

MIND YOUR OWN THICKNESS

WHEN BRAIN DISORDERS OVERLAP:
CORTICAL THICKNESS, CORRELATIONS, CLUSTERS
AND CLASSIFIER
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ABSTRACT

Neurological and psychiatric disorders are traditionally classified based on symptoms even though many may share underlying biological features. One important structural characteristic of the brain is cortical thickness, which reflects cortical development, organization, and degeneration. This project investigates how different neurological disorders affect cortical thickness, whether disorders exhibit correlated patterns of cortical thickness, and ultimately, if these correlations can be used to group disorders into meaningful clusters.

Surface-based cortical thickness data were analyzed across multiple disorders. Histograms were used to visualize patterns of cortical thinning and thickening, while correlation analyses using Cohen's d effect size quantified similarities between disorders. Statistical significance was assessed using t -tests. Hierarchical clustering and dendrograms were then applied to group disorders according to shared patterns in cortical thickness.

Results revealed distinct trends in cortical thickness across disorders. Most shared and neurodegenerative conditions, including Bipolar Disorder, Major Depressive Disorder (MDD), Obsessive-Compulsive Disorder (OCD), Epilepsy, and Parkinson's Disease, consistently exhibit widespread cortical thinning. In contrast, neurodevelopmental disorders such as Autism Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder (ADHD), and 22q11.2 Deletion Syndrome (22q11.2DS) were often characterized by cortical thickening, likely reflecting delayed or atypical cortical maturation. Correlations between cortical thickness measurements among related and comorbid disorders and across or between disorders sharing psychiatric and neurological conditions.

Clustering revealed three primary disorder groups: neurodevelopmental, mood and behavior psychiatric, and neurodegenerative. The project used principal component analysis (PCA) to reduce the dimensionality of the data and identify the most significant variables. The correlation matrix revealed that relationships observed between disorders are not highly complex, suggesting that relationships observed between disorders are not highly complex, suggesting that relationships observed between disorders are not highly complex.

A cortical morphology-based machine learning classifier using artificial neural networks and gradient descent that only requires a few features to distinguish between disorders. The classifier achieved a 70% accuracy rate, demonstrating that cortical thickness patterns can be used to distinguish between disorders.

Overall, this study demonstrates that cortical thickness patterns can be used to distinguish between disorders and group neurodegenerative disorders. These findings suggest that brain-based structural measures may provide insight into shared biological mechanisms between related and comorbid disorders and support brain research investigating structural, functional, and developmental processes.

