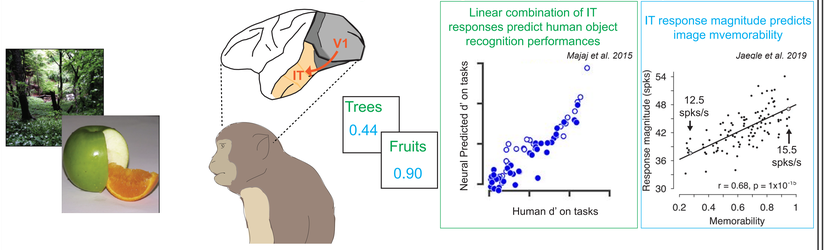
Comparing artificial neural network models with varied objectives to probe the role of sensory representation in primate visual memorability

Ram Ahuja, Soroush Ziaee, Ezgi Fide, Shayna Rosenbaum, and Kohitij Kar

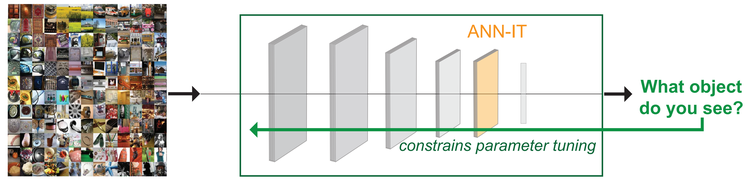
York University, Toronto

What are we trying to ask, and why?

The ventral visual stream is involved in object recognition and image memorability behaviours in primates



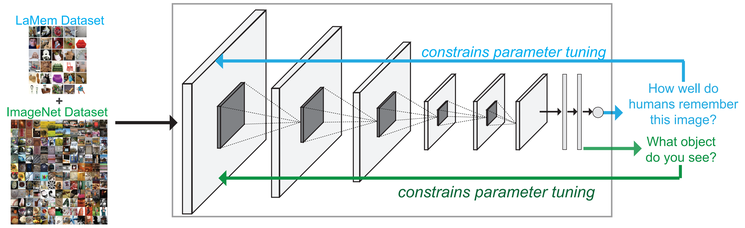
Artificial neural network (ANN) models of the ventral visual stream are typically performance-optimized on object recognition



How will training the ANNs on image memorability impact their resemblance to the ventral visual stream?

Memorability Model

Memorability models exist, but we can't use them directly to identify the distinct role of each objective separately

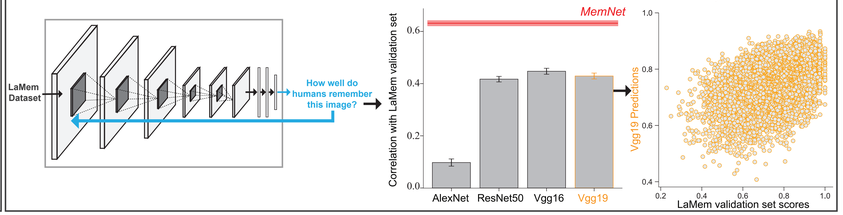


Pre-existing memorability models are also trained on object recognition datasets, making it hard to identify the individual contributions of memory

Therefore, we first trained models with only the LaMem dataset

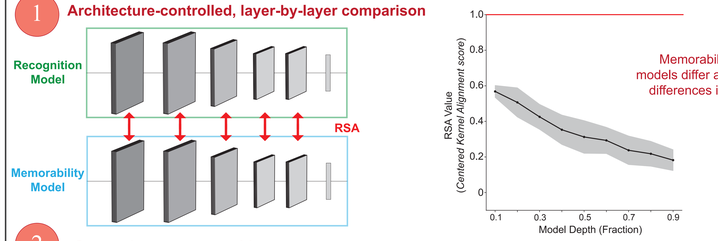
Using the LaMem dataset, we trained various ANN architectures to complete image memorability tasks

How well can we train the ANNs with just LaMem?

