Probabilistic classification of Alzheimer's Disease and Frontotemporal Dementia

Agnès Pérez-Millan[a,b], Bertrand Thirion[c], Sergi Borrego-Écija[a], José Contador[a], Jordi Juncà-Parell[a], Beatriz Bosch[a], Neus Falgàs[a], Anna Antonell[a], Mircea Balasa[a], Albert Lladó[a], Raquel Sánchez-Valle[a], Roser Sala-Llonch[b]

[a]Alzheimer's disease and other cognitive disorders unit, Neurology Service, Hospital Clínic de Barcelona, FRCB-IDIBAPS, Barcelona, Spain [b]Institute of Neuroscience, Department of Biomedicine, University of Barcelona, Barcelona, Spain [c]Inria, CEA, Université Paris-Saclay, Paris, France

INTRODUCTION

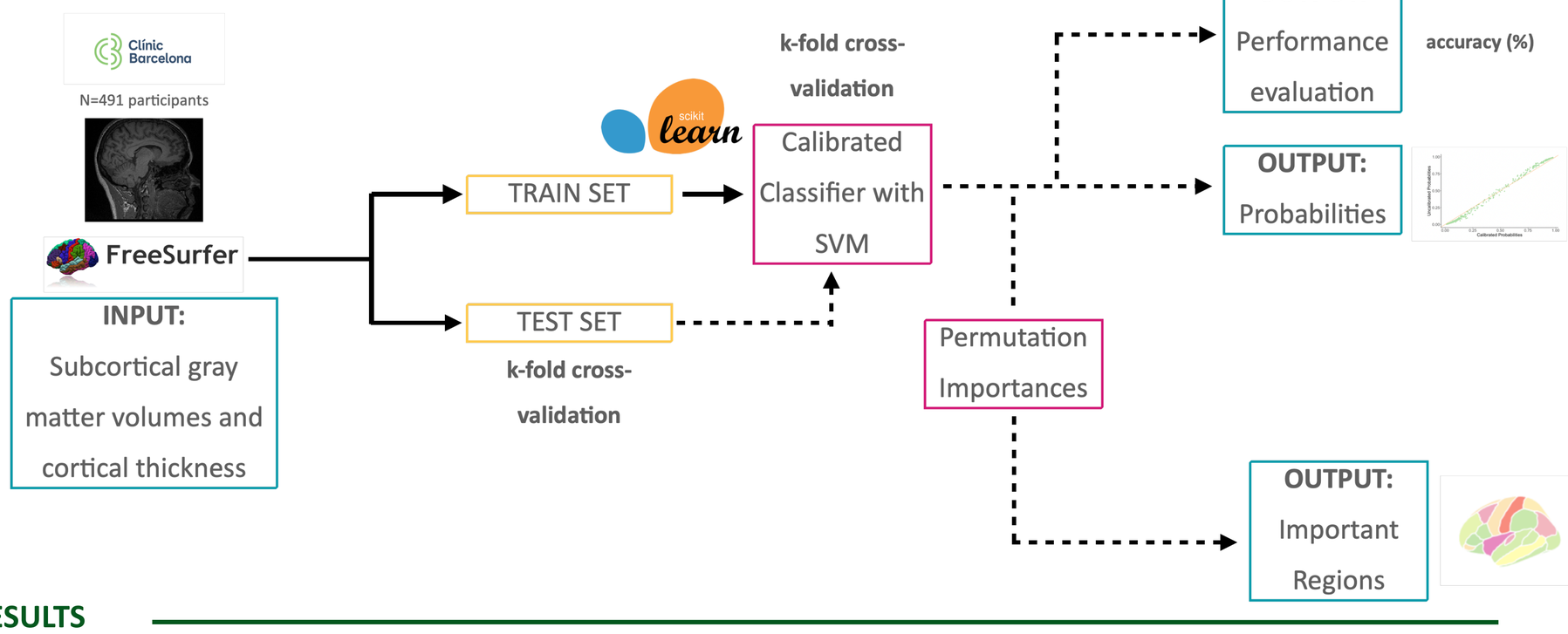
Neuroimaging and fluid biomarkers are used in clinics to differentiate frontotemporal dementia (FTD) from Alzheimer's disease (AD) and other neurodegenerative and non-neurodegenerative disorders. We implemented a machine learning (ML) algorithm that provides individual probabilistic scores for FTD and AD based on magnetic resonance imaging (MRI).

METHODS

- We used the 3T MRI images of 215 AD patients (65 ± 10 years, 137 women), 103 FTD patients (64 ± 8 years, 49 women), and 173 CTR (59 ± 15 years, 106 women).