PURPOSE

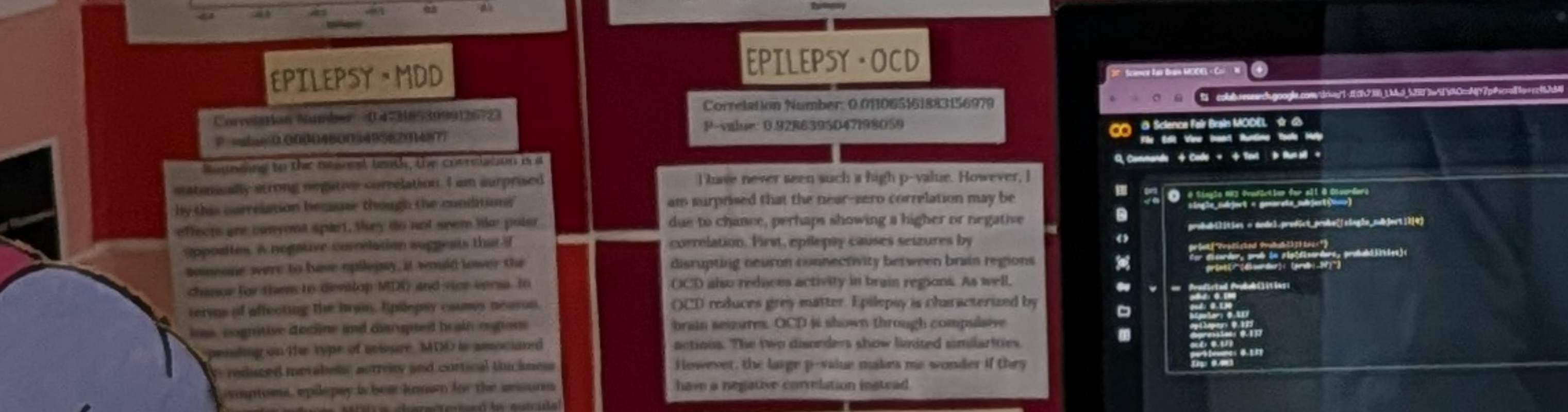
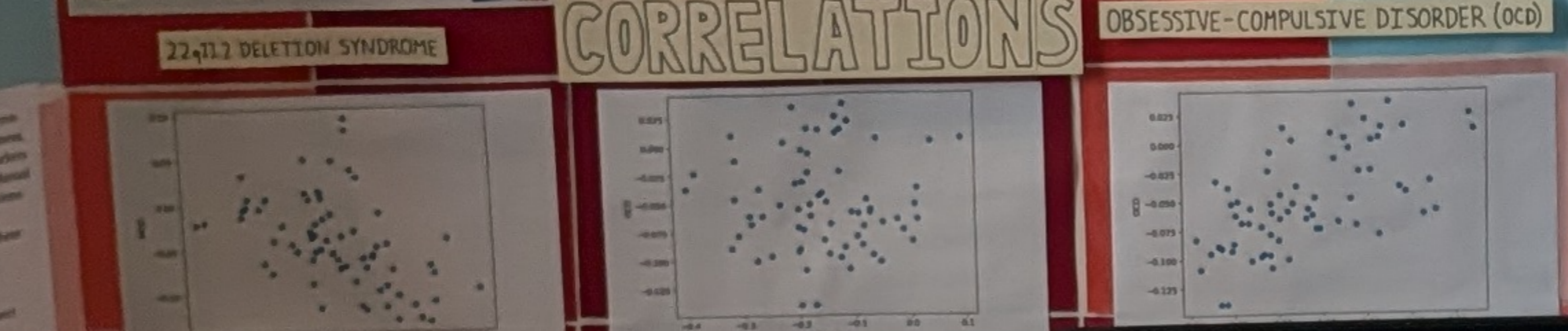
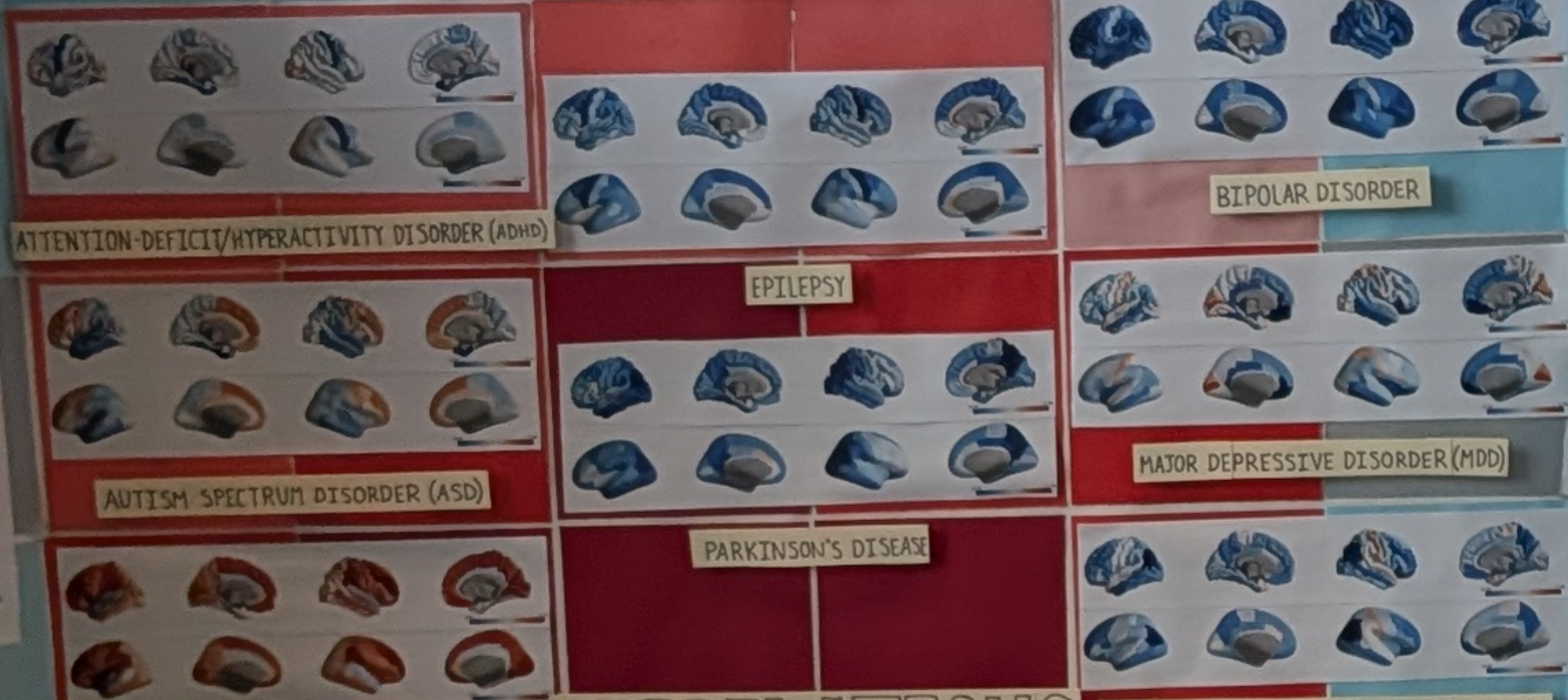
Understanding how different neurological disorders affect the brain is a major challenge in neuroscience. Characterizing biological features, such as the thickness of the brain's outer layer (cortex), which reflects the health and organization of the cortex, can provide insight into the underlying mechanisms of neurological conditions. This project aims to investigate how different neurological disorders affect cortical thickness, whether disorders exhibit correlated patterns of cortical thickness, and ultimately, if these correlations can be used to group disorders into meaningful clusters.

