High dimensional sampling in random neural networks competes with deep learning models of visual cortex

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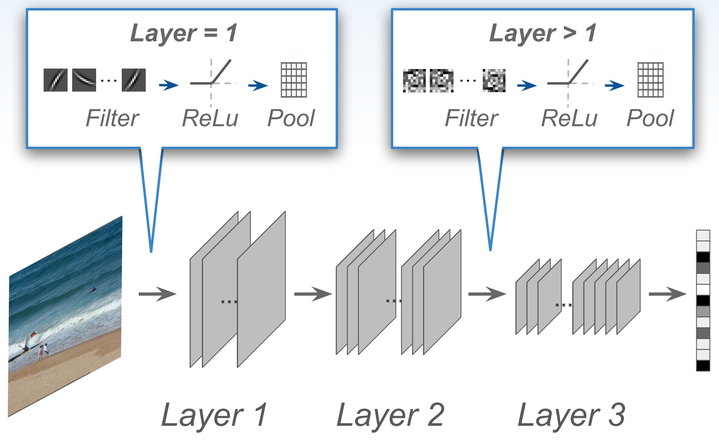
MOTIVATION

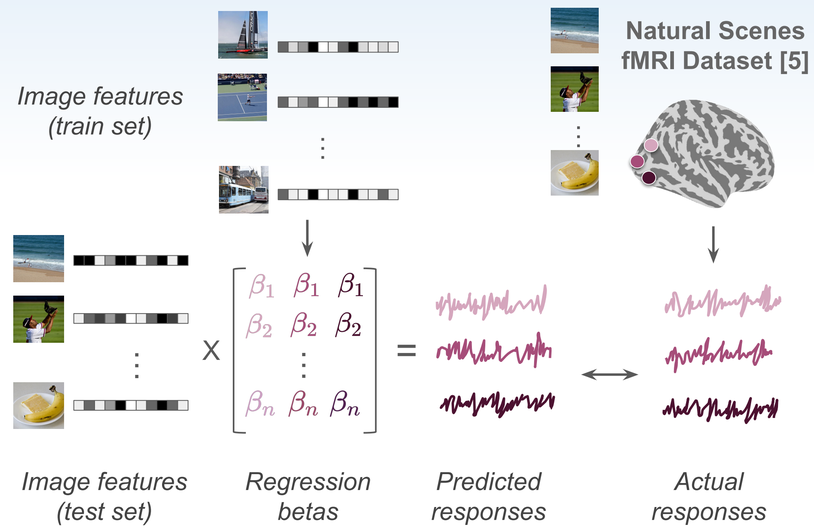
- The performance of convolutional neural networks (CNNs) as models of visual cortex is thought to be associated with task optimization [1-3].
- We hypothesize that simpler statistical principles (such as representational richness [4]) are responsible for much of this performance.
- To test this, we develop a learning-free CNN based on high dimensional random sampling and compare its performance with a pre-trained CNN.

