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# Neural Speed of visual information processing is delayed in Early Stages of Alzheimer's Disease



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## Introduction

- The process of neurodegeneration in Alzheimer's disease (AD) is irreversible using current therapeutics.
- An earlier diagnosis of the disease can lead to earlier interventions, which will help patients sustain their cognitive abilities for longer.
- To understand brain temporal dynamics in early stages of the disease, we used a task-based electroencephalography (EEG) experiment.
- Participants performed the Integrated Cognitive Assessment (ICA) test during EEG data acquisition.

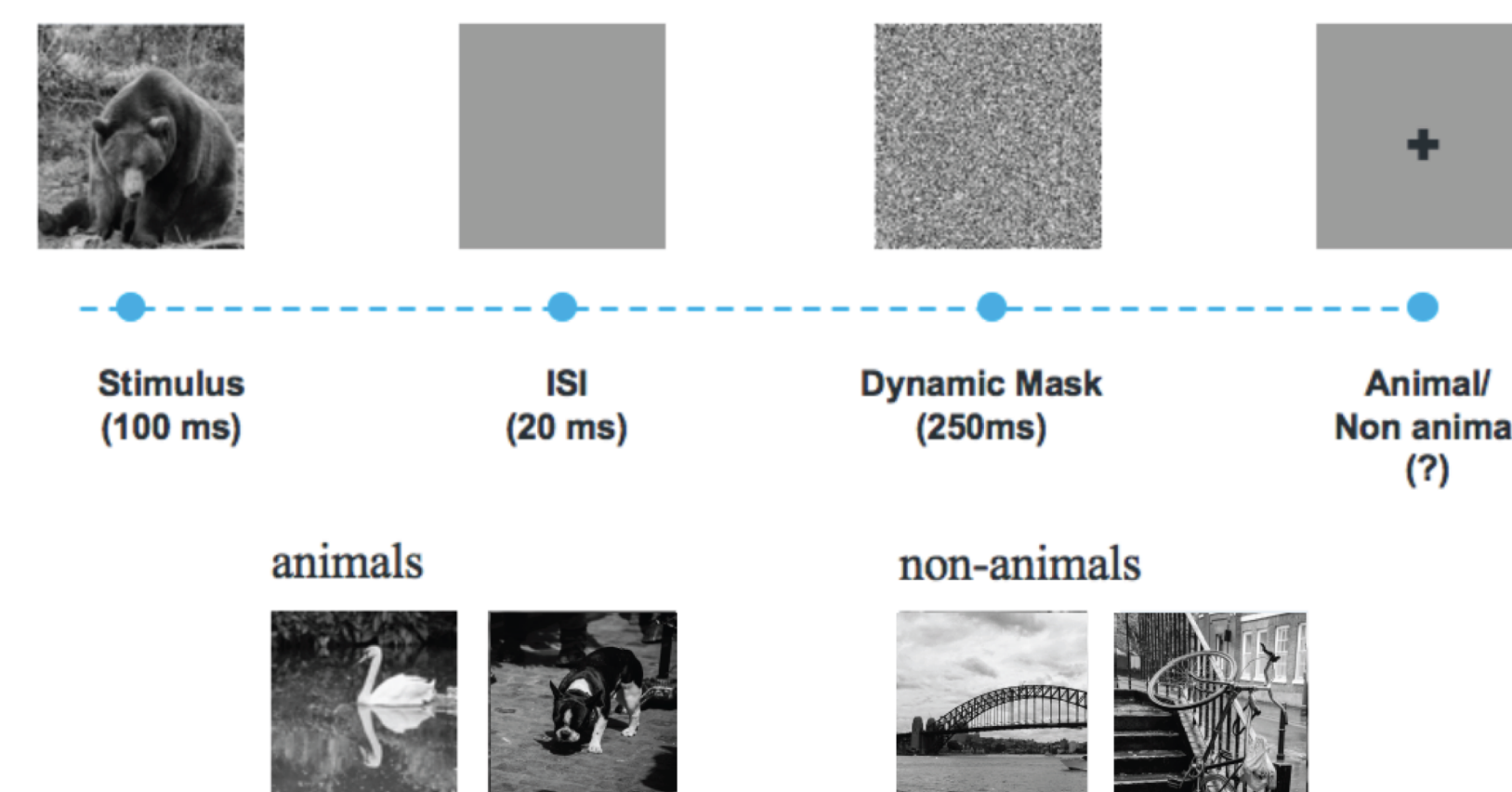
## Participants

Characteristic	HC (n = 18)	MCI (n = 14)	p-value
Age –mean years ±SD	63.63 ±6.93	65.06 ±5.38	0.51
Education in years –mean ± SD	14.63 ±4.47	14.06 ±5.10	0.52
Gender (%female)	12 (63%)	10 (66%)	0.83

- All subjects took Montreal Cognitive Assessment (MoCA) and Addenbrooke's Cognitive Examination (ACE-R) before EEG.