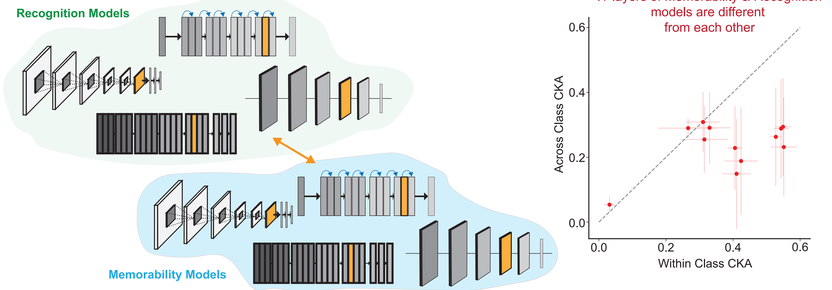


Do memorability and recognition models develop different representations?

1 Architecture-controlled, layer-by-layer comparison

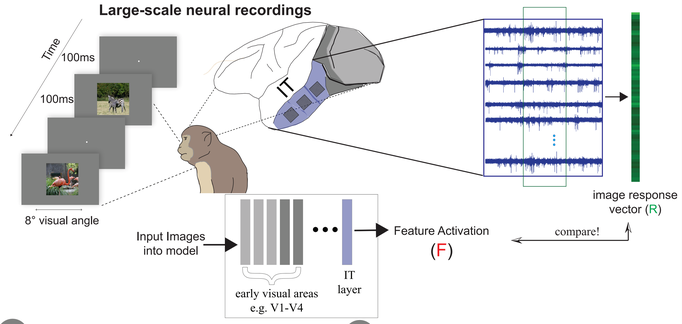


2 Comparison across architectures

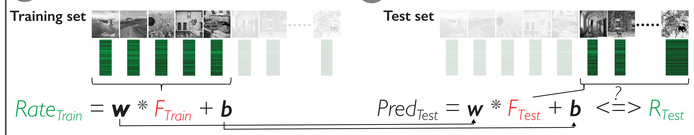


Comparing ANN-models with primate sensory responses

Large-scale neural recordings



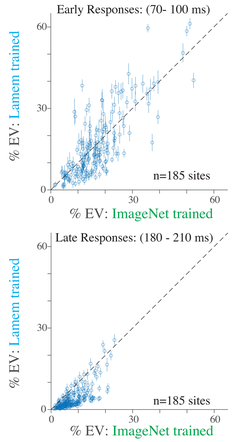
1 Estimate regression weights (Mapping) **2 Test predictions**



$Rate_{Train} = \mathbf{w} * F_{Train} + \mathbf{b}$ $\quad Pred_{Test} = \mathbf{w} * F_{Test} + \mathbf{b} \overset{?}{<=>} R_{Test}$

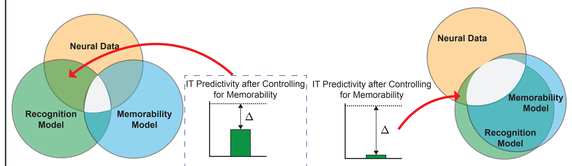
Comparison of explained IT neural variance across the models

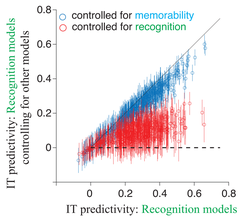
Do the Recognition and Memorability models predict any IT variance?



Do the Recognition and Memorability models predict the same IT variance?

Two Possibilities

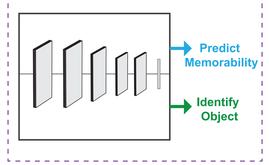




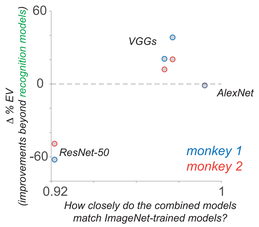
Recognition models explain different variance in neurons than memorability models

How do joint recognition and memorability models perform?

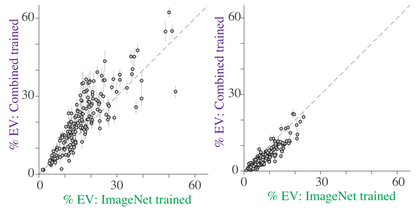
ANNs trained on both objectives



Not all combined models reach ImageNet accuracies and LaMem correlations



Improvements limited to early ("feedforward") phase?



We are training more joint models and comparing them across more neural and behavioral metrics

Google Research
SFARI Simons Foundation Autism Research Initiative
Chaires de recherche du Canada / Canada Research Chairs
Canada First Research Excellence Fund
Fondation Brain Canada Foundation