

Clinical EEG Phase-Amplitude Coupling and Portable Frontal EEG Spectral Features as Potential Markers for Amyloid- β Pathology



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KEY MESSAGE

Two EEG-based approaches suggested complementary neurophysiological features associated with AD-related biomarker status.

Clinical EEG PAC and portable frontal EEG PSD features may support accessible prescreening before confirmatory PET or CSF testing.

CLINICAL PROBLEM

PET and CSF testing are established biomarker assessments, but community-wide screening remains challenging.

Cost, invasiveness, and limited availability motivate noninvasive prescreening approaches in the disease-modifying therapy era.

POSTER STRUCTURE

Left: clinical EEG + PET · Right: portable EEG + CSF

Related biomarker questions are examined through two retrospective cohorts and complementary EEG feature spaces.

COHORT 1 · CLINICAL EEG + AMYLOID PET

Resting-state theta–high-gamma PAC in MCI Published study: Miyazaki et al., International Psychogeriatrics, 2025

Question

Can cross-frequency coupling from routine clinical EEG help classify amyloid PET-positive versus PET-negative MCI?

Design and feature extraction

PARTICIPANTS MCI, n=61 PET+ 28 / PET- 33 Mean age 72.9 y; mean MMSE 24.7

RECORDING 19-channel scalp EEG, 10–20 system, resting eyes closed

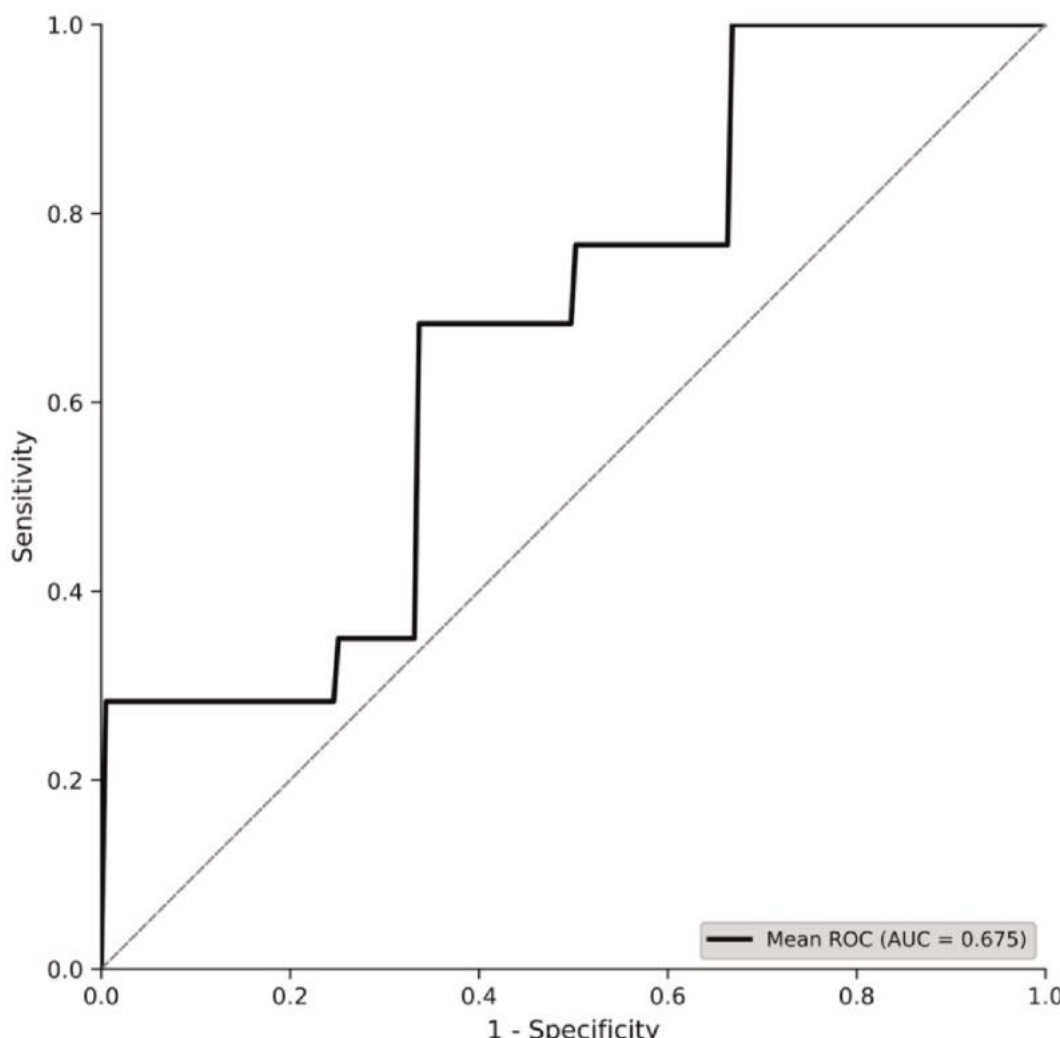
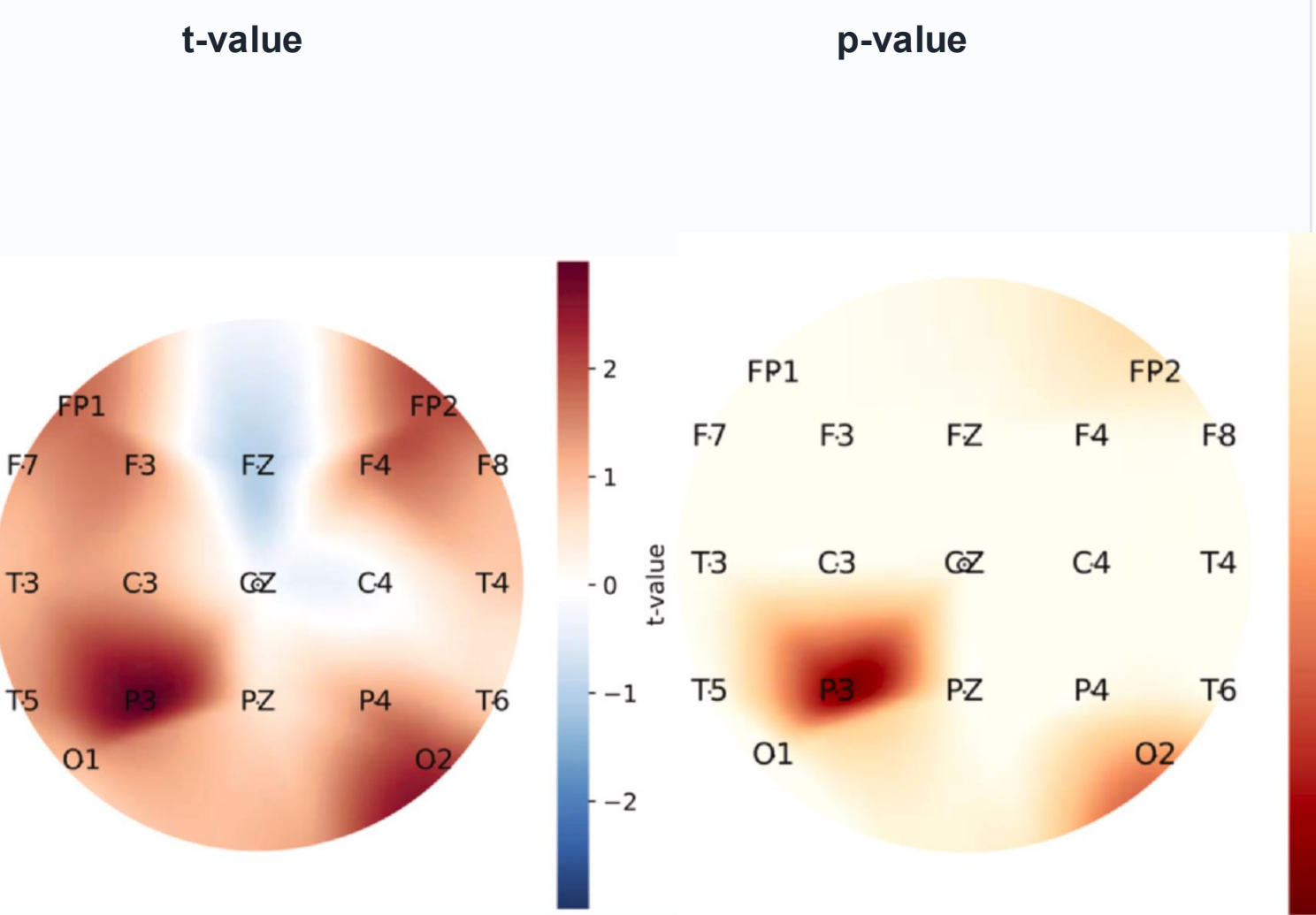
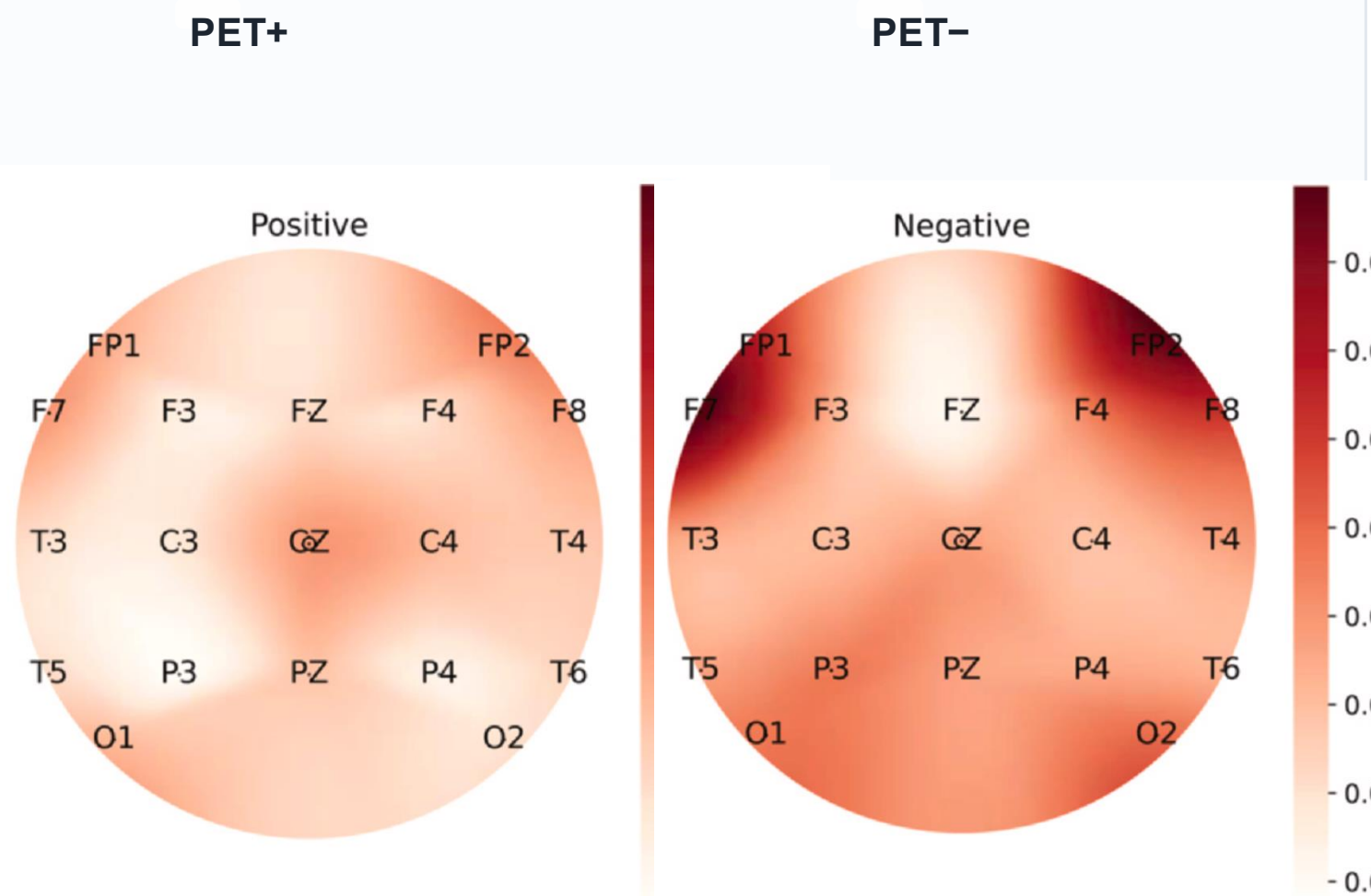
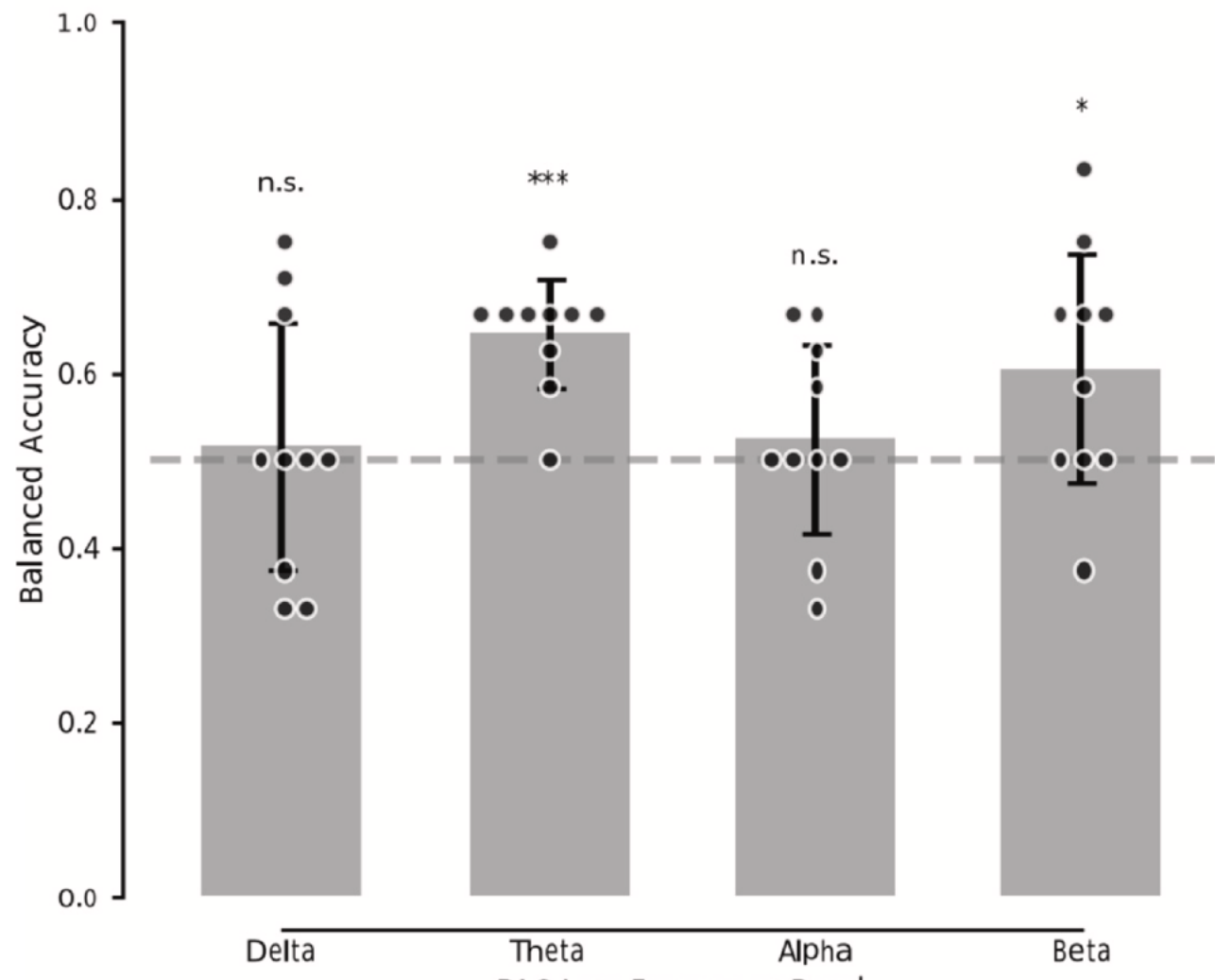
FEATURES Sync index: low-frequency phase $\times$ high-gamma amplitude (70–100 Hz)

