

# Machine Learning Reveals Global Hemispheric Differences in the Human Brain

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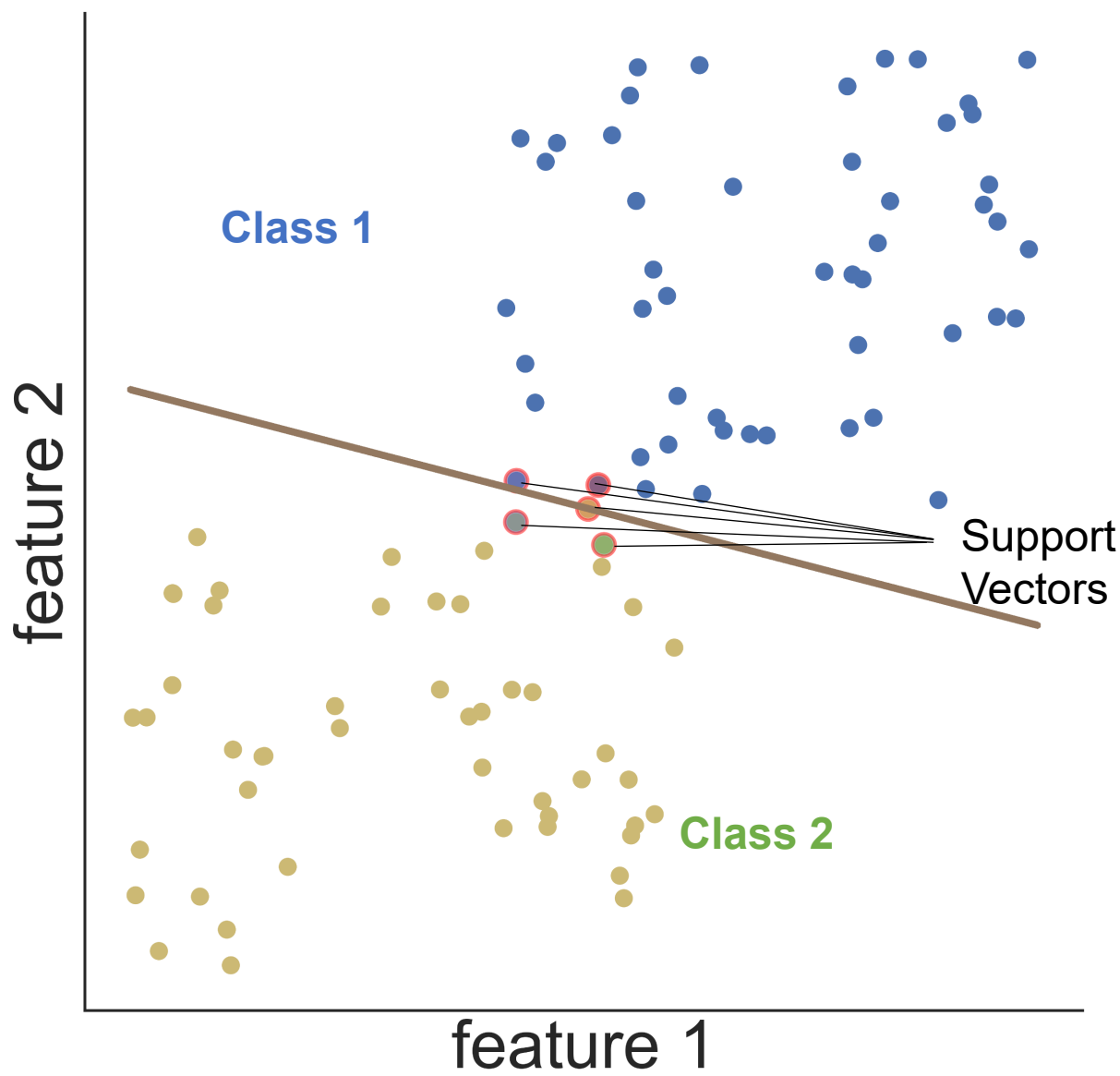
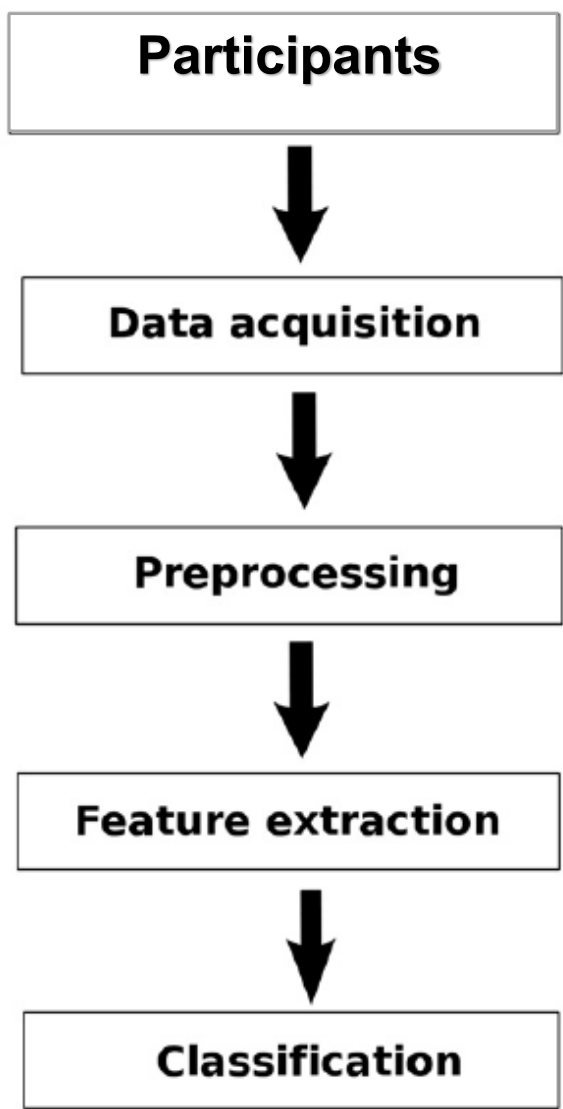
## Introduction

