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Identifying Brain Activity Biomarkers For Cognitive Skills In Children Aged 7 To 12 Years Using The EPOC X Mobile EEG

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Introduction: Neurodevelopment disorders (NDDs) are one of the most frequent disabilities among children. However, strong overlap exists across NDDs symptoms that are challenging for diagnosis and therapeutic intervention [1]. Among emerging techs, mobile electroencephalography (mEEG) is a good candidate for identifying brain activity biomarkers of NDD children and for understanding the underlying neural mechanisms of these conditions, such as cognitive, linguistic and emotional dysfunctioning [2]. The present study intends to identify brain activity biomarkers for specific cognitive skills in children aged 7 to 12 years.

Material, Methods and Results: Participants were retrieved from the EPIDIA4Kids study (CPP Sud-Est II, 2022-A00766-37) database as of December 22nd 2024. Quantitative EEG (qEEG) signals were recorded from 12 French-speaking children without brain injuries or epilepsy (mean age = 11.0 years) during gamified psychometric task sessions. These children also underwent neuropsychological assessments (WISC-V) and self-report questionnaires (children and parents). EEG data were preprocessed using Emotiv Pro. Correlations were identified between neuropsychological performance scores and EEG power bands in two fronto-central regions (FC5 and FC6). Relationships of relative alpha band power (8–13 Hz) were examined with linguistic performance through mixed models and principal component analyses (MATLAB and SAS Version 9.4).
During gamified psychometric task sessions, alpha power in FC5 and FC6 was found associated with performances on the "Similarities" ($F=5.91$, $p=0.03$) and "Vocabulary" subtests ($F=6.99$, $p=0.02$), both involved in lexical information processing and altered in NDD while no association was found on "Matrix reasoning".

Conclusion: These findings strongly suggest alpha power in the fronto-central regions as a good candidate for linguistic processes biomarker. Future analyses will extend to beta power and the theta/beta ratio (TBR) to further explore their associations with cognitive performance, providing additional insights into NDD diagnostic markers.

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