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Predicting autism diagnosis through intellectual ability. A machine-learning model

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Introduction: Autism spectrum disorder (ASD) is a pervasive neurodevelopmental condition characterized by social, communication, and sensorimotor difficulties. Traditional diagnostic procedures such as ADOS-2 are effective but time-consuming, costly, and reliant on highly trained professionals. Machine learning (ML) offers opportunities for more efficient and objective approaches. Intellectual functioning has historically been linked to ASD, yet its diagnostic role remains unclear.
Objectives: This study aimed to evaluate whether cognitive profiles measured with the Stanford-Binet Intelligence Scales, Fifth Edition (SB-5), can predict ICD-10 ASD subtypes using ML models.
Methods: A total of 68 children with ASD (51 males, 17 females; age range 2–17 years, M = 8.9, SD = 3.8) completed the SB-5. ICD-10 classifications included F84.0 (n = 11), F84.1 (n = 21), and F84.5 (n = 36). A control group of non-ASD children referred for IQ testing was used for comparison. Eight ML algorithms were tested: k-nearest neighbors, support vector machines (linear and RBF), decision tree, random forest, logistic regression, neural network, and a majority voting ensemble. Hyperparameters were tuned via grid search with nested 5-fold cross-validation, and models were evaluated using 10-fold cross-validation. Accuracy, precision, recall, and F1 score were computed. Analyses were repeated controlling for age.
Results: ASD subgroups differed significantly in intellectual functioning. Children with F84.5 had higher mean IQ scores (M = 102.1, SD = 12.7) compared with F84.0 (M = 78.1, SD = 14.5) and F84.1 (M = 71.2, SD = 18.9; $p < .001$). Among ML models, logistic regression achieved the best performance (75% accuracy), followed closely by random forest and majority voting (74%). Controlling for age increased accuracy up to 79%. Predictions for F84.1 vs. F84.5 reached 88% accuracy, whereas F84.0 proved more difficult to classify, likely due to small sample size and heterogeneity.
Conclusions: Machine learning applied to standard cognitive test data can distinguish ICD-10 ASD subtypes with promising accuracy. Logistic regression and ensemble models were most effective, suggesting interpretable approaches may have clinical utility. The predictive role of intellectual ability supports its relevance in diagnostic frameworks, though further validation in larger, diverse samples is required. Integrating ML with cognitive assessments could contribute to faster, more cost-effective, and objective ASD diagnostics.

Disclosure of Interest: None Declared

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Mapping Social Motivation Networks in Autism Spectrum Disorder: A 3D, Graph-Based Connectomics Analysis

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Introduction: Autism spectrum disorder (ASD) spans many symptoms. We focus on those most relevant to a social circuit account: reduced social motivation and initiation, cognitive inflexibility, and heightened sensory reactivity. We examined three interacting systems: a fronto-limbic cortico-striatal–thalamic loop, cerebellar modulation of mesolimbic dopamine, and a rapid subcortical visual route to the amygdala, alongside insular salience. These features are key in functional outcome and caregiver burden, and their improvement is a central target of clinical care. Prior work has connected these systems to motivation, cognitive control, and sensory regulation relevant to these domains. Building on this, we evaluate whether model-specific and convergent alterations at the level of network organization and connectivity strength account for symptom-relevant variance.
Objectives: Build a 3D connectomics dataset of the target areas and test model-specific and convergent circuit alterations relevant to social motivation and salience in ASD.
Methods: We analyzed three mouse models: Fmr1 KO, Shank3b KO, and Tsc1 cKO, with controls. Brains were processed for immunofluorescence with antibody labeling of neuronal classes and substructures, and imaged by confocal microscopy. Tiles were stitched with BigStitcher. Arivis Pro U-Net segmented soma, axon hillock, dendrites, and nuclei to generate voxel masks. Automated 3D reconstruction used Vaa3D APP2 with export as SWC. Traces and volumes were registered to a reference atlas covering the relevant target areas. A NetworkX-based data analysis pipeline converted SWC data to region-level directed graphs and performed group comparisons between each model and matched controls as well as across models. Simulations in MATLAB provided simplified models of axonal excitability, dendritic integration, and synaptic currents to contextualize the network findings.
Results: We assembled a circuit-resolution connectomics dataset across all models. Network analysis showed weaker top-down drive within the fronto-limbic loop with fewer relay connections, reduced cerebellar modulation of mesolimbic control centers (lower hub centrality), and greater fragmentation along a rapid subcortical visual–affective route. The insular network also decoupled from frontal–striatal nodes, yielding a sparser, less integrated social-circuit backbone.

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