- ◆ Hemispheric asymmetry is a cardinal feature of human brain organization.
- ◆ Altered brain asymmetry has also been linked to some cognitive and neuropsychiatric disorders.
- ◆ While in previous studies univariate approaches were used, we applied a multivariate machine learning approach to explore whether/how well multimodal brain imaging measures could be used in combination to identify the hemispheric differences.

### Present Question:

- **To what extent** can we distinguish the two hemispheres from regional neuroimaging measures?

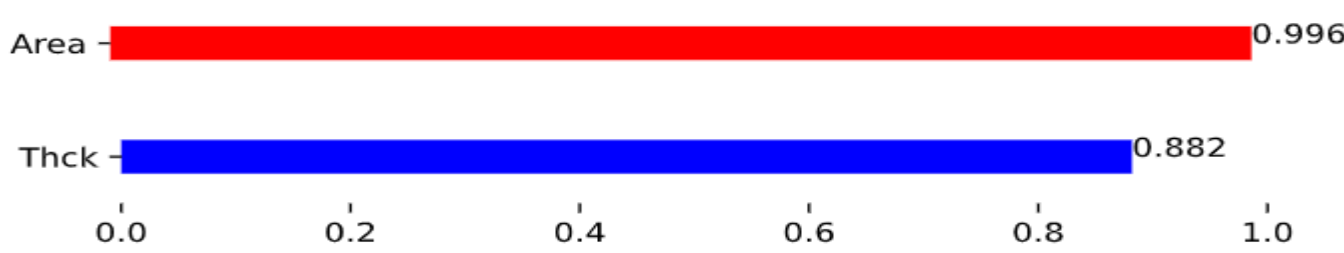
## Methods



## Basic Information

- ◆ Sample Size: 1113 sets of data with 408 features containing the information of 34 different brain regions.
- ◆ Platform: 1)VS Code with Python 3.8, in which packages like sklearn, numpy and pandas are used. 2)Rstudio.
- ◆ Machine Learning Algorithm: SVM (support vector machine) with linear kernel.
- ◆ Train-test-split: 70% for training, 30% for testing.

## Result 1: Accuracy Score



- ◆ All machine learning models based on various morphometric measures showed excellent performance (88.2%-99.6%).
- ◆ While the effect sizes of univariate hemispheric differences in thickness is low (Cohen's  $d < 0.5$ ), it is interesting that, using a multivariate approach, we could distinguish the two hemispheres with a high accuracy (88.2%).

## Conclusion & Discussion

- We investigated the hemispheric differences in a multivariate fashion by combining multi-model morphometric metrics and machine learning.
- Results showed high performance when distinguishing the two hemispheres based on regional morphometric measures.
- It is interesting that, while the effect sizes of univariate comparisons are limited, the multivariate analysis could still distinguish the two hemispheres with a high accuracy (88.2%).
- Multivariate analysis could be more useful for studies of the link between structural asymmetry and functional lateralization.

## References

- [1] Kong, Xiang-Zhen, et al. (2018)"Mapping cortical brain asymmetry in 17,141 healthy individuals worldwide via the ENIGMA Consortium." *Proceedings of the National Academy of Sciences* 115.22: E5154-E5163.
- [2] Glasser, M. F., Smith, S. M., Marcus, D. S., Andersson, J. L., Auerbach, E. J., Behrens, T. E., ... & Van Essen, D. C. (2016). The human connectome project's neuroimaging approach. *Nature neuroscience*, 19(9), 1175-1187.

## Contact

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## Result 2: Contribution of Regions

- ◆ Having selected the most representative two parts for analysis, we got the contribution of different brain regions to the classification accuracy as follows:

