Behavior measures are predicted by how information is encoded in an individual's brain

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Summary

- **Motivation:** How can we map differences in our brains to differences in our behavior?
- **Open question:** Do individual differences in how information is encoded in the brain predict behavior?
- **Proposed framework:** Utilize encoding-models to identify individual differences in brain representations and test if these differences predict behavior measures.

Takeaways:

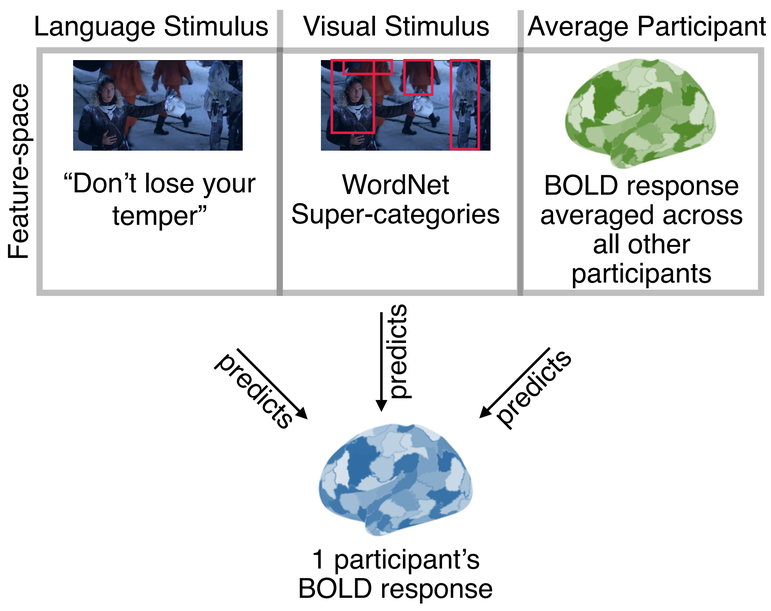
- Individual differences in brain encoding:
  (1) are feature-space and task specific
  (2) can predict variability in cognitive behavior
- Researchers should optimize their choice of task and encoding-model for their behavior of interest

Hypothesis

- **Prior work** predicted behavior measures from individual differences in functional connectivity, brain anatomy, and structural connectivity. What about the stimulus-driven response in the brain regions?
- **We hypothesize** that individual differences in how information is encoded in the brain are task-specific and predict different behavior measures
- **Analogy:** Athletic ability is not only related to the size of muscles or the connections between muscles, it is also related to how the athletic task recruits the muscles.

Data and Feature-spaces

- **Data:** fMRI data collected when 90 Human Connectome Project participants watched 1 hr of naturalistic video clips and performed a tightly controlled motor task for 7 min.
- **3 types of encoding-model feature-spaces:**



