

Detection of Auditory Syllables Through the Analysis of Brain Responses in Preterm and Full-term Infants using a Fusion of BiLSTM and CNN

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Abstract

After the 28th week of pregnancy, preterm infants respond to auditory stimuli. Examining the brain responses of infants to auditory stimuli provides new insights into their learning abilities. The electroencephalogram (EEG) responses of 15 healthy full-term infants (7 boys and 8 girls) with an average gestational age of 39.8 weeks (± 1.2) and 14 preterm infants (11 boys and 3 girls) with an average gestational age of 30.1 weeks (± 1.2) who listened to auditory stimuli (repetitive and alternating syllables) were analyzed. To determine whether preterm and full-term infants can differentiate between syllables (ba or ga), deep learning techniques, including Convolutional Neural Networks (CNN) and Bidirectional Long Short-Term Memory (BiLSTM) networks, were employed for both the repetitive and alternating protocols. The results indicate that both preterm and full-term infants are capable of distinguishing syllables in both repetitive and alternating auditory stimuli, with the CNN achieving higher accuracy than BiLSTM in both age groups. In the proposed method (combination of BiLSTM and CNN), the EEG responses of preterm and full-term infants to repetitive auditory stimuli reached accuracies of 0.855 and 0.892, respectively, while for alternating auditory stimuli, the accuracies were 0.826 and 0.859, respectively. deep learning methods demonstrated the ability to differentiate syllables without the need for feature extraction, even with a limited dataset, and the complexity of the alternating protocol did not significantly affect the responses compared to the repetitive protocol.

Keywords

Neonate ; convolutional neural networks (CNN) ; electroencephalogram (EEG) ; bidirectional long short-term memory (BiLSTM) ; auditory stimuli ; syllable

Main Subjects

Biomedical Engineering



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