

Predicting the diagnosis from speech : A Machine Learning Model for early identification of Alzheimer's or Frontotemporal pathophysiology

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Introduction

AD and FTLD share **overlapping presentations** yet require distinct therapeutic strategies.

Anti-amyloid therapies demand **accurate pathological stratification** at the earliest stage.

A single phenotype can **manifest differently** as amnesic, behavioural or language-led syndrome.

MRI, FDG-PET and CSF yield **discordant results** in 15–40% of cases, especially in PPA variants.

No scalable, non-invasive tool currently resolves this clinicopathological heterogeneity at onset.

Population

Study Objective

Can automated analysis of connected speech, acquired at first clinical visit, serve as a non-invasive digital biomarker for early etiological stratification of AD vs. FTLD, independently of clinical phenotype and anchored to biomarker-confirmed diagnoses?

Population recruitment (N=172)

Pathological Group : (N=108)

- ✓ Age 40 years and older
- ✓ Diagnosis of lvPPA or AD (Gorno-Tempini criteria, DSM-5)
- ✓ Fluent French-speaking

- ✗ Neurological disorders other than lvPPA or AD
- ✗ Medication or conditions affecting cognitive or sensory functions
- ✗ Refusal to undergo lumbar puncture

Control Group : (N=64)

- ✓ Age 40 years and older
- ✓ MMSE >27 score
- ✓ No cognitive complaint
- ✓ Fluent French-speaking

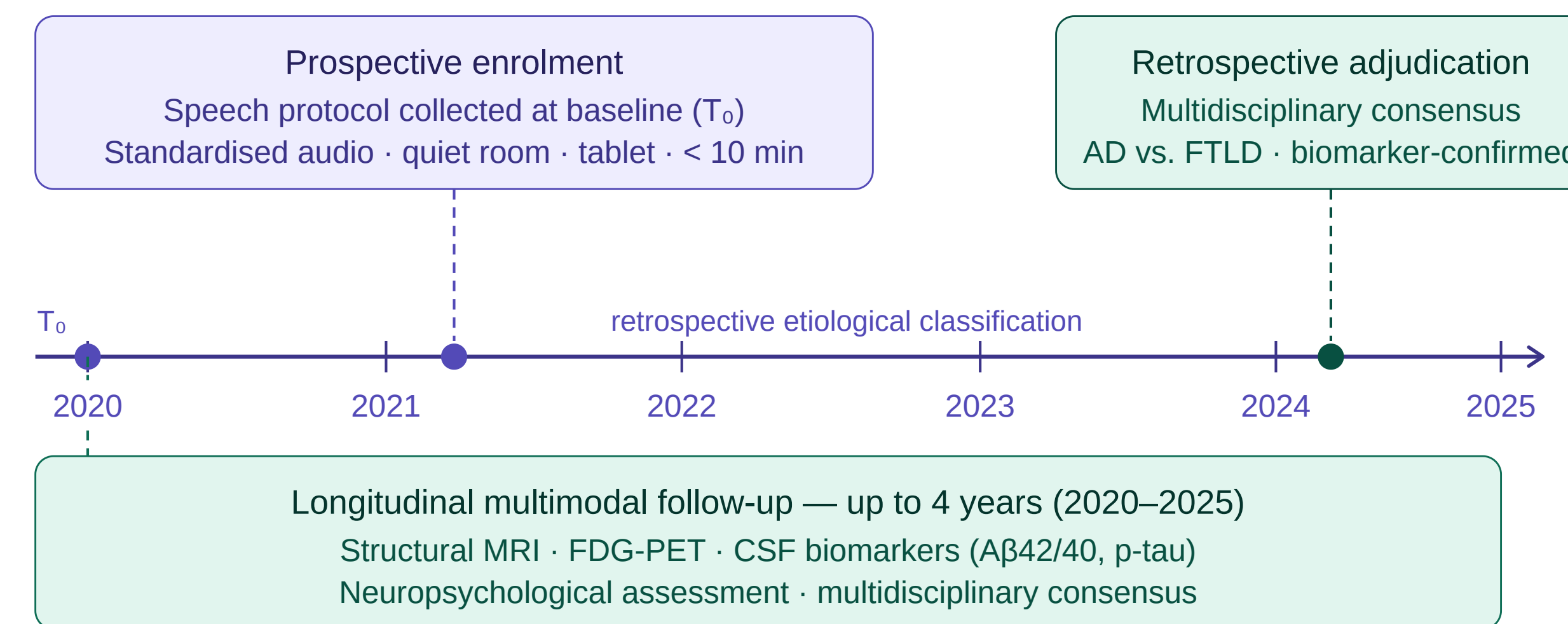
- ✗ Neurological disorders
- ✗ Positive psychiatric screening (ICOPE questionnaire)