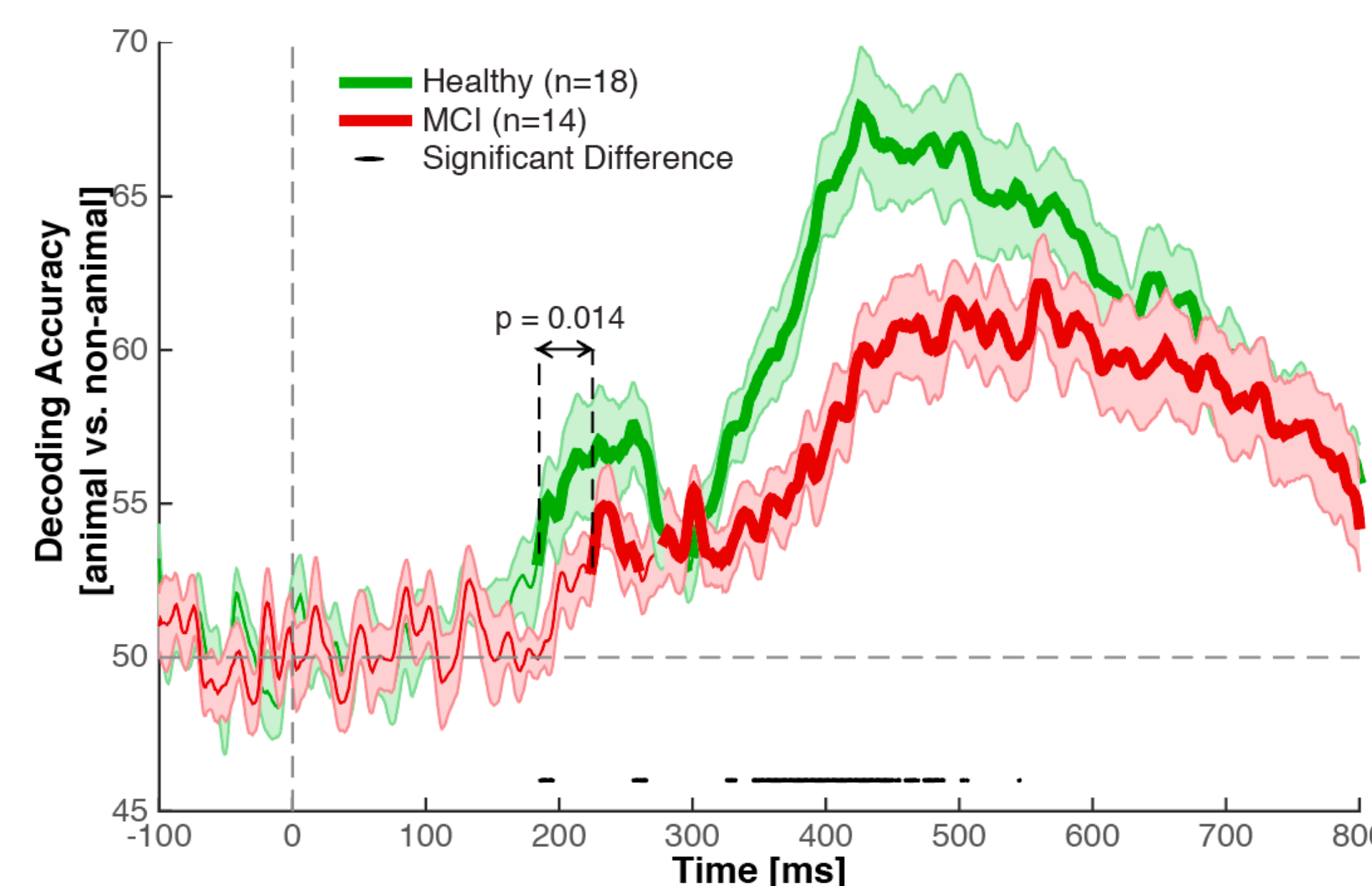
## EEG Experiment

- 64 channel EEG (g.tec).
- Task: ICA task is a rapid visual categorization. We presented 32 images (16 animal and 16 non-animal).
- There were 13 runs of the same task.

