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

QR

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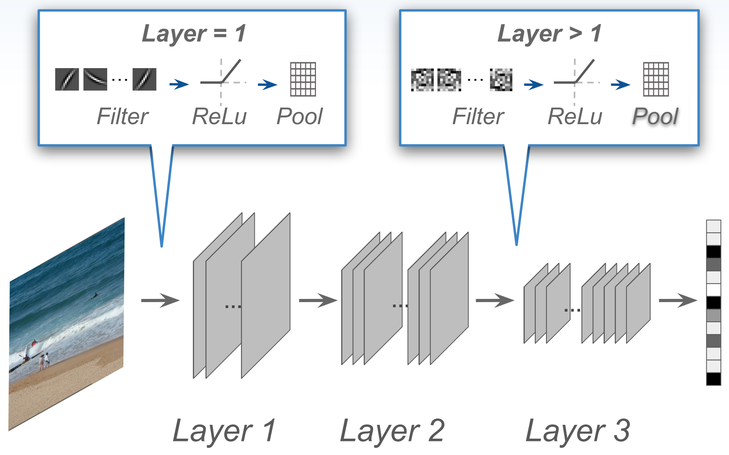
MOTIVATION

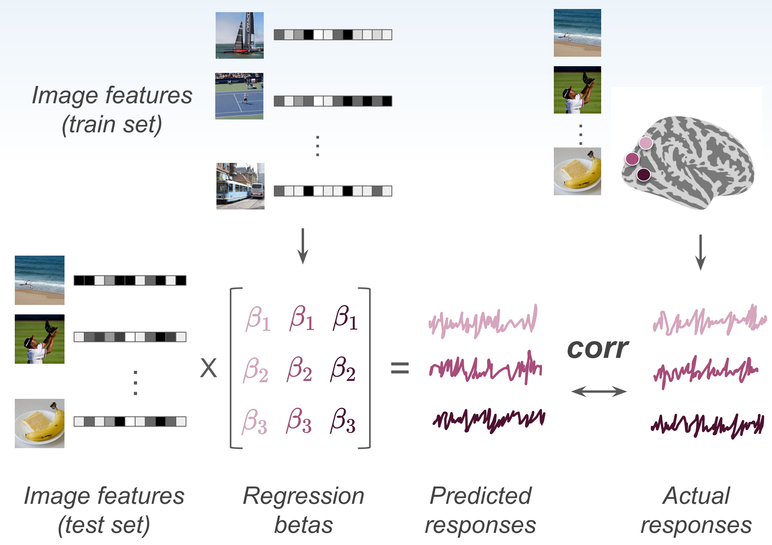
- The performance of convolutional neural networks (CNNs) as representational models of visual cortex is thought to be associated with task optimization.
- We hypothesize that there may be simpler statistical principles responsible for this, such as the latent dimensionality of representations (Elmoznino & Bonner, 2022).
- To test this, we develop a learning free CNN that uses high dimensional random sampling, and compare its performance with standard pre-trained CNN at modeling visual cortex.