Paper & Code

Paper: arXiv 2112.06048
Code: github.com/brainML/great-apes

Acknowledgements

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References

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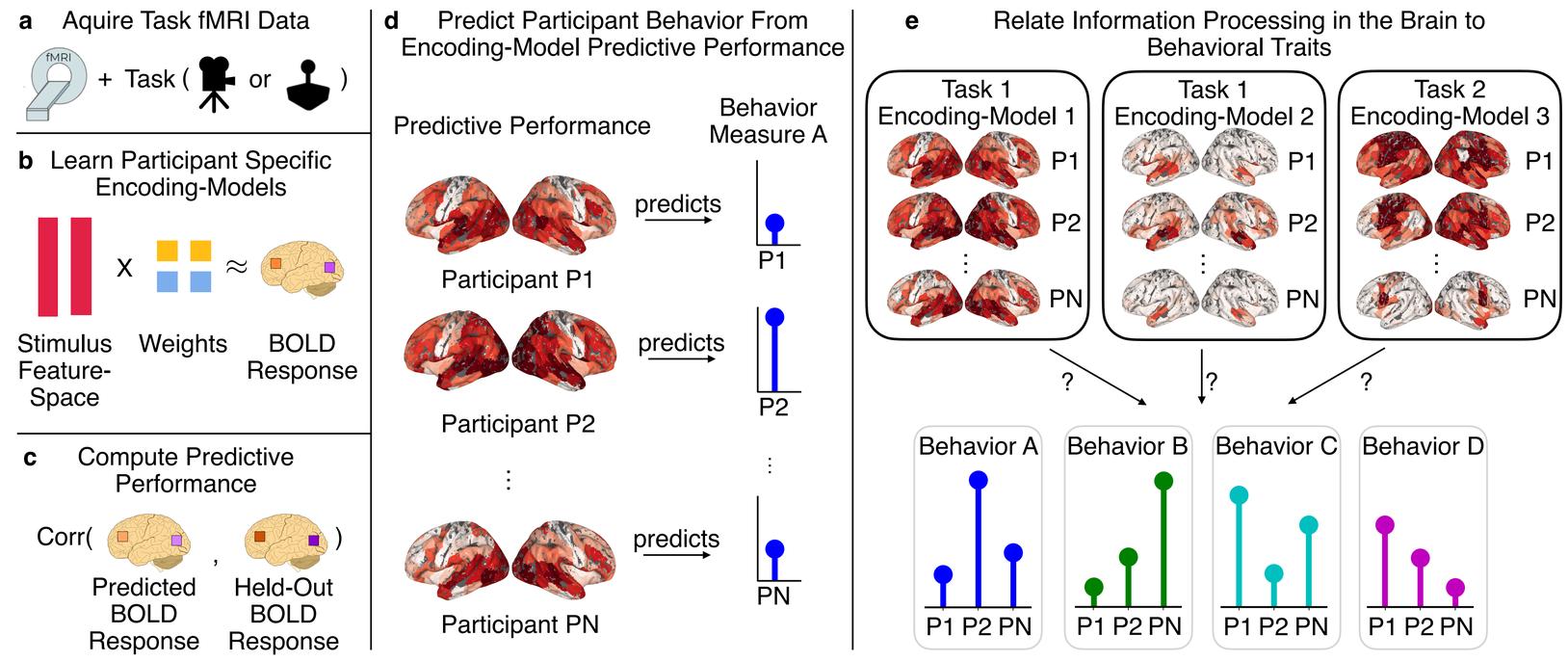
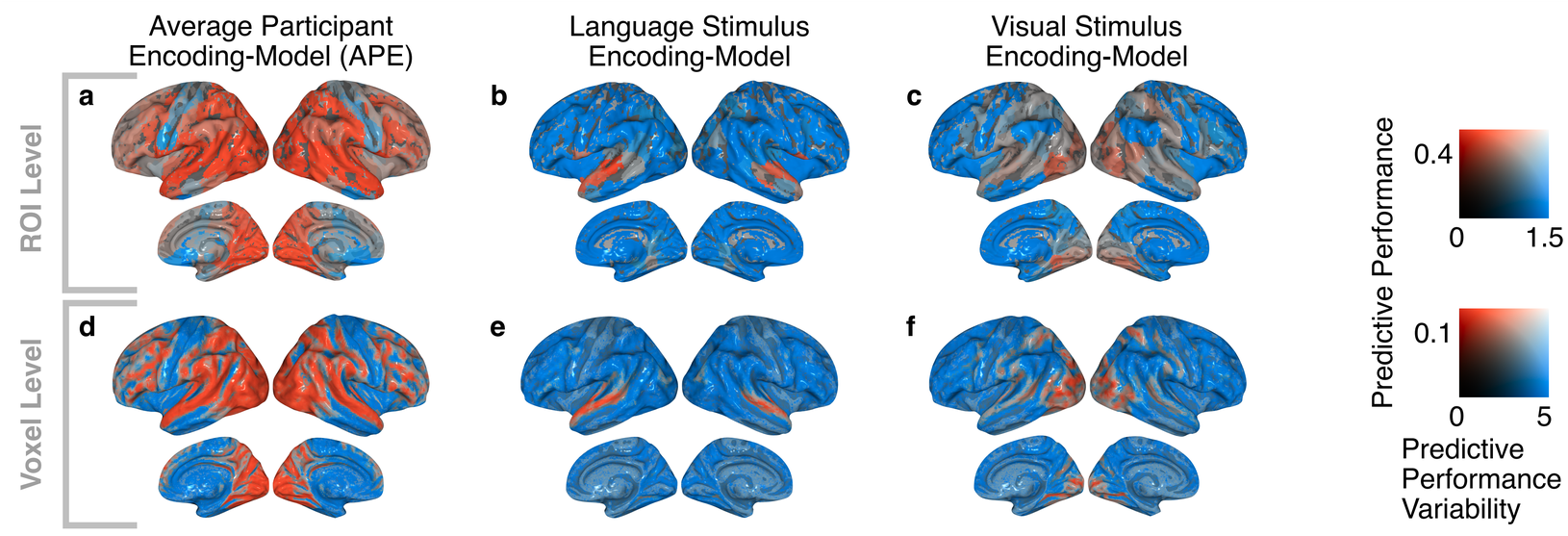
Framework