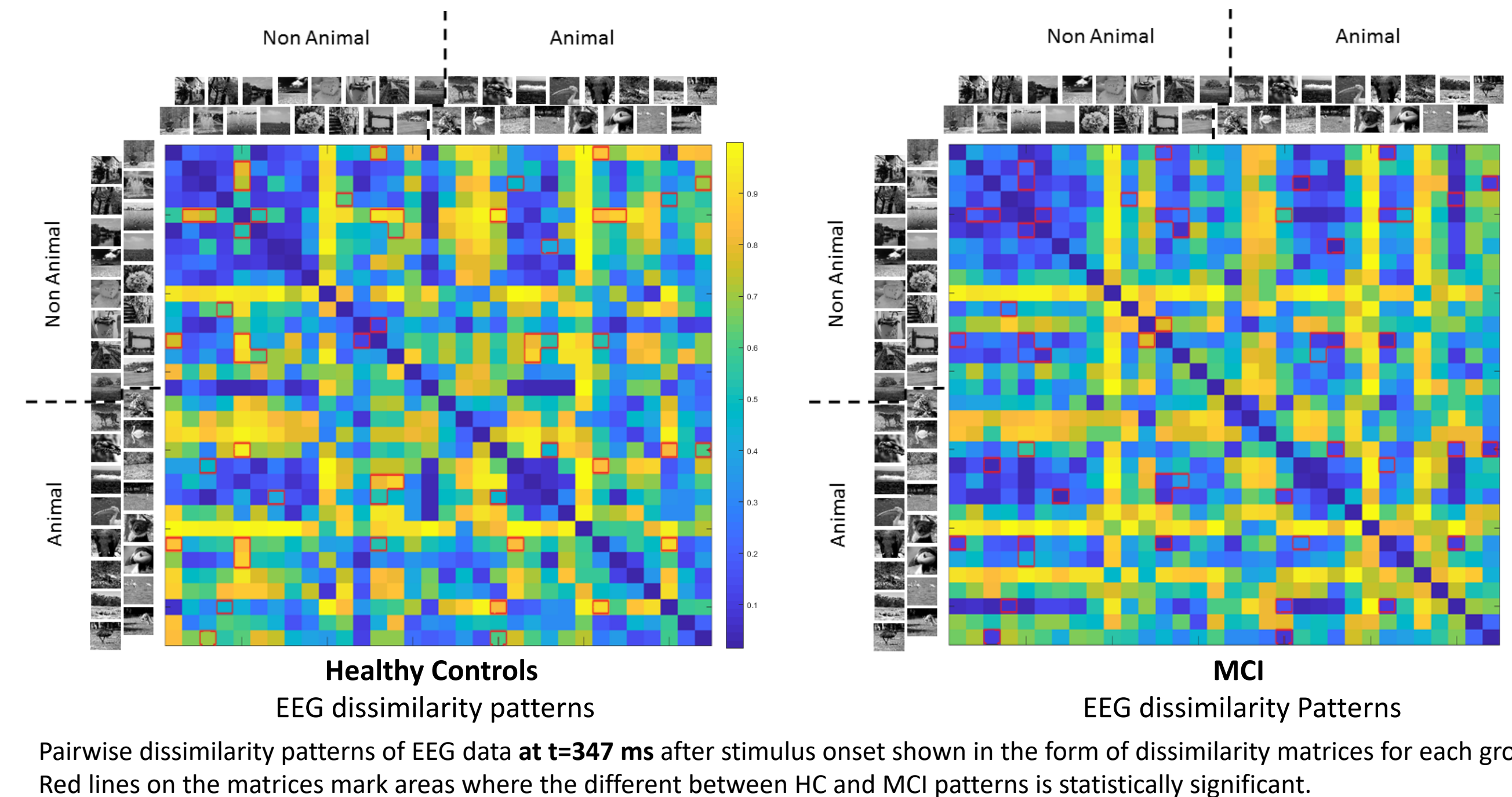


## Animal vs. Non-animal Brain Decoding

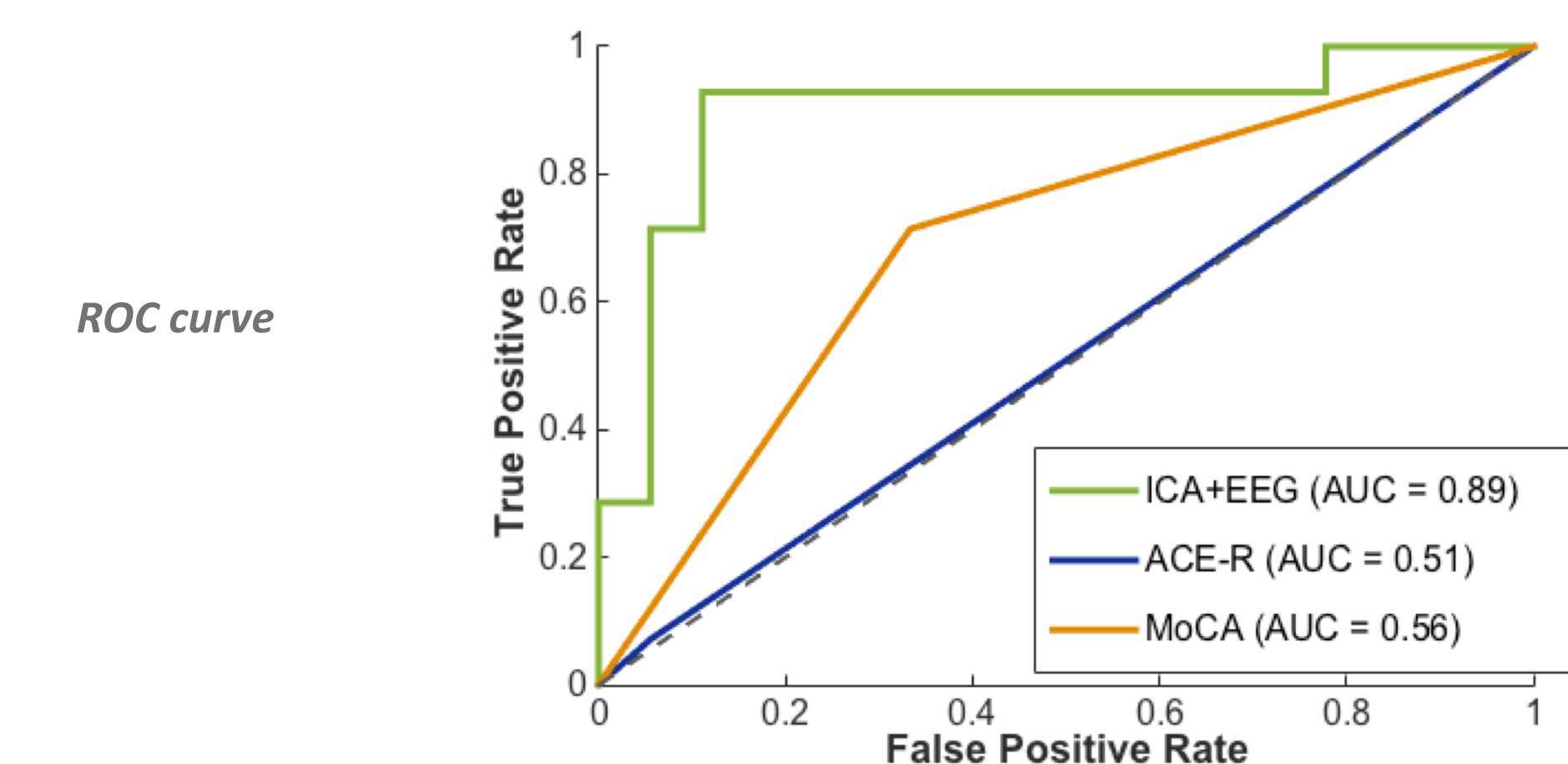
- The EEG data from 100 ms before to 800 ms after the stimulus onset are extracted.
- A SVM classifier is trained and tested at each time point, by cross-validation, to readout brain information available for decoding animacy.



## MCI and HC participants demonstrate different brain representations of animacy



## Accuracy of EEG+ICA in detecting mild cognitive impairment



## Conclusions

- EEG responses to natural images exhibited different patterns of brain representations for healthy-control subjects compared to cognitively impaired patients.
- People with mild cognitive impairment showed a significant delay in speed and accuracy of processing animacy information compared to healthy controls.
- In a head to head comparison with MoCA and ACE, EEG-based ICA test could detect mild cognitive impairments substantially better.

## References

- [1] Khaligh-Razavi, S. M., Habibi, S., Sadeghi, M., Marefat, H., Khanbagi, M., Nabavi, S. M., ... & Kalafatis, C. (2019). Integrated Cognitive Assessment: speed and Accuracy of Visual processing as a Reliable proxy to Cognitive performance. *Scientific reports*, 9(1), 1102.
- [2] Khaligh-Razavi, S. M., Sadeghi, M., Khanbagi, M., Kalafatis, C., & Nabavi, S. M. (2019). A self-administered, artificial intelligence (AI) platform for cognitive assessment in multiple sclerosis (MS). *BioRxiv*, 611335.