ADPIE: Deep phenotyping of people with AD using portable integrated equipment

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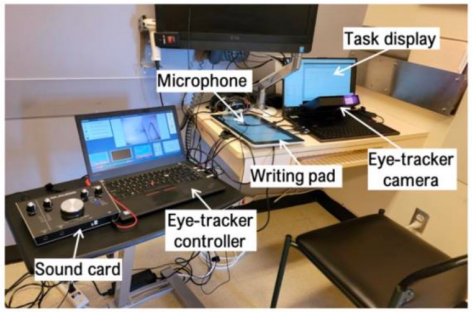
Motivation

- Phenotyping Alzheimer's Disease (AD) and other Neurological Disorders (NDs) can be crucial to providing personalized treatment.
- Most digital biomarker studies focus on a single modality.
- Multimodal biomarkers are not deeply studied.
- Most studies use high-precision equipment (HPE) to obtain digital biomarkers.
- We need to analyze if more usable Portable Integrated Equipment (PIE) can provide good precision.

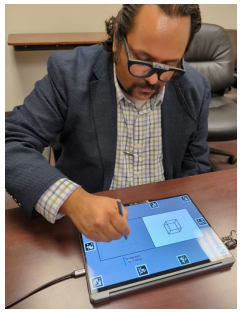
Goals

- To obtain new digital multimodal biomarkers using HPE and PIE from:
  - Extraocular Movement (EOM)
  - Voice and Speech (V&S)
  - Handwriting (HW)
- To evaluate the precision and AUC of biomarkers to distinguish AD from several control groups.

Pilot Project Highlights



High Precision Equipment (HPE)



Portable Integrated Equipment (PIE)

Fig. 1. HPE vs PIE used in this study.

Materials and methods

- Participants are recorded **performing neuropsychological tests**, including verbal fluency, word recall, video description, history recall, pro- and anti-saccades, smooth pursuit, memory guided saccades, cube and clock drawing, sentence writing, etc.
- **More than 60 participants** have been recorded so far, including people with **AD**, Parkinson's Disease (**PD**) , and cognitively normal controls.
- Uni-modal and multimodal metrics (>100) are obtained using signal processing and machine learning.

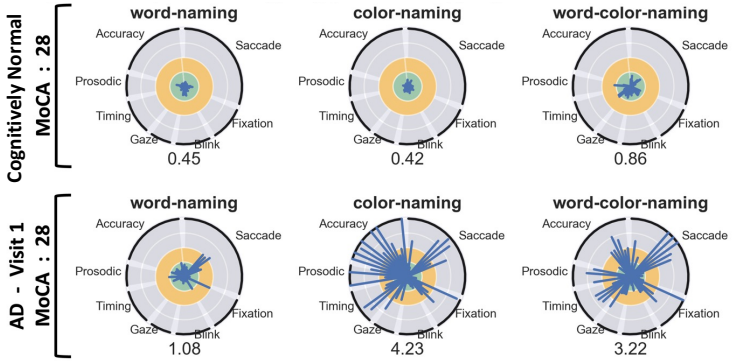


Fig. 2. *Sign profiles* obtained for two participants performing the *Stroop Test*. Each blue line represents a metric. Lines inside the green area are within the control range.

Some results

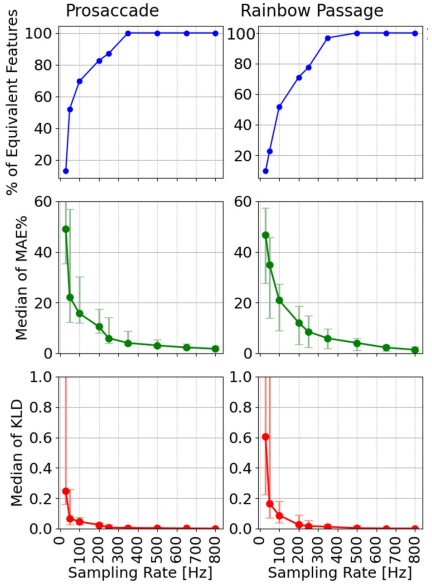


Fig. 3. Percentage of equivalent features, mean of MAE%, and mean of Kullback-Leibler Divergence (KLD) between metrics obtained with HPE vs PIE across all subjects for EOM.

Conclusions

- Multimodal and unimodal metrics can provide deep characterization of AD, in comparison to traditional neuropsychological tests.
- PIE can provide similar precision for all V&S and HW metrics and for most EOM metrics.

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