METHODS

The Expansion Model architecture

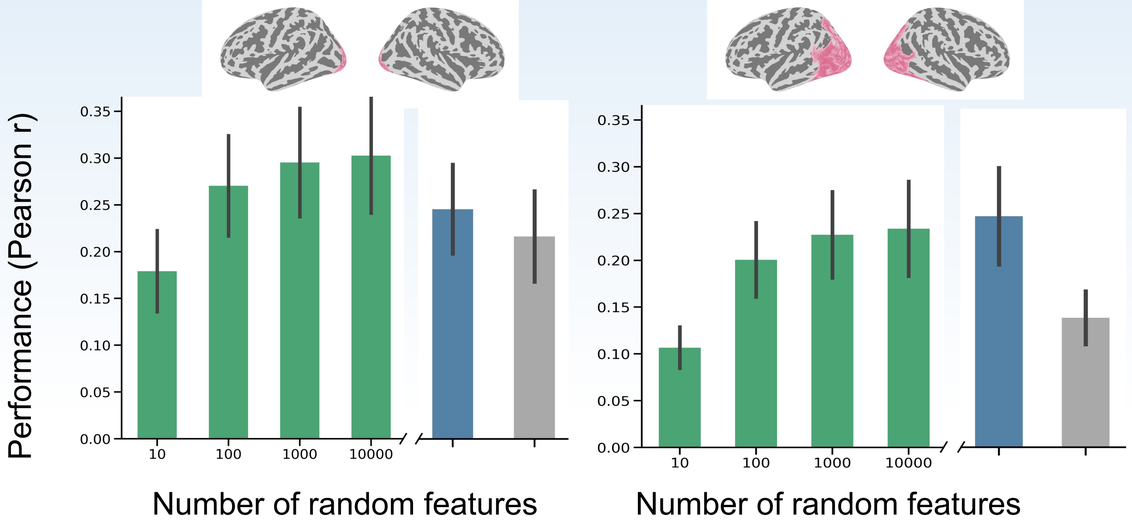


Mapping Procedure



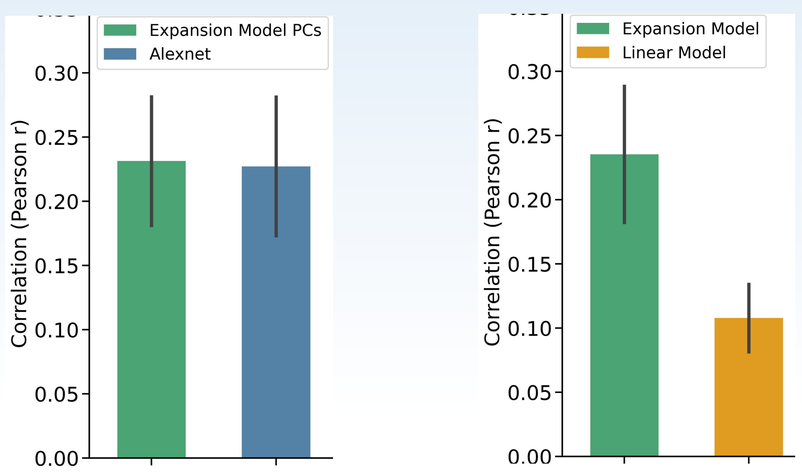
RESULTS

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

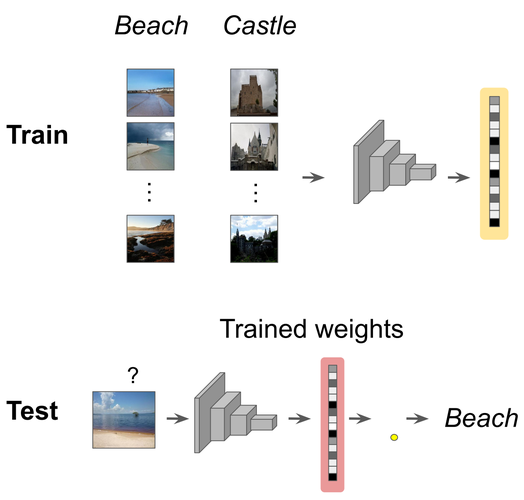


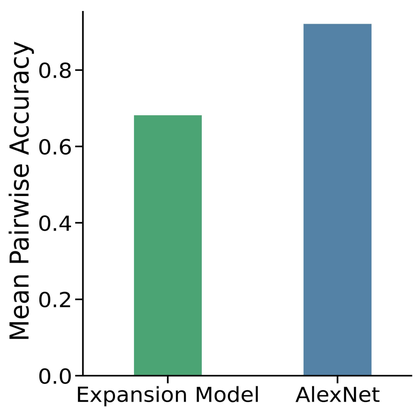
Q What factors drive encoding performance?

High dimensional regression does not have an affect

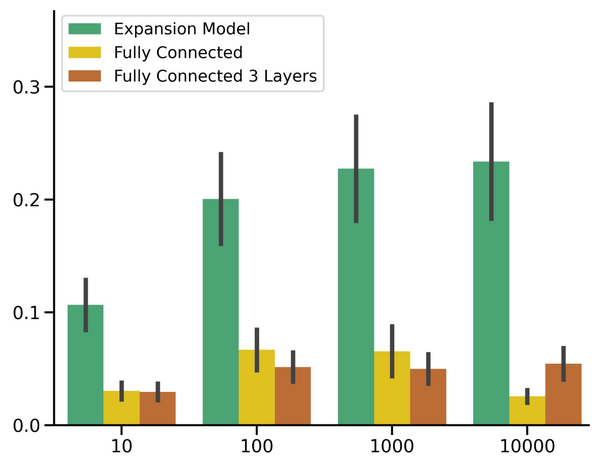


Q Is the model good at image classification?





The convolutional architecture has a significant impact



CONCLUSION

- We have shown that a learning free model that expands the dimensionality of representations competes with a standard task optimized CNN.
- The performance of the model is mainly associated with the convolutional architecture and high latent dimensionality.
- Not all high performing models of visual cortex succeed at computer vision tasks, further confirming that task optimization is one but not the only path towards generating brain-like representations.
- Our findings suggest that there may be a unifying set of statistical principles underlying deep neural networks and the visual cortex.

REFERENCES