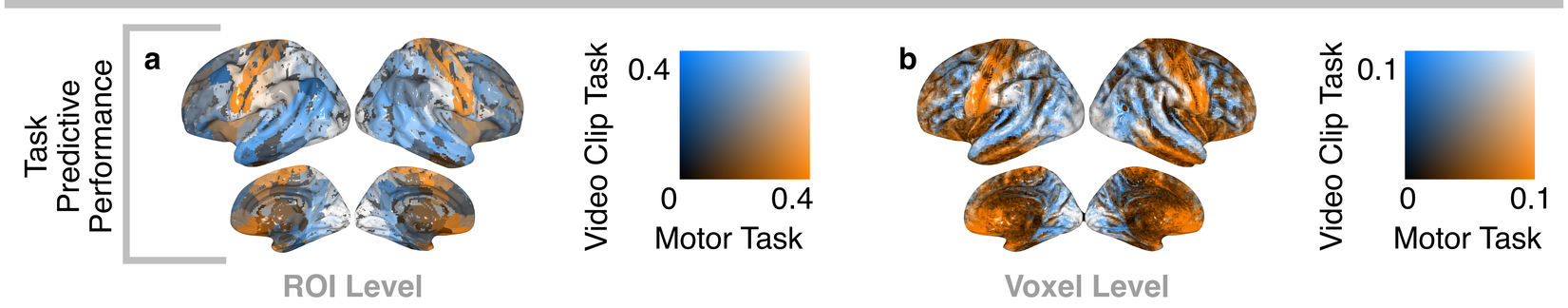
Enables testing of what task/encoding-model combinations predict different behavior measures.

Encoding-model performance is feature-space specific



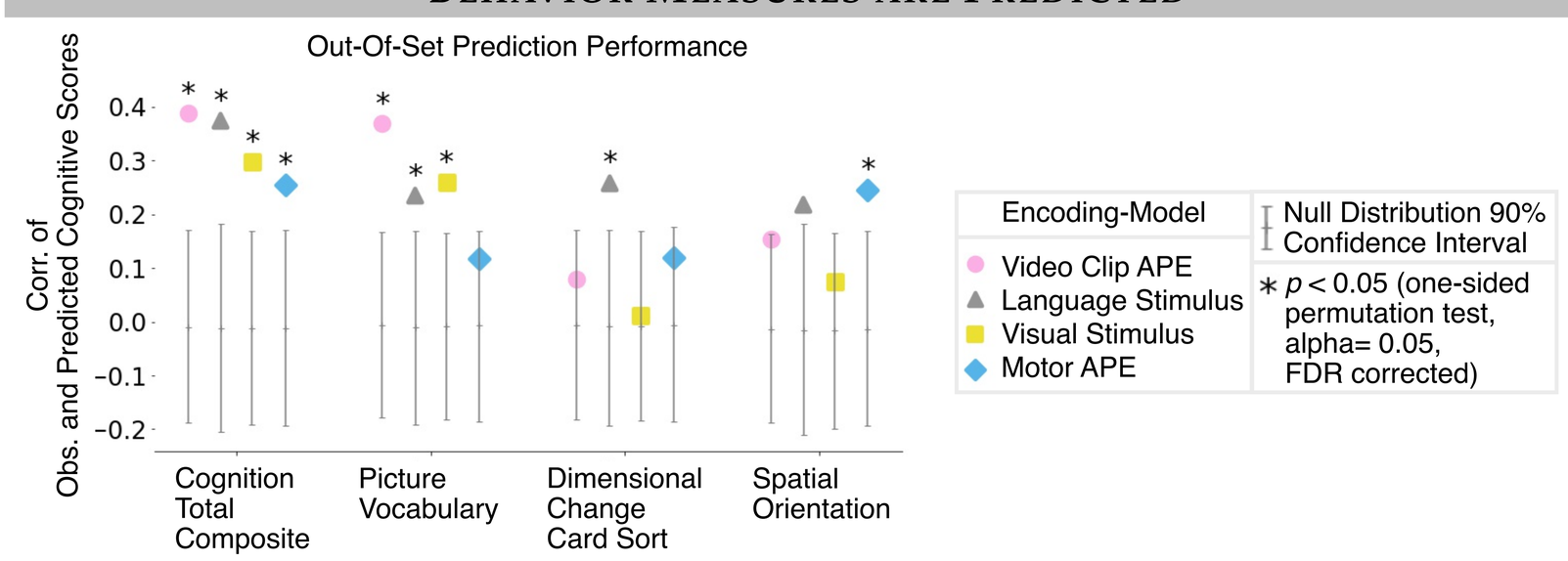
Comparison of average predictive performance (across participants) to its variability.

Encoding-model performance is task specific



Comparison of APE predictive performance between the motor and video clip task, averaged across all participants. APE predictive performance is task-specific.

Behavior Measures are Predicted



Individual differences in encoding-model performance predict cognitive behavior.

For both tasks, head motion is not significantly: correlated with any cognitive behavior measure, predicted by encoding-model performance, predictive of cognitive behavior. Significance: $p < 0.05$, FDR corrected.

Conclusion

- Encoding-models can reveal individual differences
- We can improve our understanding of the brain behavior relationship by relating how information is encoded to behavior