Computer Graphics from a Neuroscientist's perspective

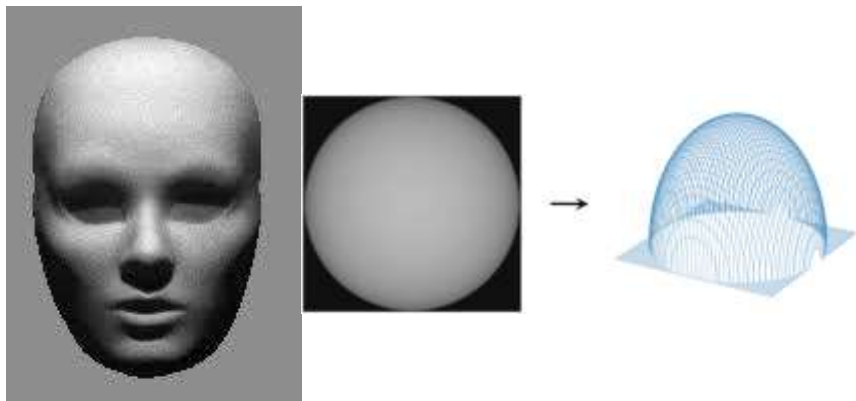**Shreya Kapoor**, Prof. Dr. Bernhard Egger

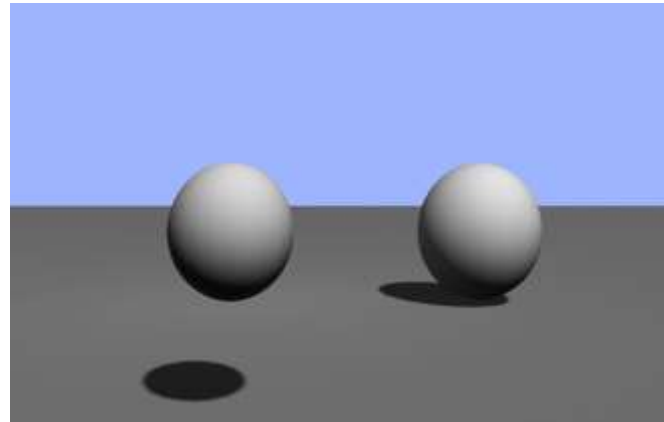Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

29 April 2025

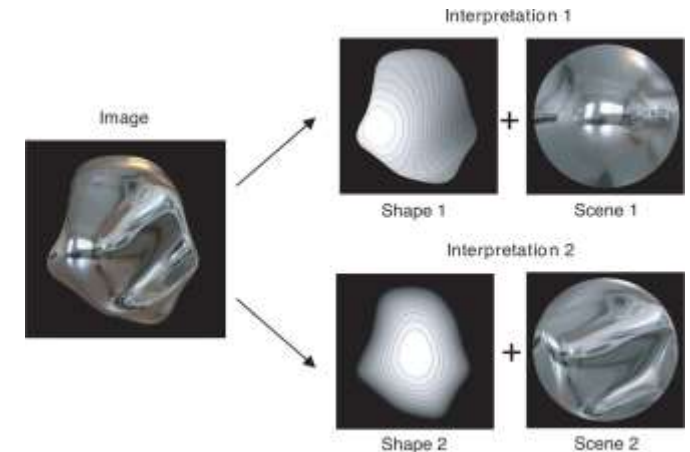# What do we want to study and why?

