



# Representations of action categories generalize across the phylum, genus, and species of the actor

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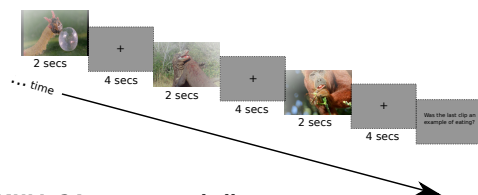
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## INTRODUCTION

Just as we perceive different categories of living objects, we also perceive different categories of actions. Common actions like eating, fighting, swimming, and running are identifiable as such whether they are performed by a human, mouse, or beetle. What are the neural correlates of such action perceptions? How general are these representations across instances where different types of animal species take the role of the actor?

### fMRI TASK



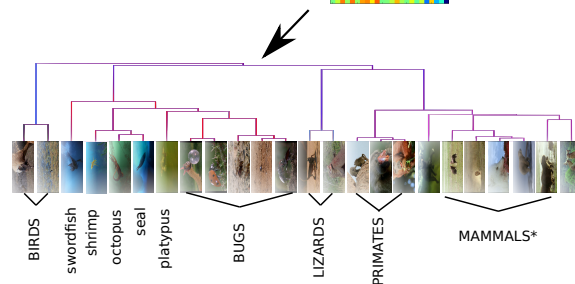
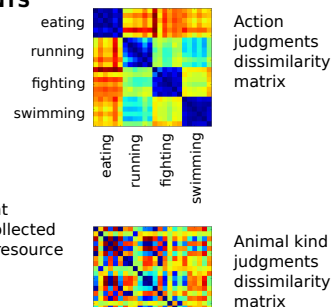
### STIMULI: 24 two-second clips



### BEHAVIORAL JUDGMENTS

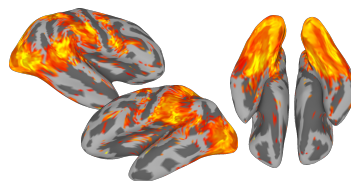


Judgments about the content of the stimulus clips were collected using the "crowd sourcing" resource Amazon's Mechanical Turk.

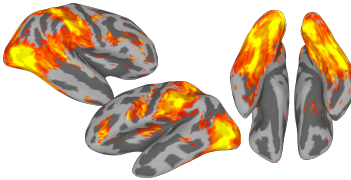


## Support-vector machine pattern classification using surface-based searchlights<sup>1,2</sup>

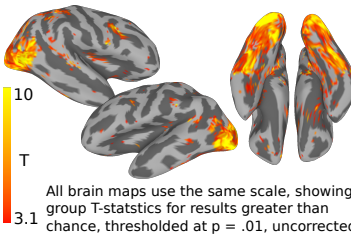
24-way classification shows good reproducibility for stimulus-specific patterns throughout visual cortex and parietal cortex.



Four-way classification for action class shows good reproducibility for action-specific patterns.

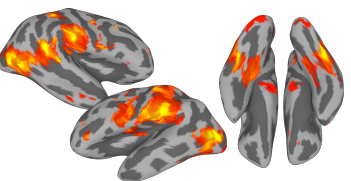


Two-way classification for mammal versus non-mammal.