Speech protocol

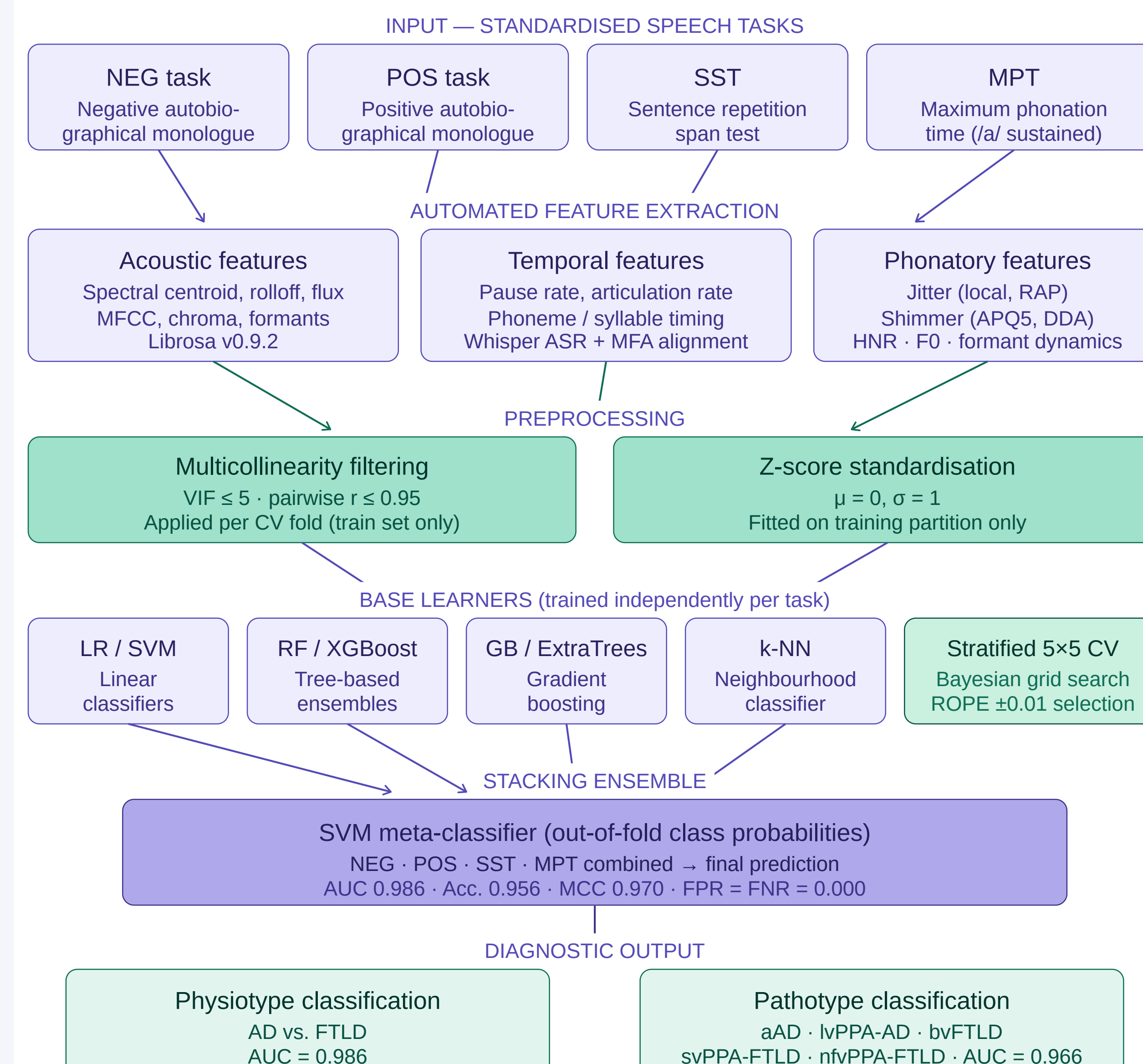
- 4 standardised tasks: NEG · POS · SST · MPT
- at first consultation
- < 10 min recordings on a consumer-grade tablet placed on a table in front of the patient

