Cognitive Assessment Estimation from Behavioral Responses in Emotional Faces Evaluation Task
— AI Regression Approach for Dementia Onset Prediction in Aging Societies —

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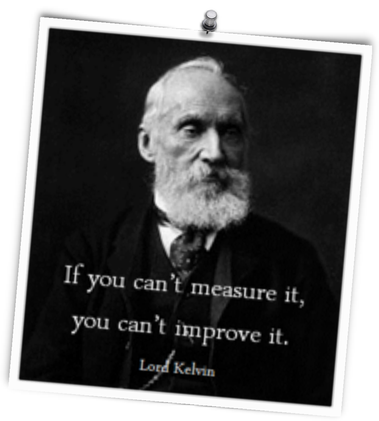
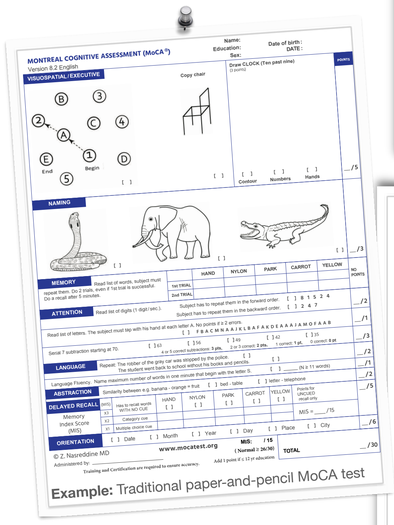
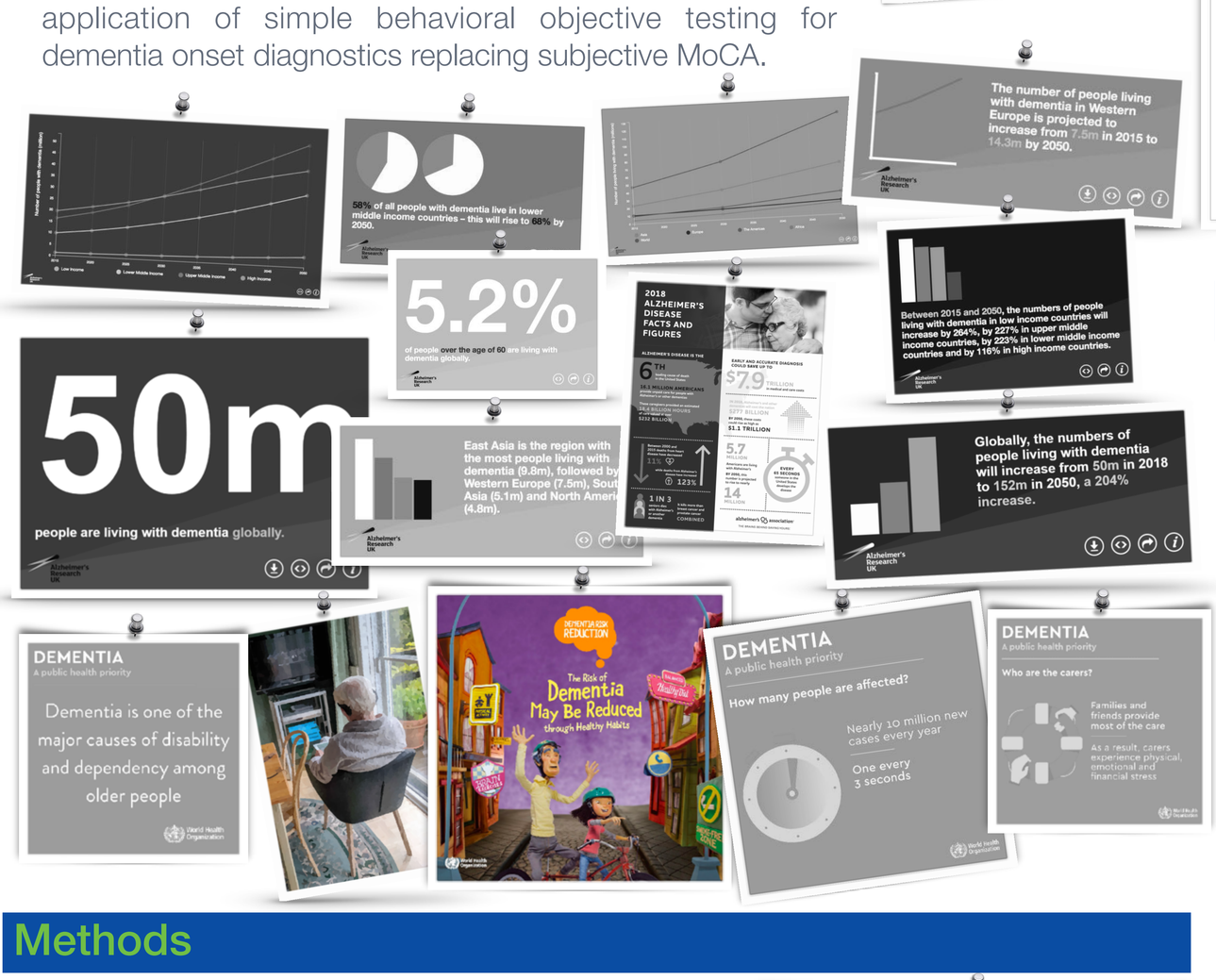
Introduction

