Neural Taskonomy: Inferring the Similarity of Task-Derived Representations from Brain Activity

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Introduction

- “Taskonomy” describes the task relationships found through transfer learning using computer vision models\textsuperscript{1}.
- The Goal: Does the brain represent task information the similar way as found through transfer learning?
- BOLD5000\textsuperscript{2} – fMRI dataset using stimuli sampled from ImageNet, COCO and SUN.

- Method: We extracted features from the latent spaces of 19 vision tasks in the Taskonomy model bank\textsuperscript{1} and constructed encoding models to predict brain activity to images. Prediction maps were used to infer the relationships between tasks.

Model Performance - Whole Brain

- Scene Class
- Distance
- Vanishing Points
- 3D vs. 2D

Model Performance - ROIs

- 2D Edges
- 3D Edges
- 2D Keypoint
- 3D Keypoint
- 2D Segm.
- 3D Segm.
- Depth
- Normal
- Occlusion
- Color
- Curve

Neural Taskonomy

- Object Class
- Layout
- Normal
- Distance
- Occlusion
- Depth
- 2D Segm.
- 3D Segm.
- Scene Class
- Vanishing Pts.
- Semantic Segm.
- 2D Keypoint
- 3D Keypoint
- Autocoding

Conclusions

- Task-specific models are useful for explicating the neural encoding of task-related information.
- Features from 2D tasks and 3D tasks recruit distinct regions of visual cortex (3D features preferred).
- The neural representation of different tasks can be used to infer the relationships between tasks.

References