experiment) with an 8 second ISI. One image appeared on each trial.
- MRI parameters: whole-brain scan of 2x2x2 mm voxels (3 object) or 2x2x2.5 mm voxels (9 object), 31 slices, TR = 2 s.



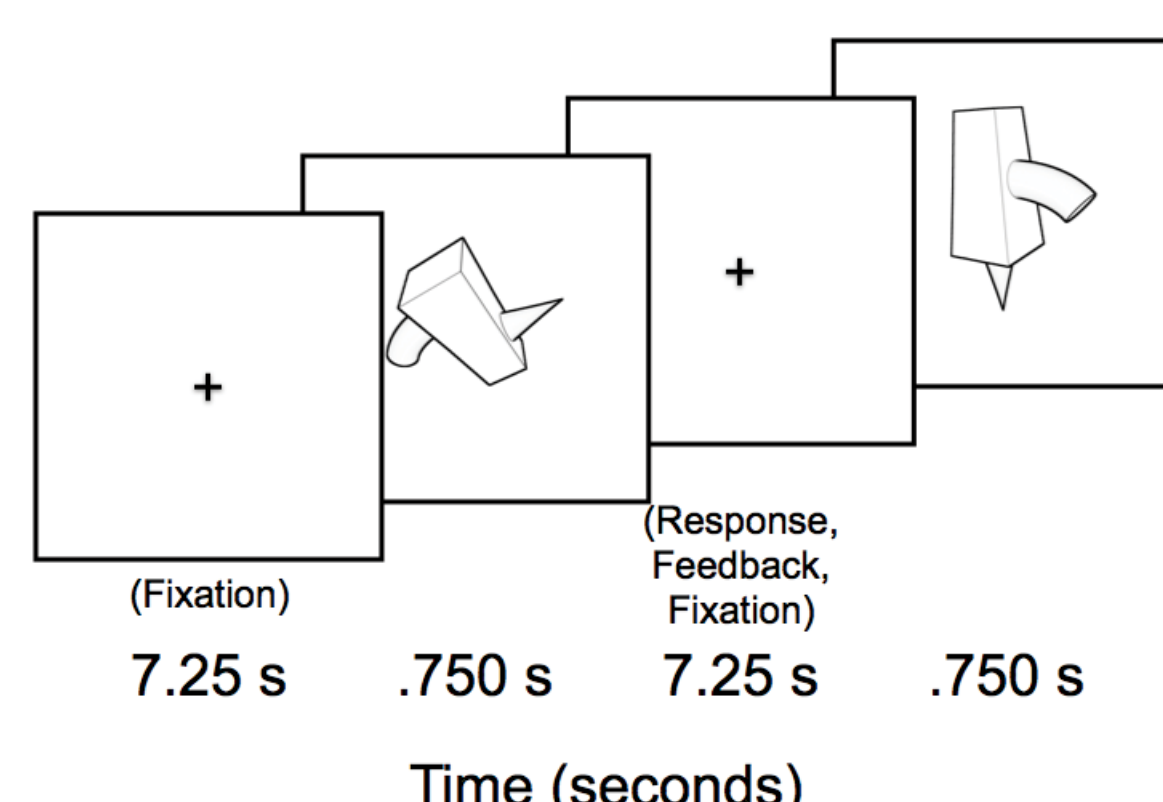
## Support Vector Machine Classifier Training



- Chance levels for classification accuracy were determined by classifying with random trial labels 100 times in each ROI.
- To test different classification schemes against one another, correctly-labeled images were re-assigned to arbitrary categories (one of 280 possibilities for 9 images is shown above). A histogram of the 280 classifiers' accuracies in V1 and in LO is shown below to the left.



- These distributions of classification accuracy were used to create z-scores for the grouping schemes of interest.



- Regions of interest were defined for each subject in independent localizer scans.
- For each region of interest, a support vector machine (SVM) classifier was trained on 7 runs of the data and tested on the 8th run, in order to test whether common axis structure and/or common body orientation produced consistently differentiable patterns in each region.

## Conclusions

- The Lateral Occipital (LO) area encodes not only an object's parts (Hayworth & Biederman, 2006) or local features (Op de Beeck et al, 2008), but also its medial axis structure.
- LO is more sensitive to the medial axis structures of objects than to their global orientation, and this coding of axis structure is independent of local parts or features.
- The coding of axis structure in LO is modulated by attention, but the response pattern in LO is not wholly determined by attention.