- The representation of scene intrinsics in human vision
- How features such as shadows, shading, and specularities affect perception in humans?
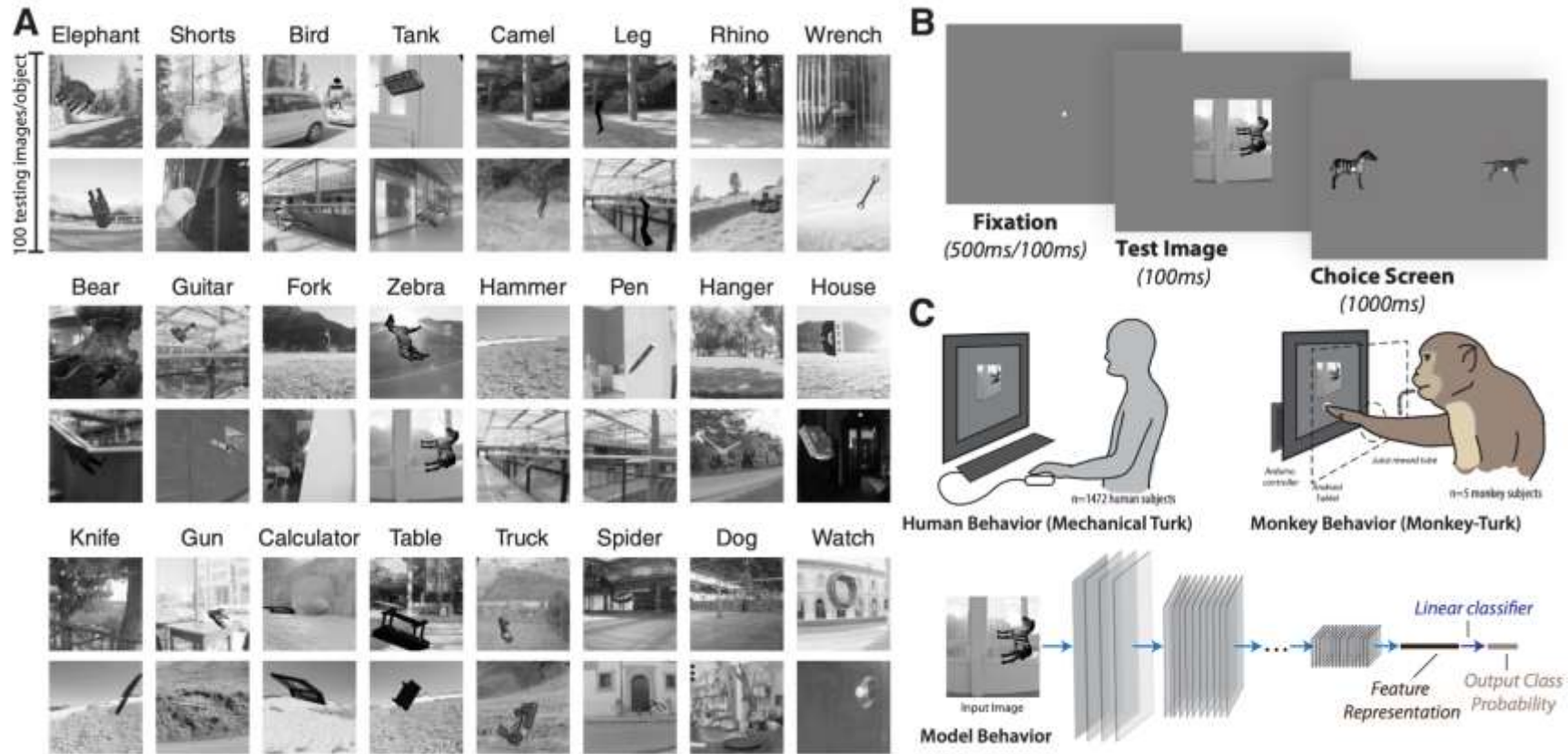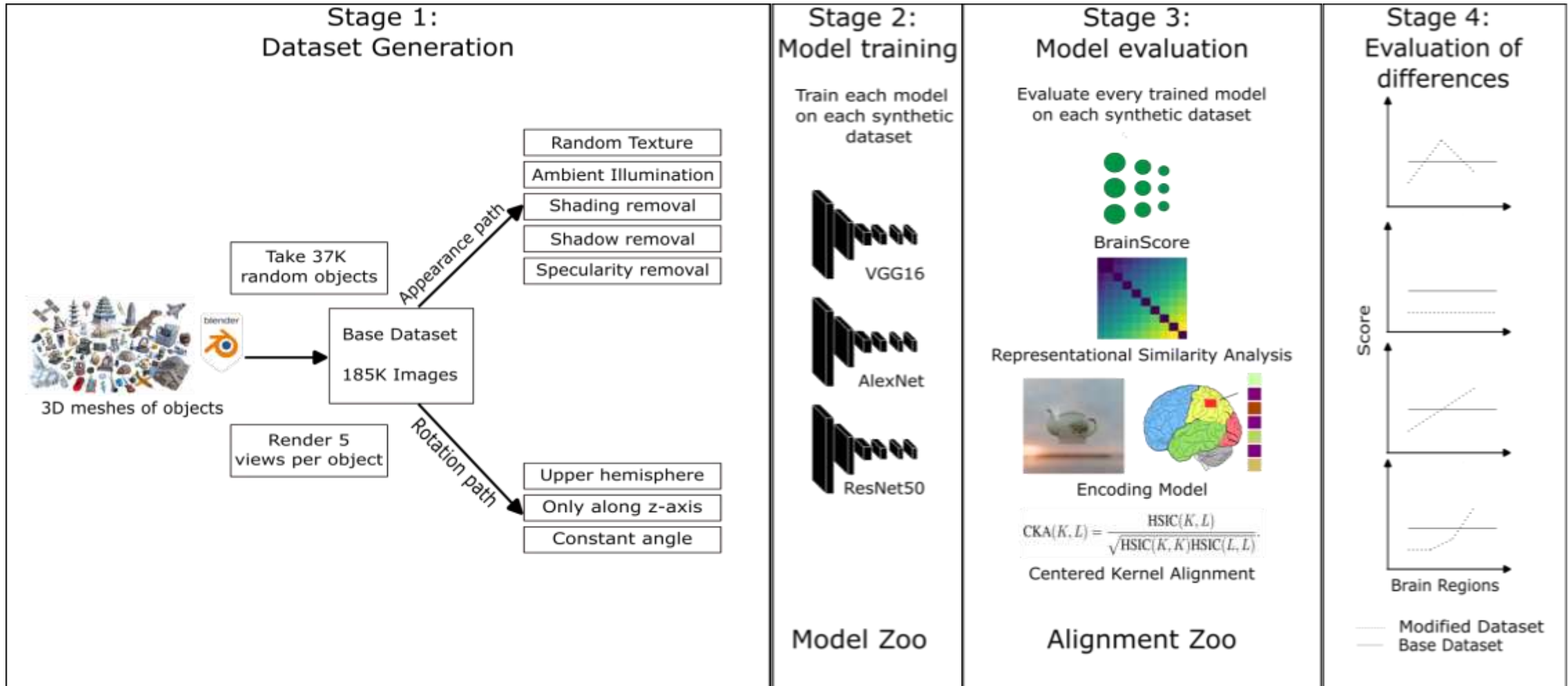