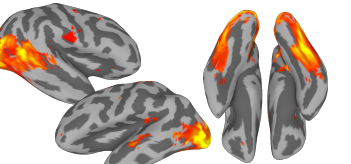


## Similarity searchlight for mapping correlations with target behavioral dissimilarity matrices

Action judgments

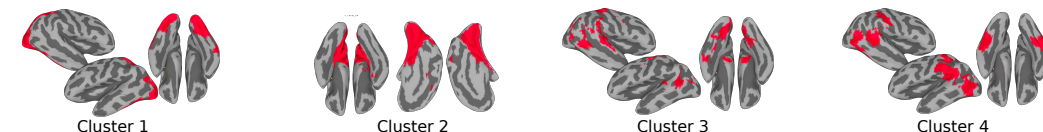


Animal Kind judgments

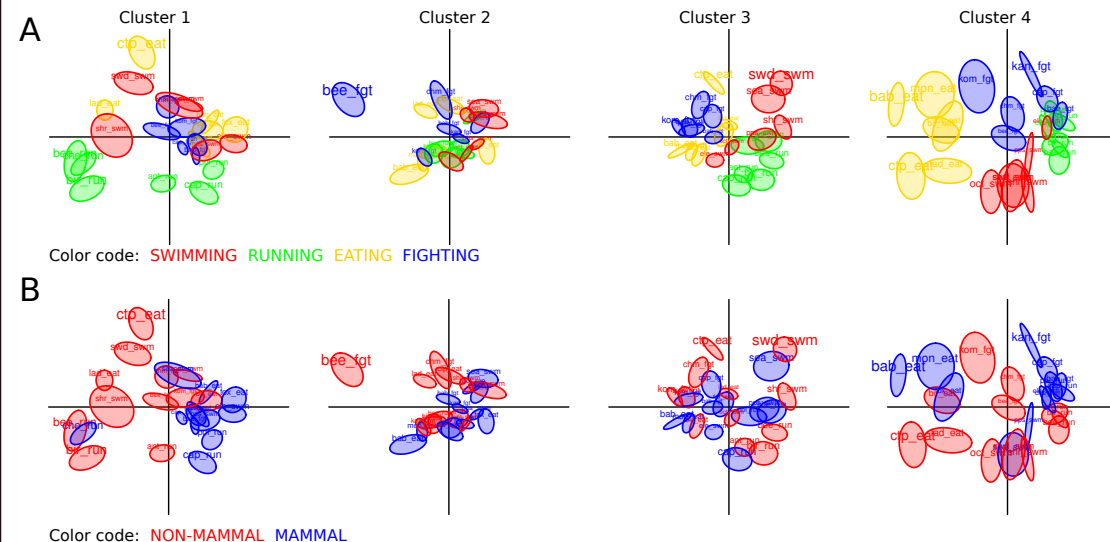


Statistical maps are on the same scale as above.

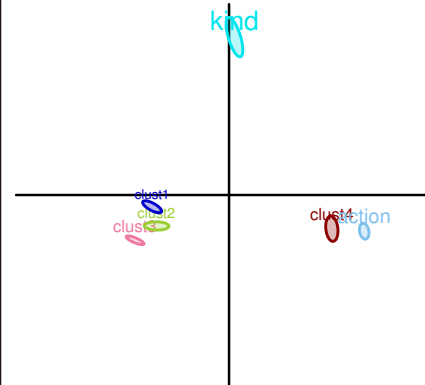
## Whole brain clustering based on functional connectivity vectors measured using searchlight dissimilarity matrices. First four clusters are shown.



**Three-way (multi-subject) multidimensional scaling (using DISTATIS<sup>3</sup>) for each cluster. First two dimensions are shown for each cluster, color-coded for action (A) and mammal versus non-mammal (B).**



## Second-level DISTATIS analysis.



## CONCLUSIONS

Convergent evidence across different analyses points to action-based semantic organization reflected in distributed patterns of BOLD activity spanning a large network of areas including the inferior parietal lobule, pSTS, posterior middle temporal, and lateral inferior temporal cortex.

The semantic organization for action categories appears to be independent of the biological class of the actor. This organization is also differentiated from the organization of patterns recorded in early visual cortex, suggesting that for this set of relatively uncontrolled naturalistic stimuli, high-level and low-level visual features are experimentally separable.

Surprisingly, we have not observed strong evidence for organization based on biological class. However, separation of mammals versus non-mammals was observed in expected regions including ventral and lateral occipito-temporal cortex

### References<sup>5</sup>

- Kriegeskorte, Goebel, Bandettini (2006) Information-based functional brain mapping. PNAS USA 103, 3863-3868
- Oosterhof, Wiggett, Diedrichsen, Tipper, Downing (2010). Surface-based information mapping reveals crossmodal vision-action representations in human parietal and occipitotemporal cortex. Journal of neurophysiology, 104, 1077-1089
- Abdi, Williams, Valentin, Bannani-Dosse (2012) STATIS and DISTATIS: optimum multitable principle component analysis and three way metric multidimensional scaling. WIRES Computational Statistics, 4, 124-165