Machine Learning - Based Brain Age Prediction Model Employing QEEG Features

Hye Rin Jeong[1], Ukeob Park[1], Seung Wan Kang[1,2]

1. iMediSync Inc., Seoul, Korea
2. National Standard Reference Data Center for Korean EEG, Seoul National University College of Nursing, Seoul, Korea

Introduction

● There has been a variety of research to predict the possibility of developmental disorder for children and adolescents, which includes Attention Deficit Hyperactivity Disorder(ADHD) which is commonly found in such age group.

● This study further extends and investigates the significance of the QEEG features for brain age prediction.

● Prediction models targeting normal state children and adolescents ages 4-19, adopting machine learning algorithms were developed in order to provide information about the region, and frequency bands which show clear differences with that of patients suffering from the developmental disability.

Methods

● Dataset : 19 channel EEG data from 618 healthy state children and adolescents (302 males, 316 females) who were selected by birth history, developmental history, Child Behavior CheckList(CBCL) and cognitive test.

● Brain age of the subjects was defined as their biological age.

● EEG data were, measured in resting state with eyes closed and pred-processed by bad epoch rejection and ICA method using iSyncBrain®.

● We differentiated male and female group, for 4 different brain regions: Left anterioir; right anterior; left posterior; right posterior.

● In order to achieve clinical interpretability, a minimum number of features were selected by implementing a tree-based feature selection algorithm.

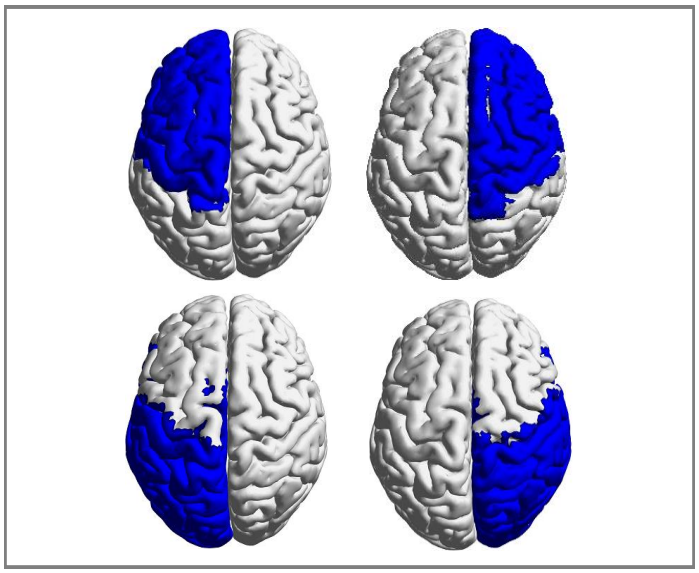

Fig. 1. 4 different brain regions; Left anterior; right anterior; left posterior; right posterior.

Results

● A prediction model for each region was selected based on the following cross validtion scores.
● Except for the prediction model corresponding to the right anterior of female, randomforset regressor was selected for all.

Sex	Region	CV Score(r^2)	Test Scores(r^2)
Male	Left anterior	0.893	0.898
	Right anterior	0.882	0.907
	Left posterior	0.873	0.842
	Right posterior	0.896	0.865
Female	Left anterior	0.90	0.877
	Right anterior	0.887	0.88
	Left posterior	0.869	0.869
	Right posterior	0.882	0.878

Table. 1. Cross-validation and testing results of eight different regression models for each sex and brain region.

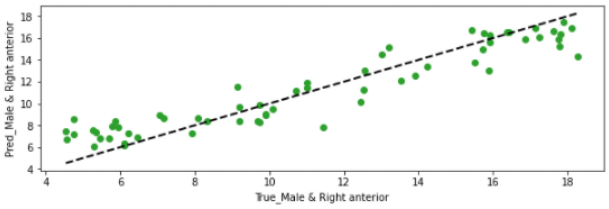

Fig. 2. One of the true vs. predicted scatterplots of prediction models using Male & Right Anterior testing dataset.

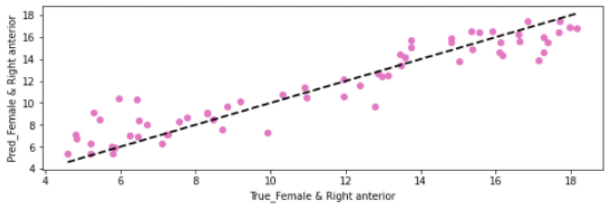

Fig. 3. One of the true vs. predicted scatterplots of prediction models using Female & Right Anterior testing dataset.

Conclusions

● Prove that machine-learning algorithm with carefully selected EEG features could predict very well the real brain age.

● These algorithms can be used to compare estimated brain age and biological brain age, and be used to be indicators for developmental disabilities in growing children and adolescent.

● In subsequent study, it will be necessary to get more test datset, which are labeled as developmental disorders, to reveal that these predict models are also clinically valid.

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