

# A Machine Learning Approach Using EEG Data to Predict Response to SSRI Treatment for Major Depressive Disorder

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## Abstract

*Objective:* The problem of identifying, in advance, the most effective treatment agent for various psychiatric conditions remains an elusive goal. To address this challenge, we investigate the performance of the proposed machine learning (ML) methodology (based on the pre-treatment electroencephalogram (EEG)) for prediction of response to treatment with a selective serotonin reuptake inhibitor (SSRI) medication in subjects suffering from major depressive disorder (MDD).

*Methods:* A relatively small number of most discriminating features are selected from a large group of candidate features extracted from the subject's pre-treatment EEG, using a machine learning procedure for feature selection. The selected features are fed into a classifier, which was realized as a mixture of factor analysis (MFA) model, whose output is the predicted response in the form of a likelihood value. This likelihood indicates the extent to which the subject belongs to the responder vs. non-responder classes. The overall method was evaluated using a "leave-*n*-out" randomized permutation cross-validation procedure.

*Results:* A list of discriminating EEG biomarkers (features) was found. The specificity of the proposed method is 80.9% while sensitivity is 94.9%, for an overall prediction accuracy of 87.9%. There is a 98.76% confidence that the estimated prediction rate is within the interval [75%, 100%].

*Conclusions:* These results indicate that the proposed ML method holds considerable promise in predicting the efficacy of SSRI antidepressant therapy for MDD, based on a simple and cost-effective pre-treatment EEG.

*Significance:* The proposed approach offers the potential to improve the treatment of major depression and to reduce health care costs.

*Keywords:* Prediction, Machine Learning, Mood Disorders, Major Depressive Disorder, EEG, Antidepressants, Personalized Medicine, Biomarkers.

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