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Explainable Artificial Intelligence Modeling of Social Participation in Children with Intellectual Disabilities: A SHAP-Based CatBoost Analysis of Adaptive Behavior, Communication Competence, and Parental Involvement

Ayako. Nishimura[1], Ágnes. Tóth[2*]

[1] Department of Clinical Psychology, University of Tokyo, Tokyo, Japan
[2] Department of Clinical Psychology, Eötvös Loránd University, Budapest, Hungary

*** Corresponding author email address**: agnes.toth@ppk.elte.hu

Editor	Reviewers
Ghorban Hemati Alamdarloo Associate Professor, Department of Exceptional Children, Shiraz University, Shiraz, Iran ghemati@shirazu.ac.ir	**Reviewer 1:** Thseen Nazir Professor of Psychology and Counseling Department, Ibn Haldun University, Istanbul, Turkey. Email: thseen.nazir@ihu.edu.tr **Reviewer 2:** Abolghasem Khoshkanesh Assistant Professor, Counseling Department, Shahid Beheshti University, Tehran, Iran. Email: akhoshkonesh@sbu.ac.ir

1. Round 1

1.1. Reviewer 1

Reviewer:

The paragraph stating “Consequently, findings derived from broader developmental disability literature provide important theoretical foundations for understanding social participation among children with intellectual disabilities” requires stronger justification. While developmental disability literature is relevant, intellectual disability represents a distinct diagnostic category. The authors should provide a more detailed rationale for generalizing findings from autism and other neurodevelopmental disorders to children with intellectual disabilities.

In the Introduction section discussing adaptive behavior, the sentence “Adaptive behavior serves as a critical determinant of independence and inclusion” is theoretically important but lacks discussion of potential bidirectional relationships. The authors

should acknowledge that increased participation opportunities may themselves promote adaptive functioning, creating reciprocal developmental effects rather than a purely unidirectional influence.

The statement "Hyperparameter optimization was conducted using five-fold cross-validation combined with grid-search procedures" lacks sufficient technical detail. The authors should provide the complete hyperparameter search space, optimal parameter values obtained, and the rationale for selecting these parameters. Such information is essential for reproducibility and transparency.

In the Findings section, Table 1 reports descriptive statistics, but no reliability coefficients are presented for the study instruments. Given the reliance on psychometric measures, Cronbach's alpha, McDonald's omega, or other reliability indices should be reported for the current sample rather than relying solely on prior validation studies.

Authors revised the manuscript and uploaded the document.

1.2. Reviewer 2

Reviewer:

The paragraph beginning with "Family-related factors also play a critical role in shaping developmental trajectories" would benefit from a more comprehensive theoretical framework. The authors may strengthen the manuscript by integrating Family Systems Theory, Bronfenbrenner's ecological systems model, or the International Classification of Functioning, Disability and Health (ICF) framework to better explain the mechanisms linking parental involvement to participation outcomes.

In the final paragraph of the Introduction, the authors state that "relatively few studies have applied explainable machine learning methods to examine social participation among children with intellectual disabilities." This claim requires stronger empirical support. A more systematic review of prior machine learning applications in developmental disability research should be included to substantiate the novelty of the present investigation.

In the Methods section, the statement "Participants were selected using a multistage cluster sampling procedure" is insufficiently detailed. The manuscript should specify the number of institutions initially identified, the number agreeing to participate, cluster selection criteria, and whether sampling weights were considered. These details are necessary to evaluate sample representativeness.

The paragraph describing inclusion criteria states that participants required "sufficient communication abilities to complete assessments with support when necessary." This criterion is ambiguous. The authors should specify how communication sufficiency was determined, who evaluated eligibility, and whether standardized criteria were applied to avoid selection bias.

In the Measures section, the authors indicate that communication competence was assessed using both the CFCS and CCC-2. However, it remains unclear how scores from these two instruments were combined into a single predictor variable. The manuscript should provide a detailed explanation of score aggregation procedures, weighting strategies, and psychometric justification for creating a composite communication competence index.

The description of the PEM-CY notes that it assesses "frequency of participation, level of involvement, and environmental supports and barriers." However, the manuscript does not specify which PEM-CY domain served as the dependent variable. The authors should clarify whether the outcome represents total participation, average involvement, domain-specific participation, or a composite score.

In the Data Analysis section, the sentence "Missing data constituted less than 5% of the dataset and were addressed through multiple imputation procedures" requires additional information. The authors should report the specific imputation method, number of imputations performed, variables included in the imputation model, and diagnostics used to evaluate imputation quality.

Authors revised the manuscript and uploaded the document.

2. Revised

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