BIOMARKER OUTCOME florbetapir amyloid PET

CLASSIFIER Naïve Bayes; stratified 10-fold CV

Main result

Theta–high-gamma PAC was lower in PET-positive participants, with notable group differences at P3, O2, and FP2.



64.6%

Balanced accuracy

0.675

AUROC

Take-home from Cohort 1

- Theta–high-gamma PAC was the most informative PAC feature for amyloid PET classification.
- These findings suggest that routine clinical EEG PAC may capture neurophysiological correlates of amyloid PET status in MCI.

COHORT 2 · PORTABLE FRONTAL EEG + CSF BIOMARKERS

2-minute patch-type EEG and machine learning Published study: Hata & Miyazaki et al., Scientific Reports, 2025

Question

Can brief frontal EEG recordings from a wearable patch-type device help classify CSF A β and phosphorylated tau status?

Design and feature extraction

PARTICIPANTS Cognitive evaluation, n=102 A β + 55 / A β - 47 p-tau+ 51 / p-tau- 51

RECORDING HARU-1 patch-type EEG; 3 frontal channels; 2-min eyes closed

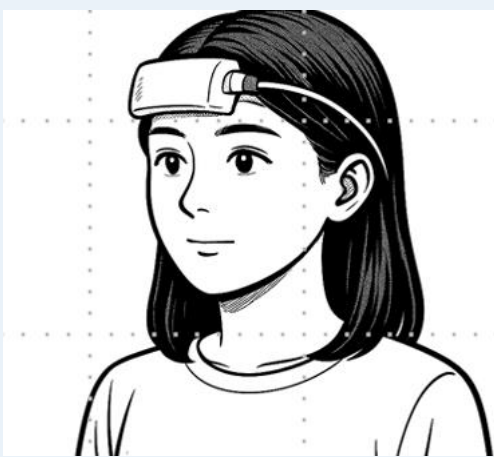
FEATURES PSD: theta, alpha, beta, gamma1, gamma2 $\times$ 3 ch = 15 features