- We used the individual probabilities to address the clinical problem of confidence in the diagnosis.

- We investigated whether combining MRI and cerebrospinal fluid (CSF) levels of NfL and 14-3-3 could improve the diagnosis confidence.



RESULTS

1. We obtained accuracies of 88% in the AD vs. CTR, 87% for FTD vs. CTR, 82% for AD vs. FTD, and 80% when differentiating the three groups. A total of 74% of FTD and 73% of AD participants have a high (≥0.8) probability of accurate diagnosis in the FTD vs. AD comparison **[Figure 1]**.

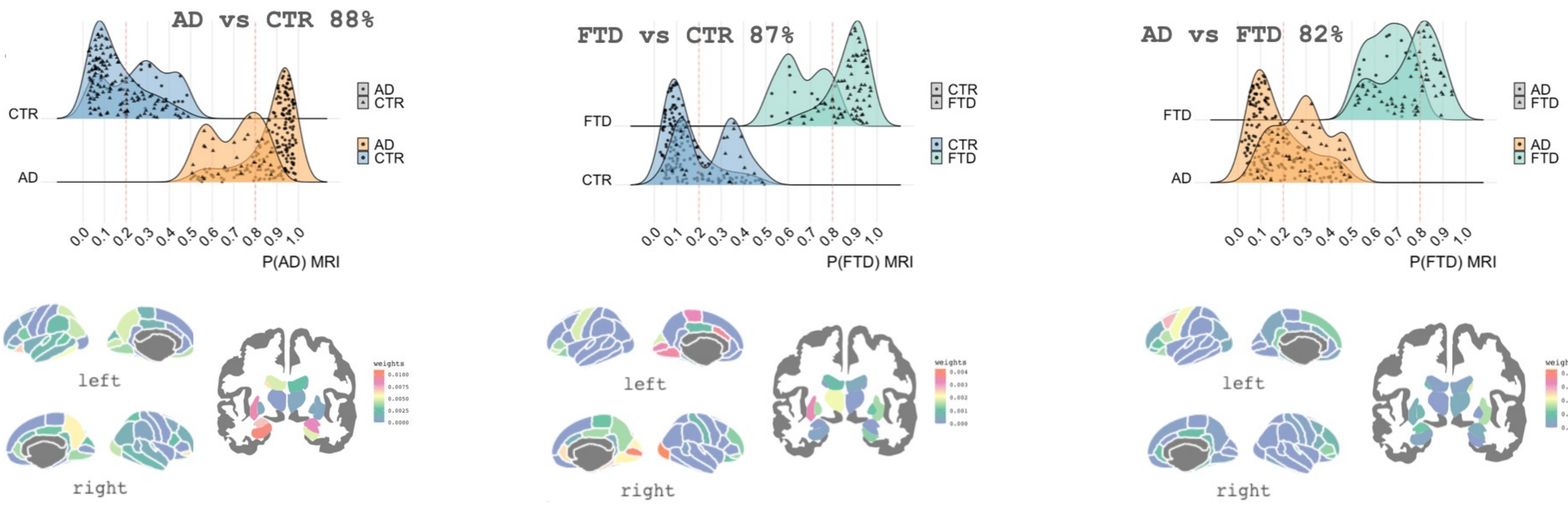


Figure 1. Top: Density plot to study the obtained individual probabilities with the MRI-based algorithm. **Bottom:** Cortical and subcortical patterns of the feature importance of each region associated with AD and FTD.

2. Adding CSF-NfL and 14-3-3 levels did not improve the accuracy or the number of patients in the high diagnosis confidence group **[Table 1 & Figure 2]**.

Table 1: Classification performance of the different approaches and the percentage of participants with a higher probability of 0.8 in the diagnosis grouped by diagnosis.

	AD vs CTR	FTD vs CTR	AD vs FTD
MRI all data (N=491)	Accuracy: 87.7% AD: 73.4% CTR: 64.5%	Accuracy: 86.9% FTD: 74.2% CTR: 73.3%	Accuracy: 81.8% AD: 73.3% FTD: 74.2%
MRI reduced data (N=178)	Accuracy: 88.5% AD: 67.2% CTR: 55.3%	Accuracy: 85.6% FTD: 68.1% CTR: 54.3%	Accuracy: 84.6% AD: 53.2% FTD: 54.4%
CSF data (N=178)	Accuracy: 93.0% AD: 72.1% CTR: 71.7%	Accuracy: 86.6% FTD: 72.1% CTR: 23.5%	Accuracy: 83.8% AD: 40.6% FTD: 45.9%
MRI and CSF data (N=178)	Accuracy: 90.3% AD: 68.1% CTR: 64.4%	Accuracy: 86.5% FTD: 70.8% CTR: 53.2%	Accuracy: 88.5% AD: 60.7% FTD: 55.1%