METHODS

Expansion model architecture

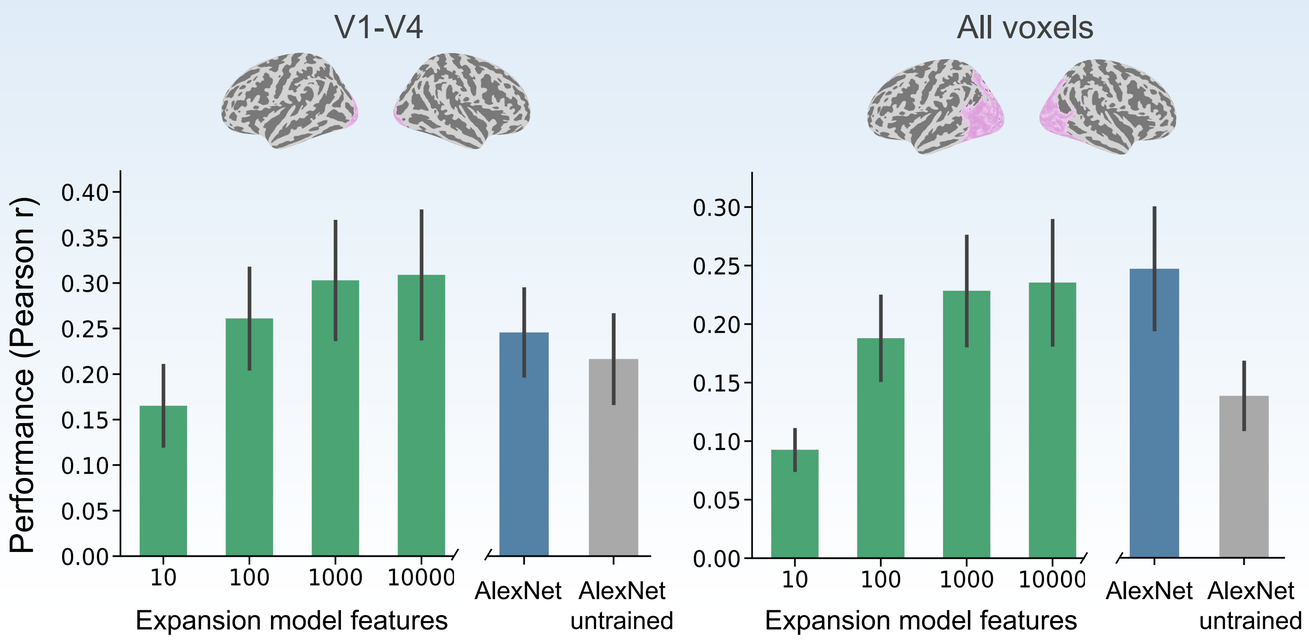


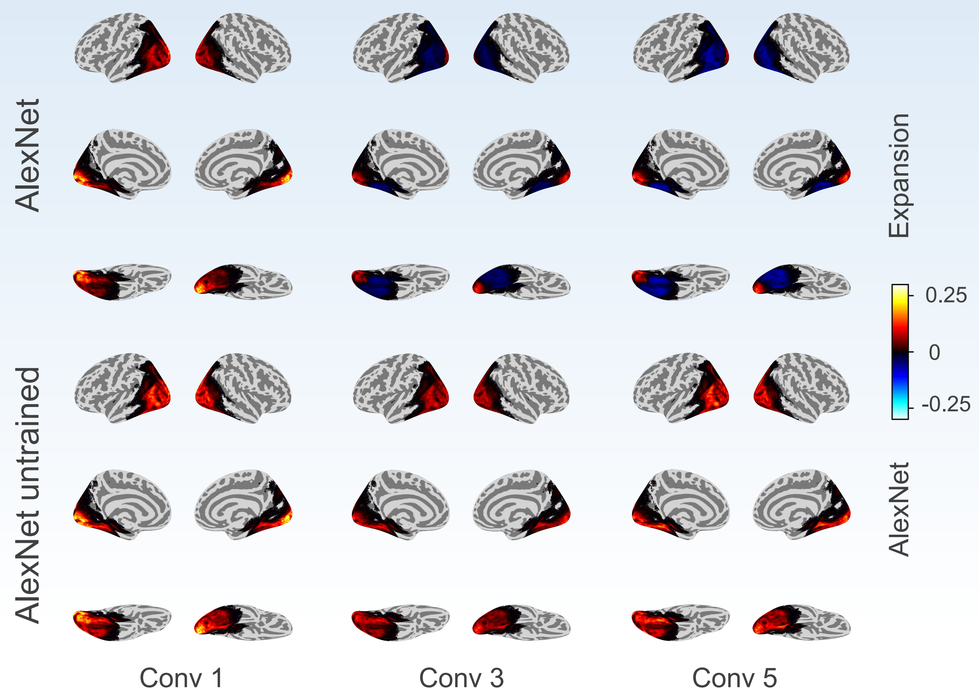
Mapping procedure



RESULTS

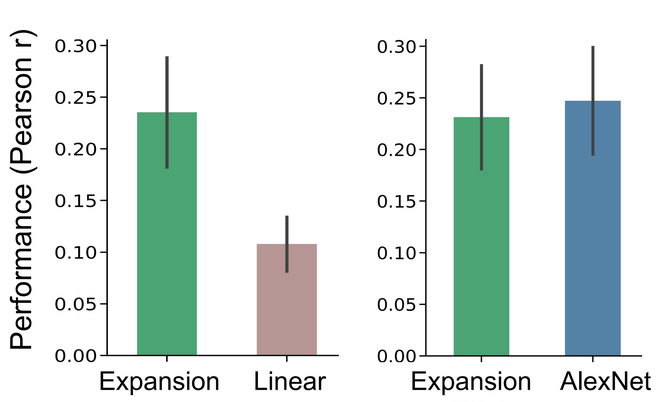
The Expansion model competes with a pre-trained CNN at modeling visual cortex



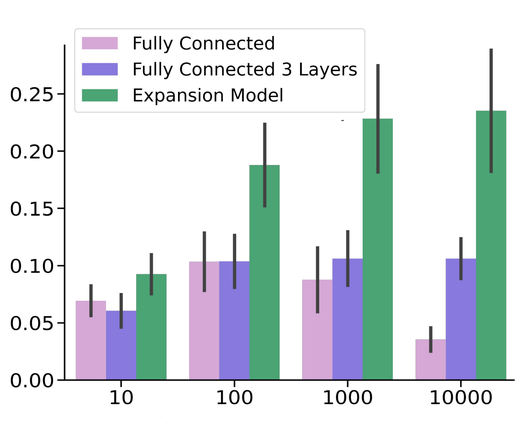


Q What factors drive encoding performance?

High dimensional regression does **not** *drive performance*

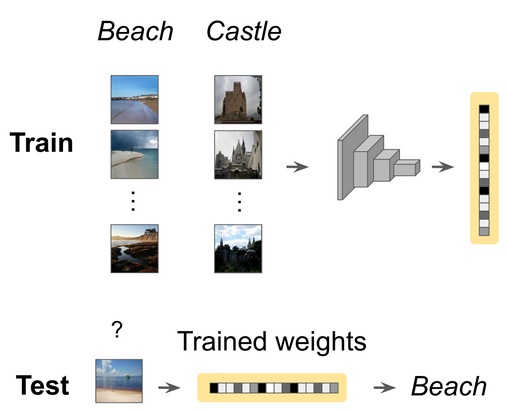


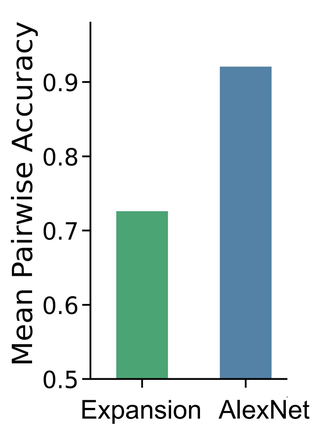
Convolutional ***architecture*** *is needed*



Q Is the model good at image classification?

Not all high performing models of visual cortex are good at computer vision tasks





CONCLUSION

- An untrained model that expands the dimensionality of representations competes with a pre-trained CNN at modeling visual responses.
- The performance of the model is mainly associated with the convolutional architecture and high dimensional random sampling.
- The model's low image classification performance shows that this metric does not always correlated with brain-similarity.
- Our results suggest that there may be simplifying statistical principles underlying the image representations of deep neural networks and visual cortex.

REFERENCES

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