- Dementia, especially the age-related memory decline, is one of the most significant global challenges in the 21st century's mental well-being and social welfare.
- Worldwide, the increased longevity and mainly for elderly adults of above 65 years old, dementia numbers, and costs are rising.
- The Cabinet Office in Japan announces annual reports on an aging society to address the difficulty. United Nations Sustainable Development Goal #3 entitled “Good Health and Well-being” also stresses a necessity to address the aging problem with a focus on healthy lives, and it promotes well-being for all at all ages.
- We present a behavioral data collection concept for a subsequent AI-based application together with a range of regression encouraging results of Montreal Cognitive Assessment (MoCA) scores in the leave-one-subject-out cross-validation setup.
- The regressor input variables include experimental subject's emotional valence and arousal recognition responses, as well as reaction times, together with self-reported education levels and ages, obtained from a group of twenty older adults taking part in the reported data collection project.
- The presented results showcase the potential social benefits of artificial intelligence application for elderly and establish a step forward to develop ML approaches, for the subsequent application of simple behavioral objective testing for dementia onset diagnostics replacing subjective MoCA.







Methods

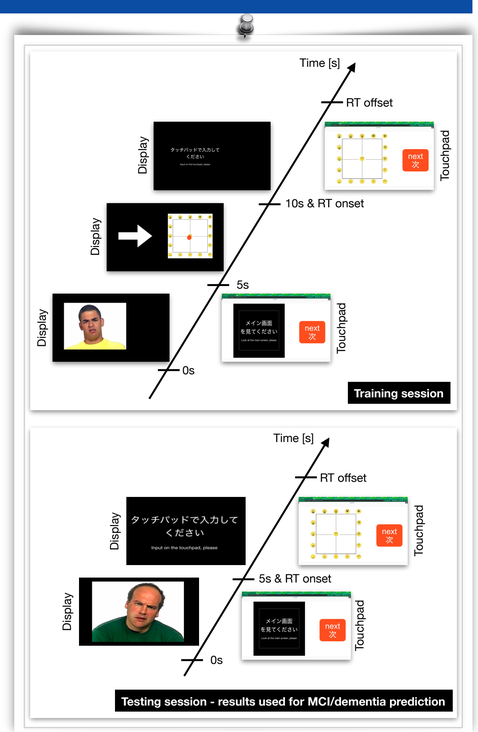
We conducted experiments with human subjects with guidelines and approval of the RIKEN Ethical Committee for Experiments with Human Subjects in the Center for Advanced Intelligence Project (AIP). In the experimental session, twenty elder participants (number of females = 11; mean age = 76.5 years old; age STD = 4.95).

Each subject experiment consisted of 72 video presentation trials (5~7 seconds each) with 24 different emotion categories.

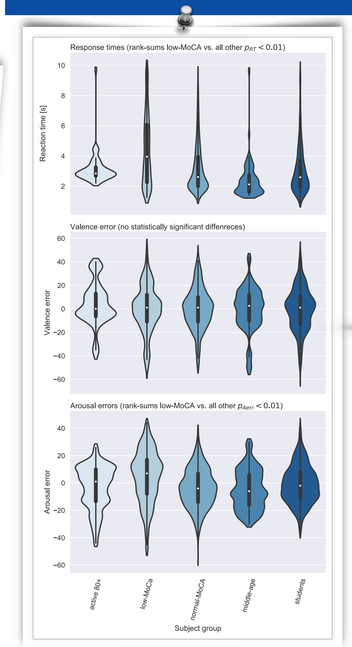
During the data recording experiments valence and arousal responses, as well as the reaction times were recorded.

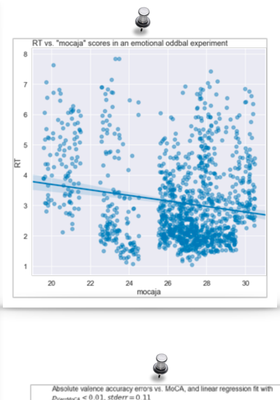
We tested regressors for continues prediction of MoCA values characterizing cognition stages of the 20 participants in our study using input features:

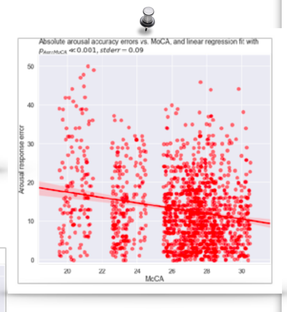
$$\mathbf{F}_{i,s} = [v_e(i,s), a_e(i,s), r_t(i,s), e(s), g(s)]$$