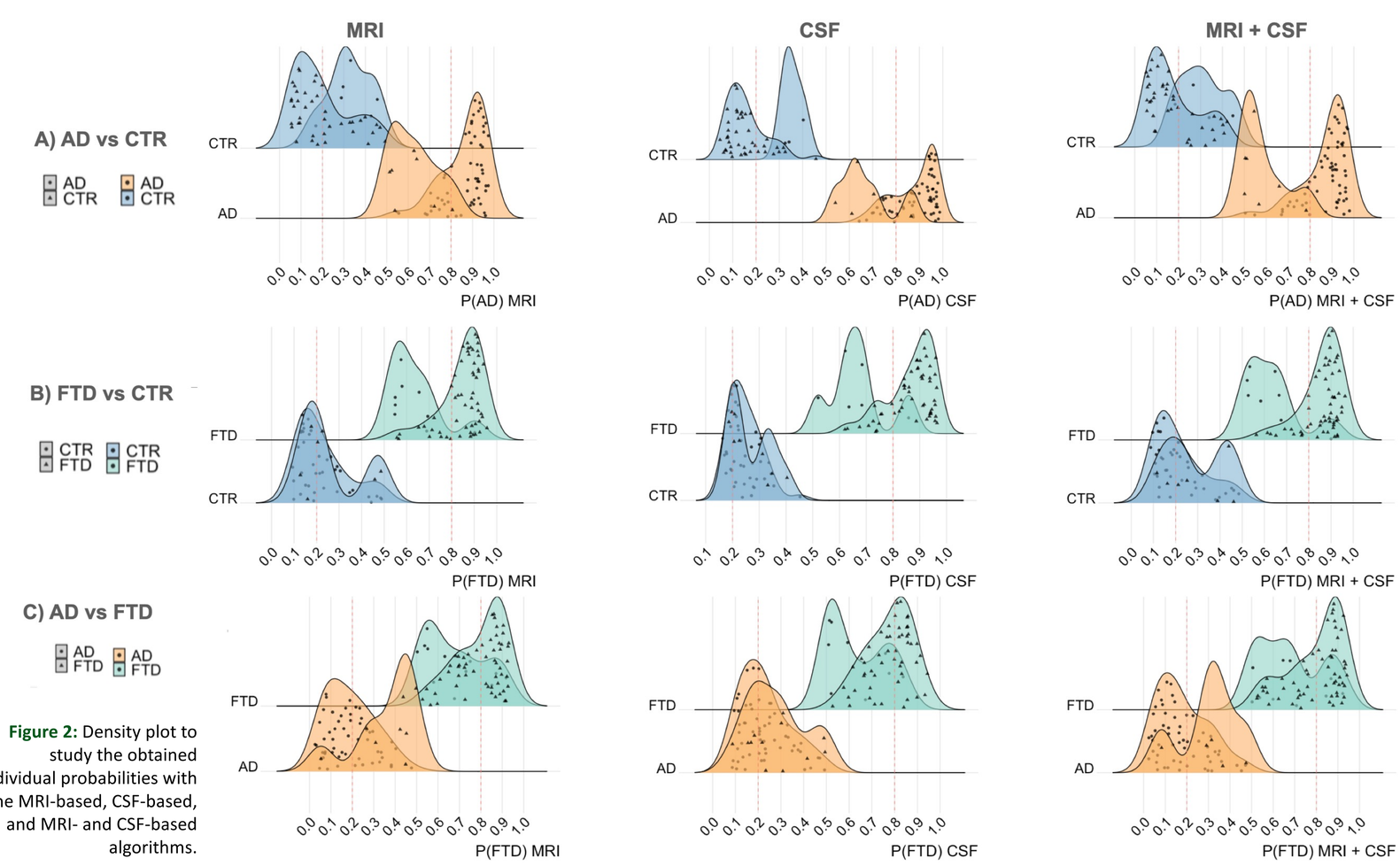


Figure 2: Density plot to study the obtained individual probabilities with the MRI-based, CSF-based, and MRI- and CSF-based algorithms.

CONCLUSIONS

Our ML approach provides individual probabilities and holds promise toward individual diagnoses, especially in doubtful cases as support to clinical findings or in settings with limited access to expert diagnoses.

Contact Information:
Agnès Pérez-Millan
agperez@recerca.clinic.cat
@agnesperezmi

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