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BACKGROUND

Cortical thickness is a measure of the thickness of the brain's outer layer, the cortex. It is a key structural feature of the brain and is thought to be related to cognitive function and mental health. Research has shown that cortical thickness is affected by a variety of factors, including genetics, environment, and age. This project aims to investigate how different neurological disorders affect cortical thickness, whether disorders exhibit correlated patterns of cortical thickness, and ultimately, if these correlations can be used to group disorders into meaningful clusters.

DATA CORTICAL THICKNESS



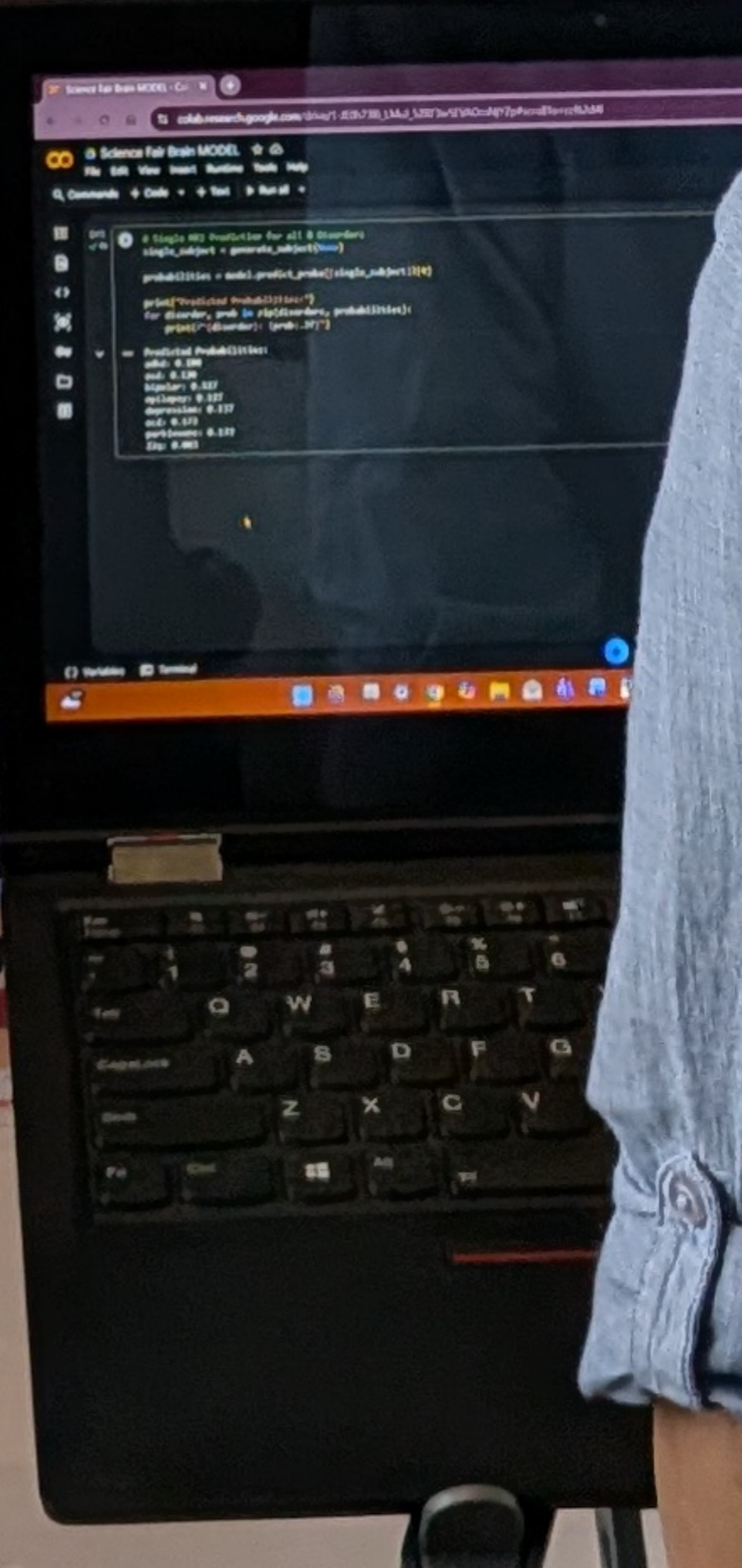
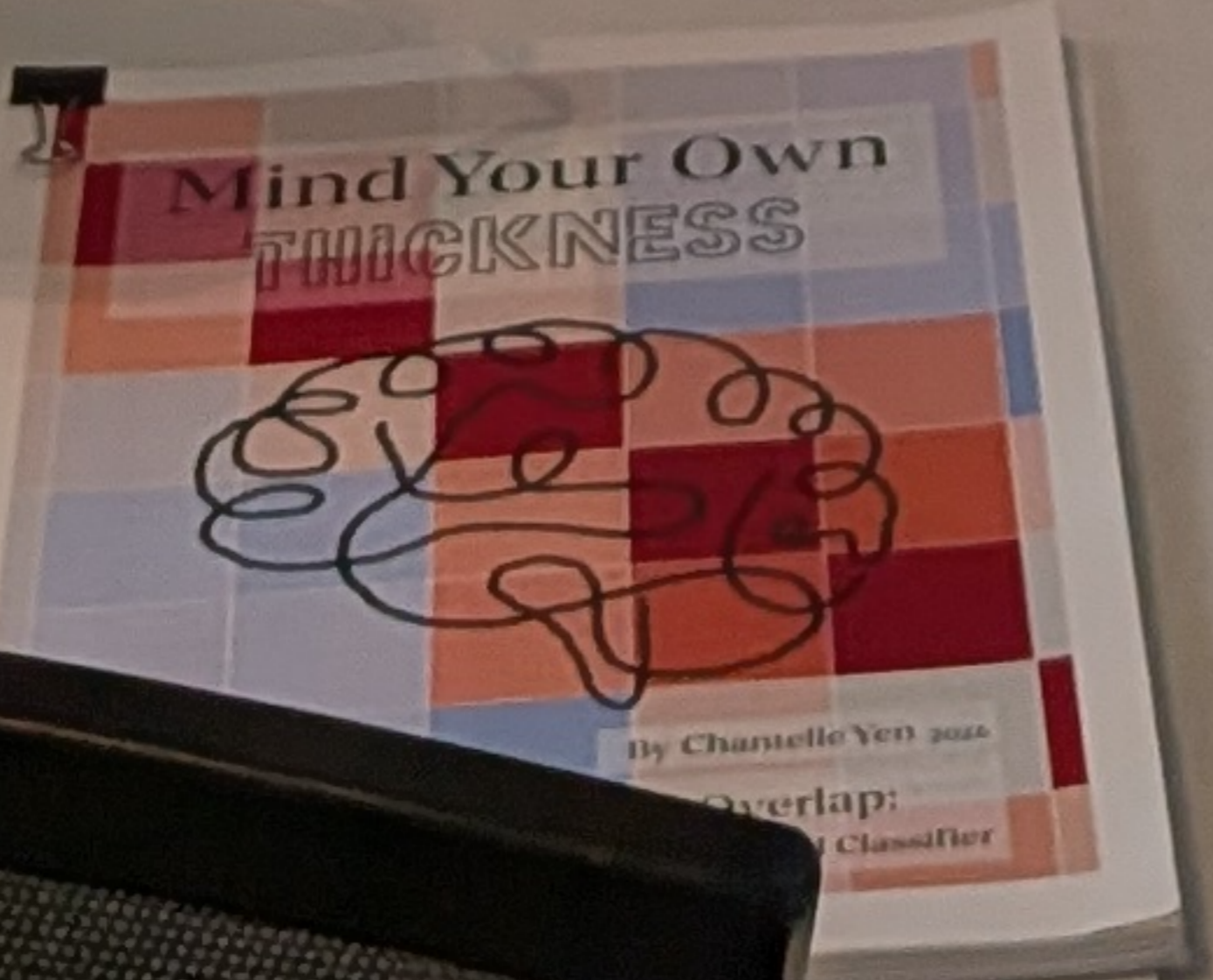
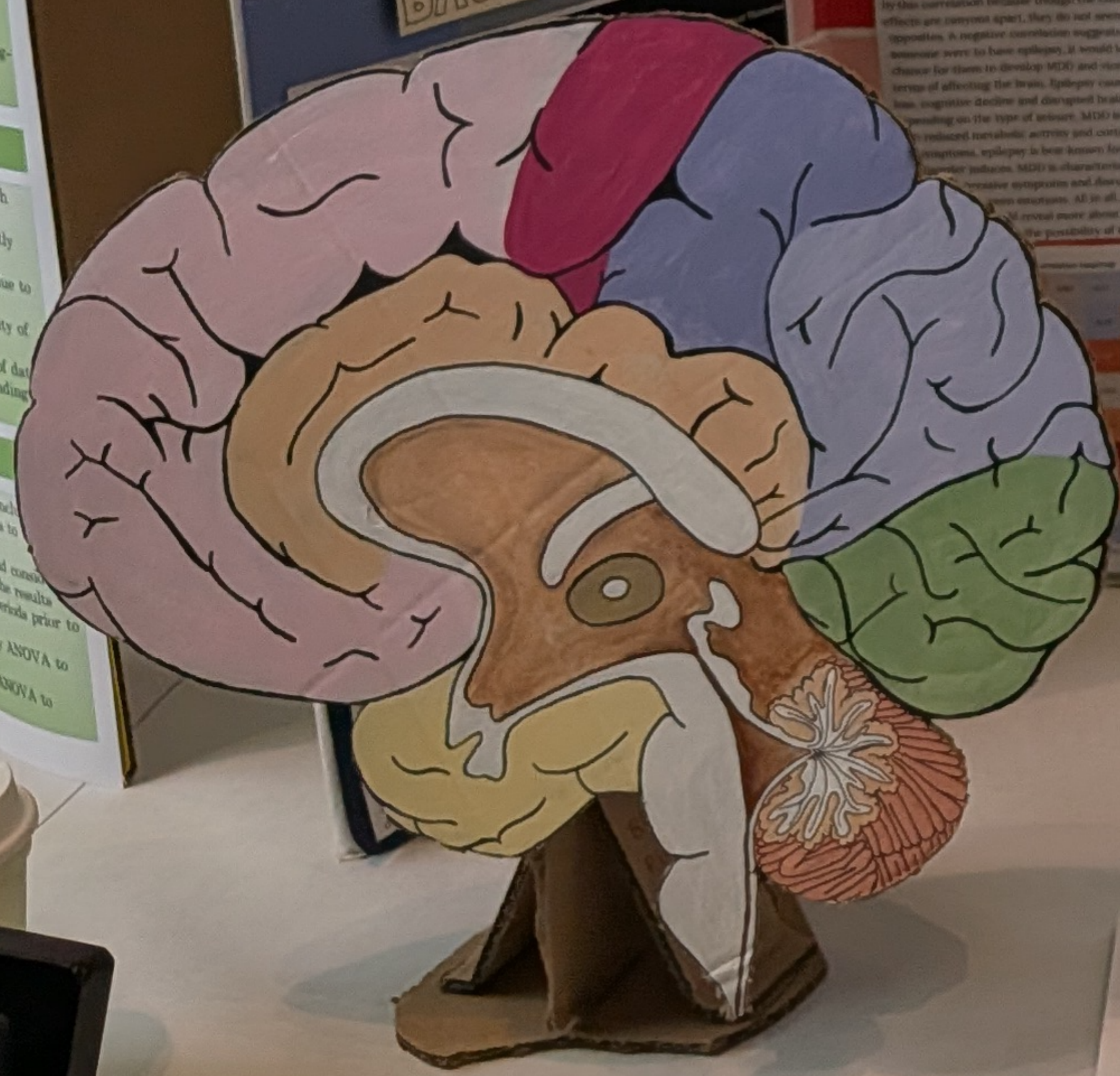
CLASSIFIER

Machine learning classifier using Artificial Neural Networks (ANN) to predict disorder groups based on cortical thickness data. The classifier achieved a 70% accuracy rate.

SOURCES OF ERROR

Several factors could contribute to errors in the classifier, including noise in the data, overfitting, and the choice of features. Future work could explore more advanced machine learning models and feature engineering to improve performance.

5202



YORK HOUSE SCHOOL 5201

Insulin

The results of this study are consistent with the original hypothesis. The insulin hypothesis (IH) which proposed that in-diets women will significantly affect liver tissue weight. In support, the results of this study demonstrate that exposure to certain in-diets sweeteners can influence liver tissue weight. A statistically significant difference in liver tissue weight was observed between the control group and the in-diets group. The p -value = 0.0081, indicating that it is not due to chance. The results of this study suggest that exposure to certain in-diets sweeteners can influence liver tissue weight. This suggests that exposure to certain in-diets sweeteners can influence liver tissue weight. This suggests that exposure to certain in-diets sweeteners can influence liver tissue weight.

on Liver Tissue Weight

Substance	Weight (g)
Control	~1.5
Stevia	~1.8
Sucralose	~2.2
Aspartame	~2.5

How Yeast

Materials

- Instant Yeast
- Erlenmeyer Flask (125x250mm)
- Vinegar
- Table salt
- Ethanol
- Stirring rod
- Thermometer
- Table sugar
- Balloons
- Scale
- Funnel
- Weight

Pilot Experiment - Objective

- Identify concentrations of sub-ambient individual stressors (acid, ethanol) that limit survivability.
- Record qualitative observations of yeast under subsequent preparation of cross-stress experimentation.

Cross-stress Experiments - Objective

- Utilize concentrations of stress levels determined during the pilot experiment to test cross-stress capabilities by measuring carbon dioxide output.
- Record qualitative observations of yeast under subsequent contact with two stressors.

Stress Combinations

Stressor	Control	Control	S1 - S3
Osmotic	Control - Control	Control - S1	S2 - S3
Acid	Control - S2	Control - S3	S1 - S2