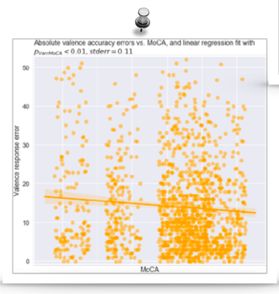


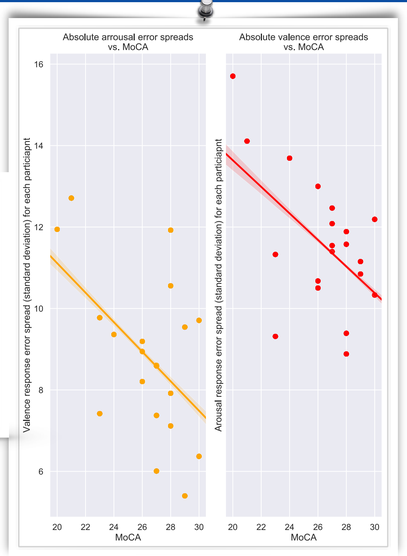
Results

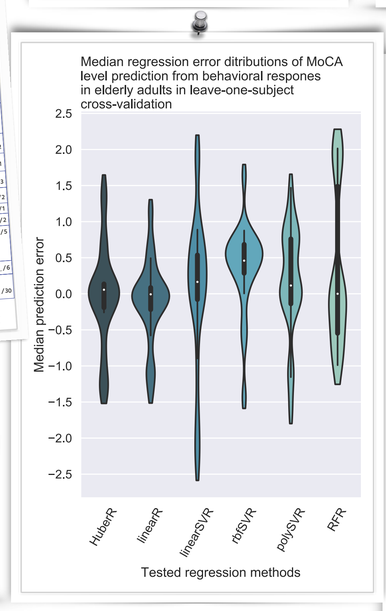


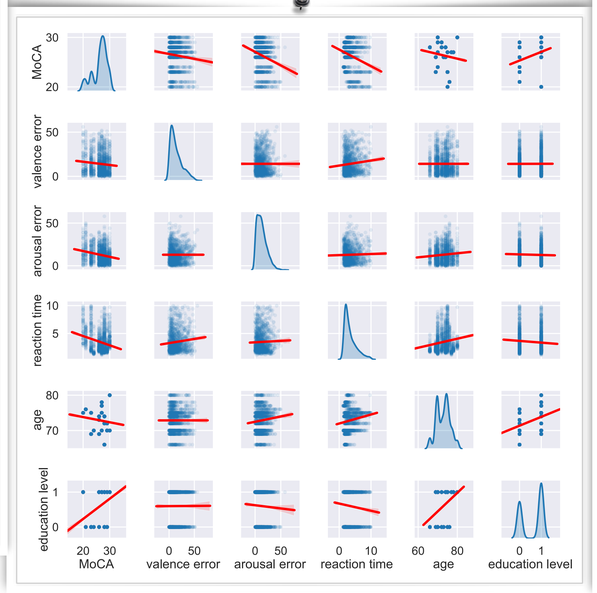


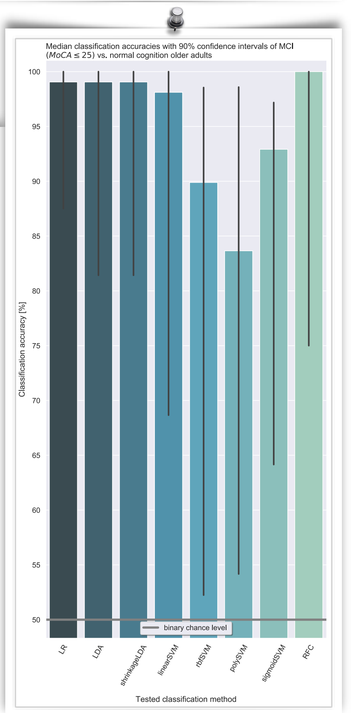












Conclusions

- The study resulted in MoCA pathology prediction from behavioral responses in the spatial- and implicit- working-memory task of emotional valence and arousal levels estimation together with reaction times in simple video clips watching task.
- In the study involving older adults with known MoCA scores, we were able to evaluate several shallow learning regressors.
- The regression-based prediction of MoCA scores (usually MoCA 25 has been considered as mild cognitive impairment (MCI) stage already, while above this threshold an elderly adult cognition has been evaluated as standard) in the simple emotional faces evaluation task resulted in robust and small errors.
- The successful application of such AI/ML-based dementia onset prediction shall lead to a healthcare cost lowering benefiting the aging societies.
- We also acknowledge the potential limitations of the current approach as we only infer human-error-prone MoCA scores, which are only proxy estimators of dementia.
- AI-based dementia estimators, if used without proper evaluation, might also pose a danger of misuse or abuse; thus, proper ethical standards will need to be in place too.
- In the next step of our research project, we plan to evaluate the developed methods with a larger sample of ordinary versus SCI/MCI, or even dementia diagnosed members of the society.

References

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