Post-Traumatic Stress Disorder (PTSD) Biomarker Identification Using Integrative Network Fusion and Deep Learning With Bayesian Hyperparameter Optimization

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PTSD is a neuropsychological disorder resulting from a traumatizing event. Given biases associated with self-assessment and diagnosis of PTSD, researchers are actively searching for unbiased biological markers (biomarkers) for predicting PTSD. The Systems Biology of PTSD Consortium has collected molecular and clinical measurements of male veterans, and PTSD positive and negative subjects were separated based on DSM-IV Clinician Administered PTSD Scale (CAPS) scores, derived from structured interviews to measure an individual's abundance of symptoms. Deep learning models were created to classify PTSD positive and negative individuals using metabolomics, miRNA, protein expression, endocrine markers, and DNA methylation datasets. Model training involved the Bayesian Hyperparameter Optimization algorithm with 5-fold cross-validation. Each model was calibrated based on cross-validation performance and variance across iterations and then fit to the entire respective dataset. The trained models were applied to an independent validation cohort to assess accuracy on unseen datasets. The top performing datasets from the validation cohort based on classification accuracy were metabolomics (65%) and protein expression (62%). Additionally, the Integrative Network Fusion (INF) algorithm was used, which integrates a combination of multiple omics datasets to determine the most influential biomarkers. The INF model was trained using 5-fold cross-validation on the original cohort and tested it on the validation cohort. The highest performing combination consisted of miRNA, DNA methylation, protein expression, endocrine, and metabolomics datasets and classified subjects at 76% accuracy. It is anticipated that candidate biomarkers identified will assist with the diagnosis of PTSD.

Awards Won:
Air Force Research Laboratory on behalf of the United States Air Force: Glass trophy and USAF medal for each recipient
Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Regeneron ISEF Category