BIOMARKER OUTCOME CSF A β _{1–42}/A β _{1–40} and p-tau181

CLASSIFIER Extra Trees Classifier; feature importance

Main result

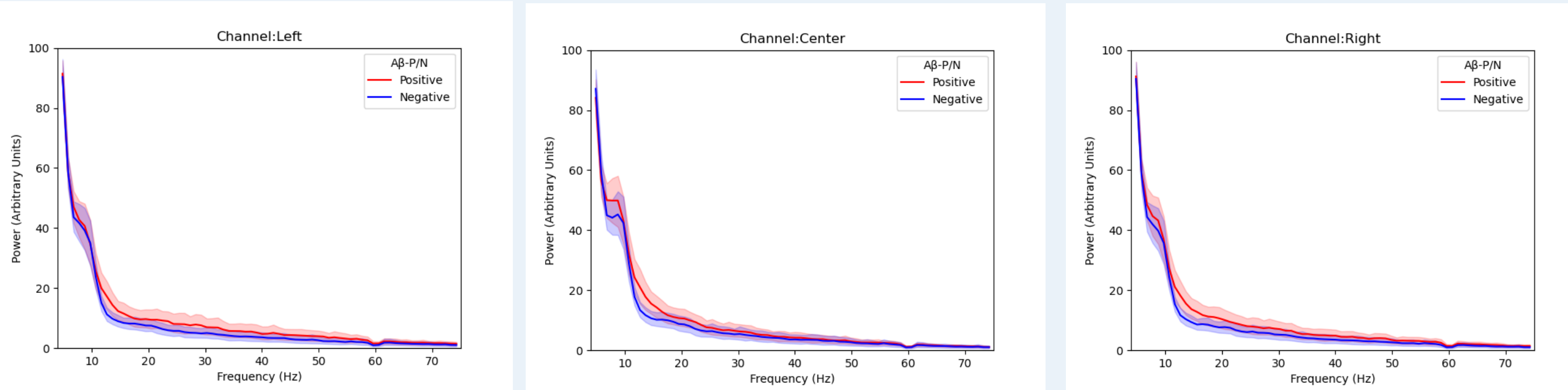
HARU-1 patch-type EEG; Japan-certified Class II EEG device; 3 frontal channels;



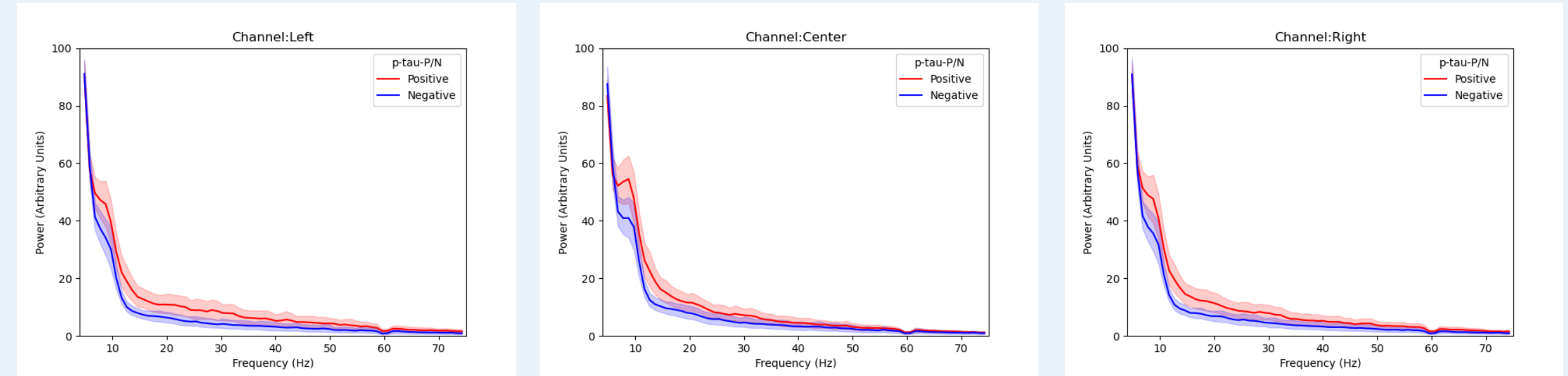
Schematic illustration of frontal patch-type EEG placement