Methods

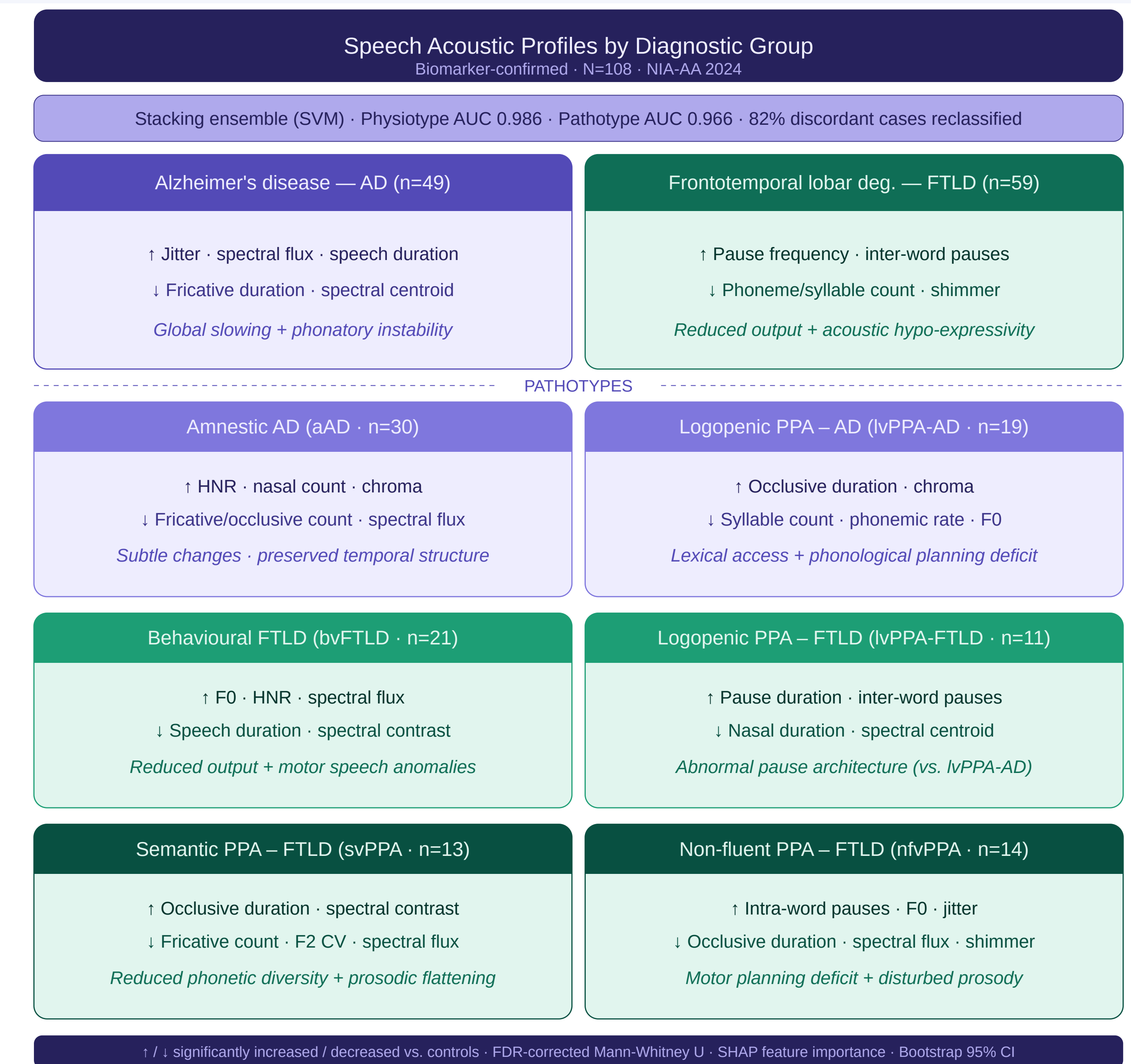
Data Collection Timeline



Speech-based Machine learning pipeline



Results



Conclusion

Automated speech analysis achieves physiotype AUC 0.986 and pathotype AUC 0.966, with **82% of clinicopathologically discordant cases correctly reclassified**

Distinct acoustic signatures identified per group:

AD → global slowing + phonatory instability

FTLD → reduced verbal output + acoustic flatness

Non-invasive, low-cost and scalable, speech appears as a **complementary digital biomarker** within existing diagnostic frameworks, pending external multicentre validation