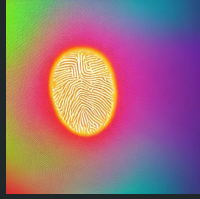

Predicting Personality Traits From Cognitive Task Performance Through Task-fMRI Analysis

By: Anna-Lea Beyer, Thananya Charoenpattarawut, Rajdeep Chakraborty, Shu Fangqi, Rajarshi Mondal, Fatma Waleed

Lambeosaurus_Mask/Cognitive_Cortex_Crew

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Introduction

Research Question(s)

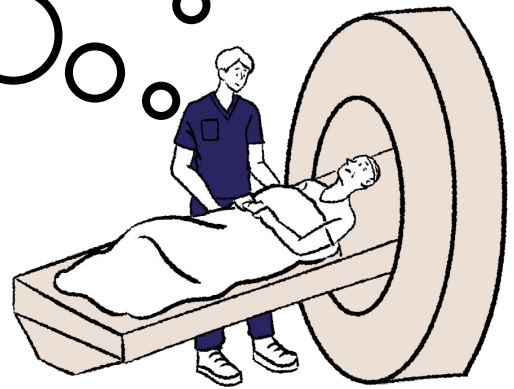
- **Personality**
- **Cognition**
- **Brain Activity**

Can **fMRI data** help us **predict personality** from cognitive **task performance?**

→ Does the fMRI data capture more about **cognition and personality** than the **task performance scores alone?**

Can we predict **personality** from **cognitive task performance**?

→ We are looking for an individual *"cognitive fingerprint"*



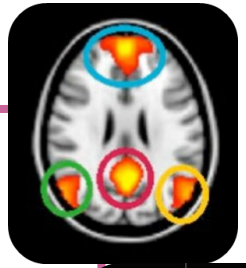
Background

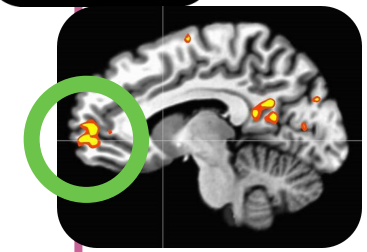
HCP Dataset tasks:

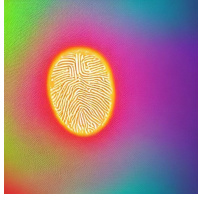
- **Social Cognition:**
  Traits: Agreeableness, Extraversion
  Brain regions: Default mode network (eg. medial prefrontal cortex, posterior cingulate, precuneus) (Sampaio et al., 2013)

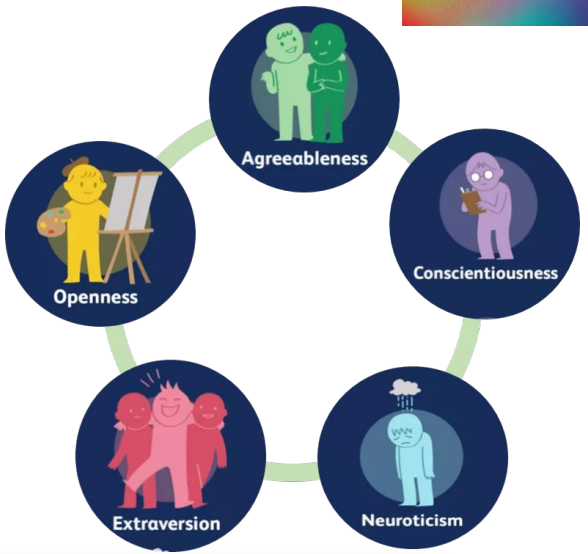
- **Gambling:**
  Traits: Extraversion, Openness
  Brain Regions: Ventral prefrontal cortex, ACC (Bogg et al., 2012), parietal (Leland et al., 2006)

- **Emotion Processing (fear, neutral)**
  Traits: Neuroticism
  Brain Region: prefrontal cortex (Wittmann et al., 2006)









Research Gap

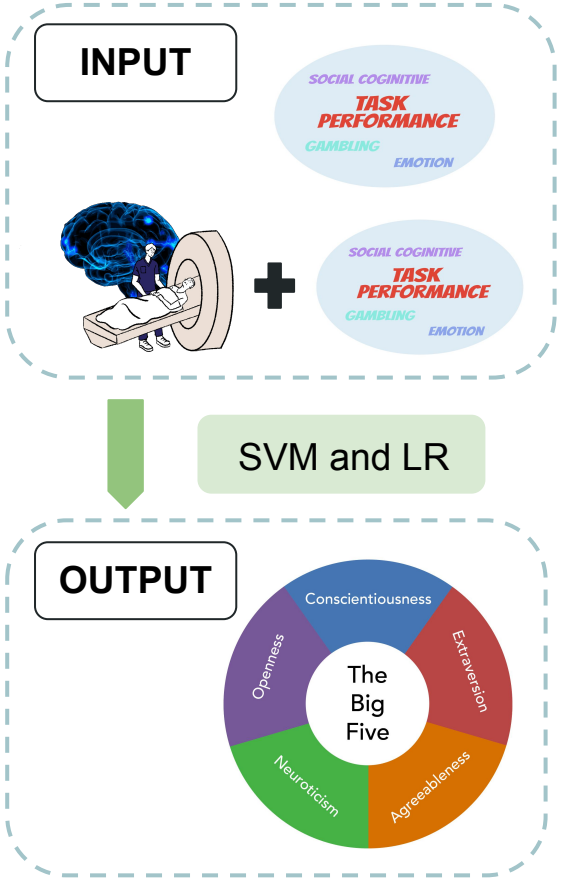
- Use of t-fMRI rather than r-fMRI
- Studying brain activity, personality, and cognitive tasks