(a)   (b)   (c)

(a) (b) Source CSE IITM (c) Fleming et. al 2004

Traditional Way of Studying Human Vision Computationally

Majaj et. al 2018

Pipeline

Illumination Components

Dataset: Original with all Scene Properties intact

Dataset: with Textures swapped

Dataset: with Ambient Illumination only

Dataset: with Shading Removed

Dataset: with Shadows Removed

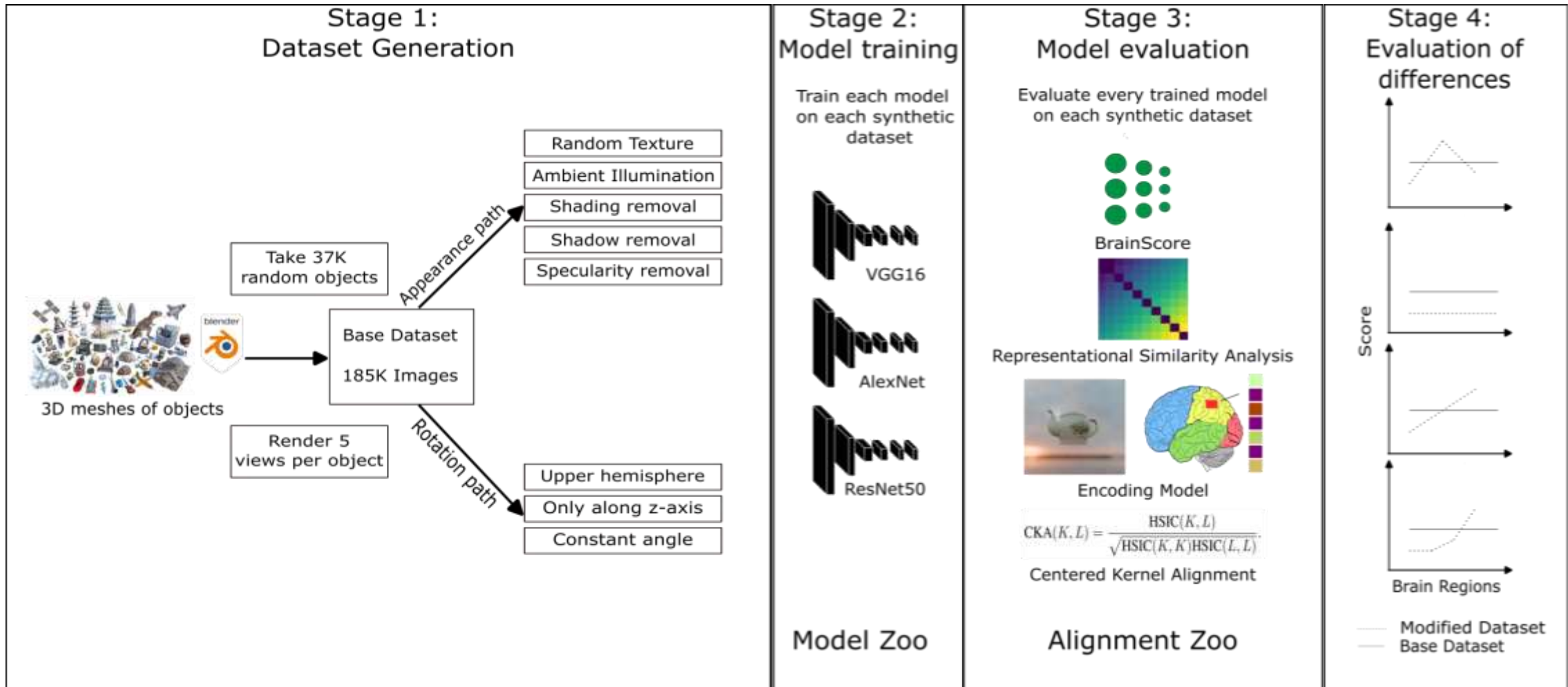# Dataset: with all Specular Highlights removed
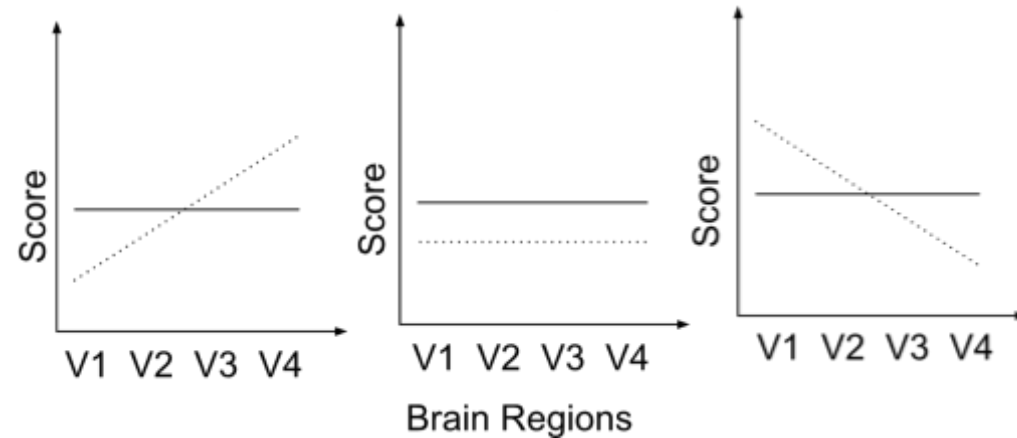
Rotation Components
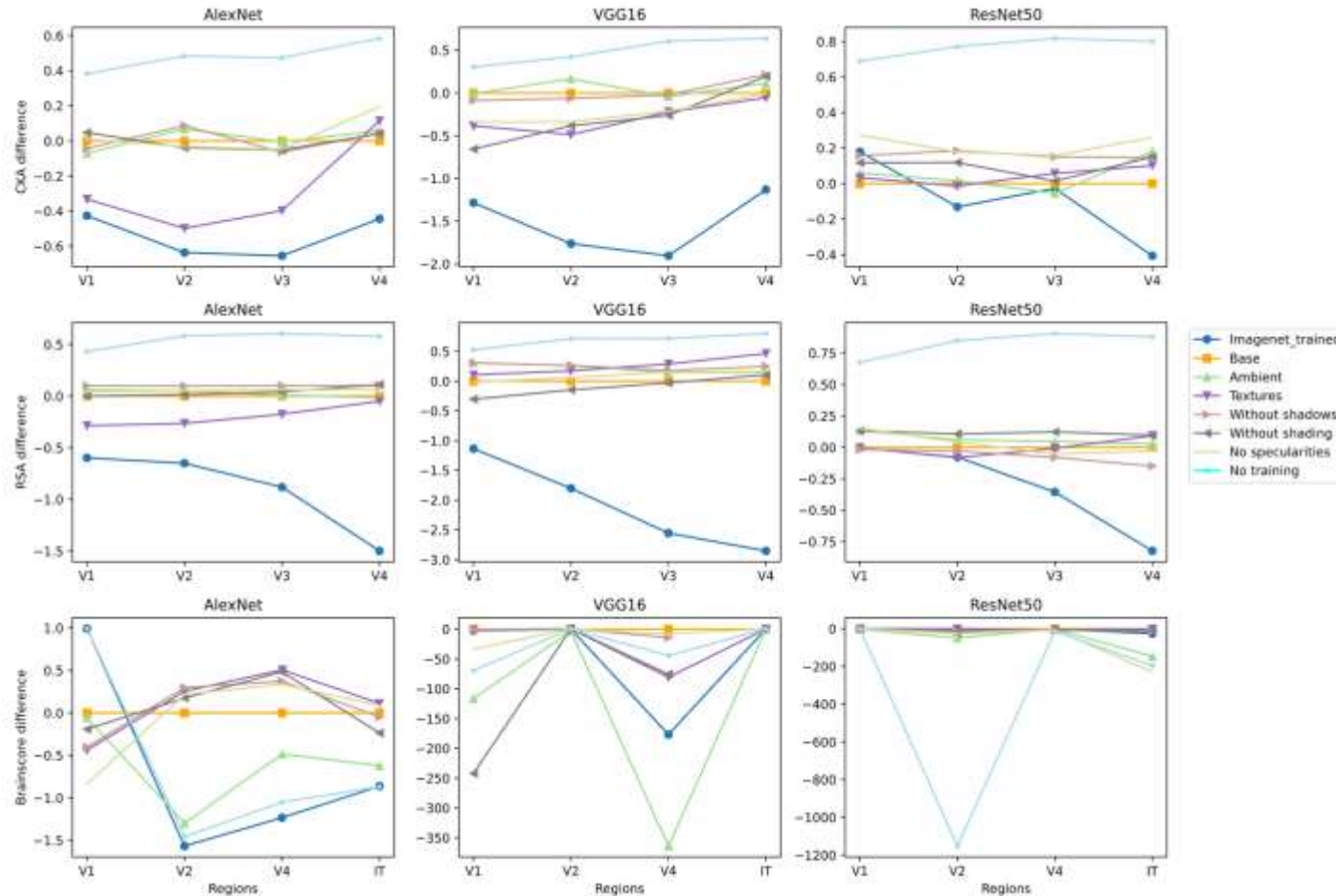
Dataset: Pose Variation

