Leveraging Machine Learning for Acoustic Feature Analysis in Neurodevelopmental Disorders: Insights into Emotional Profiles

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Abstract

Neurodevelopmental disorders (NDDs) in preschoolers often involve social and communication deficits, contributing to heightened anger, sadness, and anxiety. This study examined whether acoustic features of speech could detect emotional dysregulation in 65 French-speaking children (age 4) diagnosed with ADHD, developmental language disorder, psychosocial issues, or cognitive impairments. Using standardized assessments, participants were grouped by emotional/psychological, speech/language, or cognitive/motor difficulties. Audio recordings from structured and unstructured tasks were processed via openSMILE, generating 153 features capturing spectral, prosodic, and energy parameters linked to emotion. A random forest classifier compared these acoustic profiles to EmoDB samples labeled with negative emotions. Results showed that children with NDDs exhibited unique acoustic markers of negative emotions, though differences among subgroups were minimal. Attempts to pinpoint anxiety as a diagnostic feature were inconclusive. Overall, machine learning–based acoustic analysis holds promise for identifying emotional dysregulation, encouraging further multimodal approaches in clinical assessments, and more robust early interventions overall.

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