2-min eyes-closed resting recording

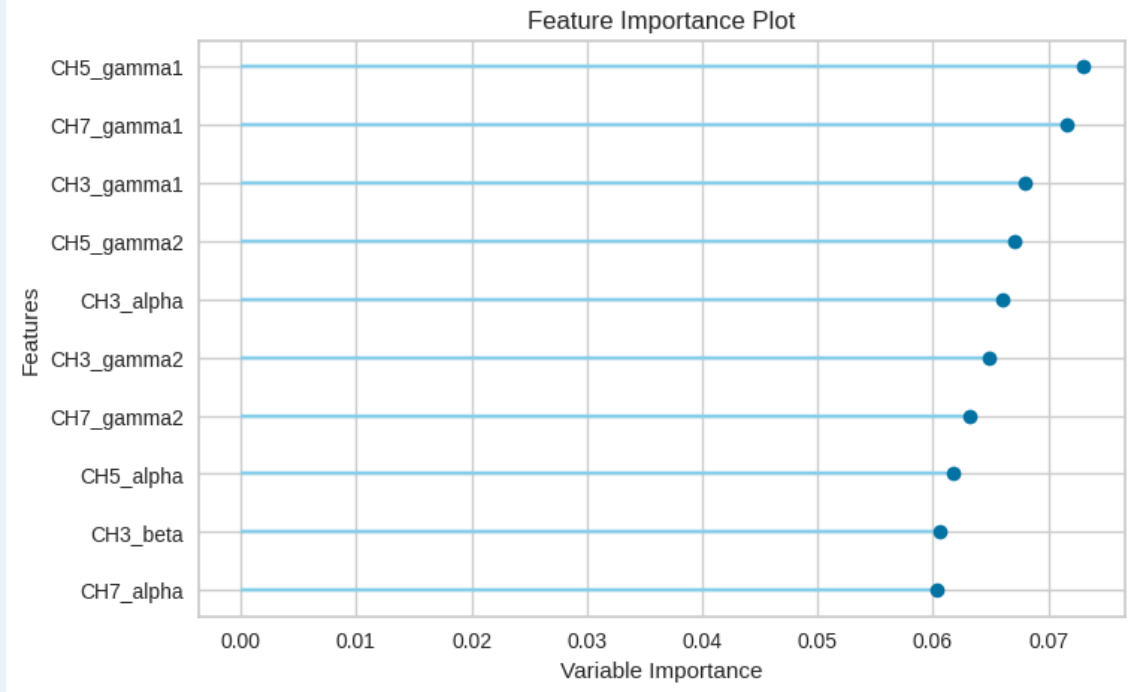
A β



p-tau



Gamma-band features were among the strongest contributors for both A β and p-tau classification.



0.75

A β AUROC : accuracy 68.1%

0.77

p-tau AUROC : accuracy 71.2%

Take-home from Cohort 2

- Short frontal EEG recordings provided useful PSD features for machine-learning classification of CSF A β and p-tau status.
- Gamma activity was repeatedly identified as a key predictive feature.

Conclusion

01 · Clinical EEG

Theta–high-gamma PAC from 19-channel EEG classified amyloid PET status in MCI with above-chance performance.

02 · Portable EEG

PSD features from a 2-minute frontal patch recording supported moderate classification of CSF A β and p-tau status, with gamma features central to classification.

03 · Implication

EEG-based neurophysiological features may support scalable prescreening strategies before confirmatory PET or CSF testing.

SOURCE STUDIES / DISCLOSURES

- Miyazaki Y, Hata M, Takahashi S, et al. Inferring amyloid pathologies among patients with mild cognitive impairment using phase–amplitude coupling of electroencephalography. *International Psychogeriatrics*. 2025. doi:10.1016/j.inpsyc.2025.100132.
- Hata M*, Miyazaki Y*, Mori K, et al. Screening of A β and phosphorylated tau status in the cerebrospinal fluid through machine learning analysis of portable electroencephalography data. *Scientific Reports*. 2025;15:2067. doi:10.1038/s41598-025-86449-2.

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Disclosures: no conflicts of interest declared in the source manuscripts. Contact: miyazaki@psy.med.osaka-u.ac.jp