Pipeline

Trends we want to see

Base ———————
Modified ················

- Base always has similarity value of 0
- Modified dataset always has value
 $(Base - Modified)/Base$

Results

- Imagenet is almost always negative
- Untrained is almost always positive
- Textures become more positive down the hierarchy; early visual areas represent texture
- Ambient illumination, without shadows or shading, show a positive trend in the early visual system, might be represented in the early visual system

(1) S. O. Murray et al,. Brightness and transparency in the early visual cortex. Journal of Vision, 6(6):1064–1074, 2006. doi: 10.1167/6.6.1064

Results
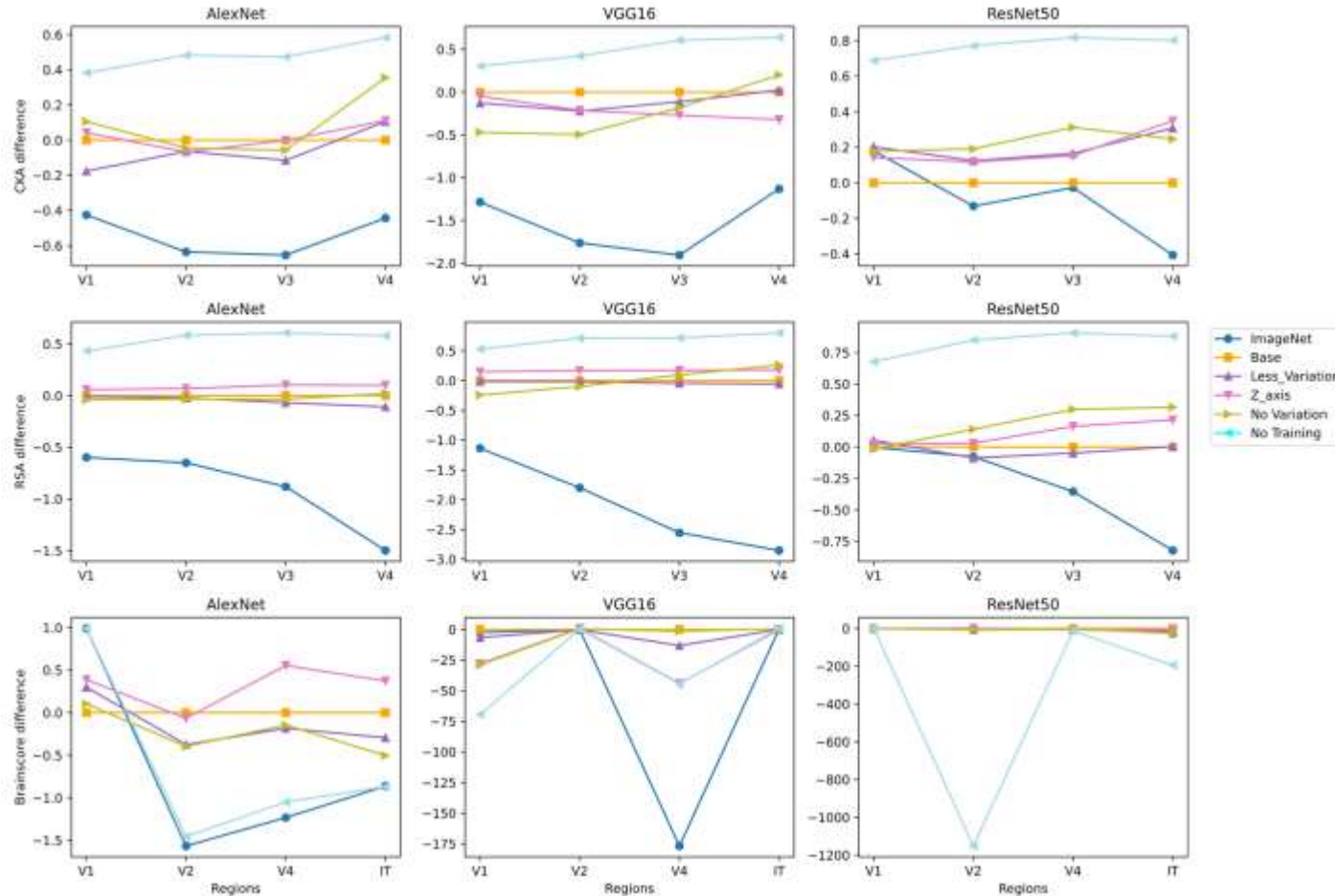
- More positive as the variation in the dataset decreases
- Imagenet trained is almost always negative
- Untrained networks almost always positive
- Later visual areas might represent rotation