Model/Methods

- Logistic regression
- Support vector machine (SVM)

98 Subjects from HCP:

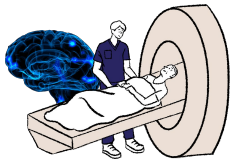
- Task performance:
  - Inverse Efficiency Score: $IES = \frac{RT}{1 - ACC}$
  - 5 features from 5 IES
- Brain activation:
  - Divide 360 brain regions into 12 networks
  - 7 networks from 3 tasks average contrast
- Personality
  - According to NEO-FFI scores divided into 2 categories

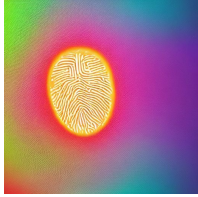


Results

IES

IES + networks BOLD





	F1 - SVM	F1 - LG	Acc - **SVM**	Acc - LG	F1 - SVM	F1 - LG	Acc - SVM	Acc - LG
Agreeableness	**0.61**	**0.60**	**57.33**	56.33	0.57	0.56	55.33	54.33
Openness	0.56	0.55	53.33	52.33	0.46	0.43	49.11	47.00
Conscientiousness	0.53	0.53	42.78	43.89	0.57	0.58	51.89	52.89
Neuroticism	0.51	0.51	49.22	48.11	0.55	0.56	54.0	55.00
Extraversion	**0.63**	**0.59**	**58.33**	52.23	0.53	0.53	51.22	50.22

Conclusion

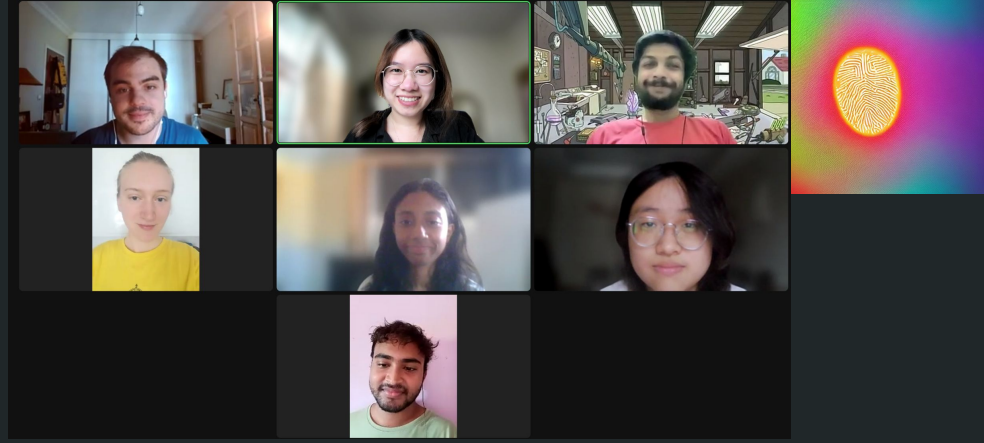
Limitation and Future Work

- Different fMRI features extraction: Voxel-wise analysis
- Dimensionality reduction: PCA
- Small sample size: larger set is needed to stabilize the test-set variance for cross validation (Varoquaux et al., 2016)

Implication and Direction

- The personality traits of individuals are associated with latent brain mechanisms that influence their behavioral performance.
- Emotion, Social Cognition, and Gambling tasks might not be able to predict all 5 aspects

IES from emotion, social cognition, and gambling tasks has **potential** (~60%) to reliably predict **Agreeableness** and **Extraversion** aspects (Udochi et al., 2022, Li et al., 2010)



Thank you for your attention!

And a special thanks to our teaching assistant Batı Yılmaz, our project assistant Yalda Foroutan, and our mentor Prof. Vladimir Litvak!

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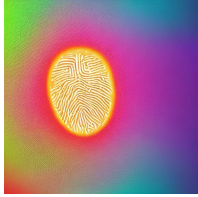
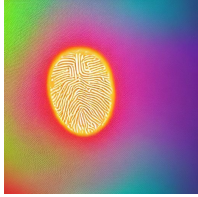
General Discussion



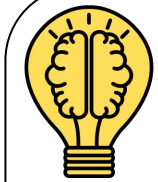
1. What was missing in the dataset that we would have really liked to have?
2. Do we plan to continue working on this project in the future?
3. Which one of the 10 steps to modeling was hardest and why?
4. What surprised us the most about the process of doing a project?
5. In what way was this project different from others we have done in the past?
6. Based on our experience, what project would we most like to do next?
7. What technique did we learn at NMA that we can immediately apply to our own project outside of NMA?

Project Development



- Seek inspiration from literature and HCP data
- Initial question:

  Decode neural activity across various tasks within the fMRI task battery to accurately predict task performance using the Human Connectome Project (HCP) dataset?



With the help of mentor and TAs We …

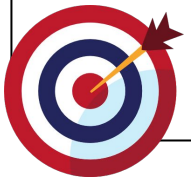
- refining question
- confirm methods:

  Task performance score, personality classification, brain activation, model…

Code:

- filter the data
- calculate the feature scores: 1) task score 2) brain networks average activation
- classify the personality traits
- fit the model

Prepare for presentation



Finish!

However, there remains a considerable distance to cover…