(1) Anna W. Roe, et. al, Toward a unified theory of visual area v4. Neuron, 74(1):12– 29, 2012. doi: 10.1016/j.neuron.2012.03.011

Results

Difference in the mean intensity of predicted voxels
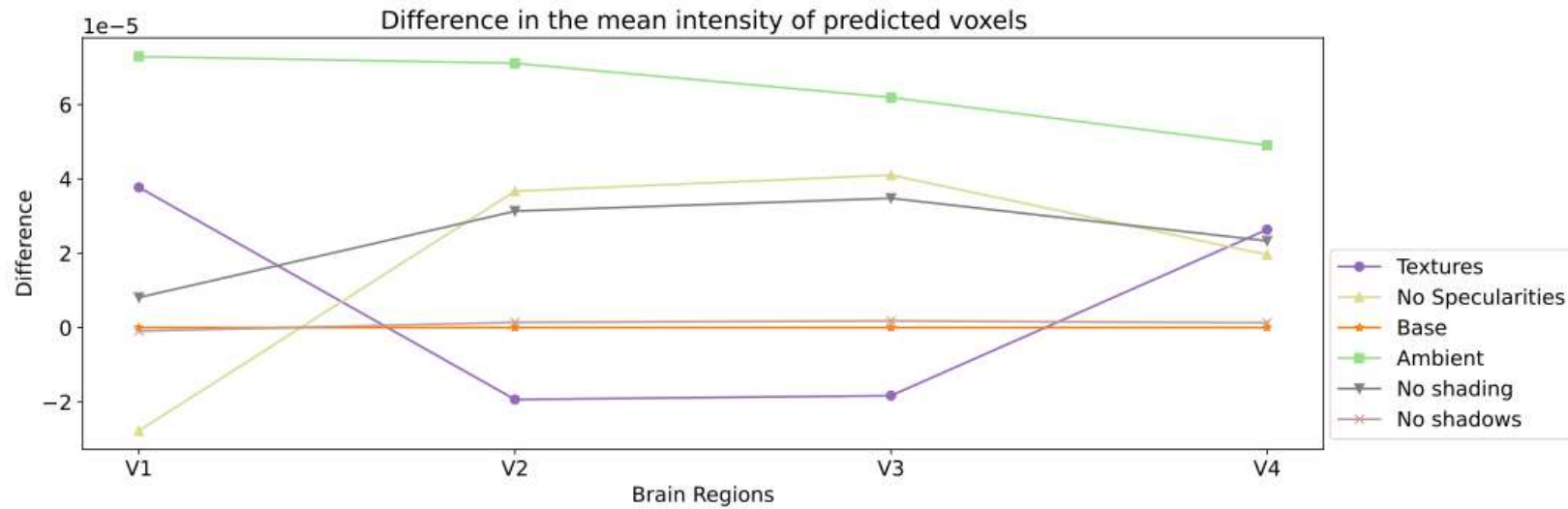
1. Difference = Base – Modified / Modified

Thank You!