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Babbling analysis: A neurodevelopment marker

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Statement: Since young infants are born, they begin with the production of vocal sounds as a result of the interaction between breath, phonation, articulation, and central nervous system (Pachtner, 2017; I. Medicine, N. A. Sciences Engineering y Medicine, 2016; Kent & Hustad, 2009). During an infant's first year, these vocal sounds have a continue and progressive development from crying, babbling and finally words (Najnin & Banerjee, 2017; Kent & Hustad, 2009). Therefore, vocal sounds have acoustic patterns which may indicate a developmental stage or a pathological status (Woynaroski et al., 2016; Oller, 2014). Those patterns are being studied through feature extraction methods and classification algorithms. Previous studies have focused on crying using different approaches. Despite they have achieved successful outcomes, none of them have been established as a reliable method for clinical diagnosis (Hariharan et al., 2018; Chittora & Patil, 2017), for the reason databases have biases related with the number of patients signals vs controls signals, and with the number of recordings made per infant. Moreover, in some cases it is difficult to identify the original and real cause of each crying (Saraswathy, Hariharan, Yaacob & Khairunizam, 2012). As delays on the onset of expected babbling patterns is considered as a predictor of developmental impairment, this study set as hypothesis that infant's patients and controls can be differentiated according to acoustic patterns in babblings.

Methodology and Theoretical Orientation: Babblings were recorded with smartphones, and data related to early warnings or normal development were given by parents, with previous sign of the inform consent. The acoustic data was normalized according to rms values, noise filter, and transform using the short time fourier transform. Then, a two steps methodology was proposed based on previous studies of crying classification: I Signal processing, and II Classification algorithms. Three types of signal processing were applied to extract acoustic features from signals: Linear Predictive Coding (LPC), Mel frequency Scale, and Mel-frequency Ceptrum Coefficients (MFCC). And two classification algorithms, to classify between infants patients and controls: K-nearest neighbours (K-nn) and Backpropagation Neural Network (BPNN). Each acoustic signal was tagged with the retrieved data referring to the neurodevelopmental status and the biological age. The data was divided into training (90%) and validation (10%) phases for the II. step, and the accuracy and the precision of each classification algorithm were evaluated.

Findings: According to the results, the training phase achieved better values of accuracy and precision compared to the validation phase. Having a better performance with the BPNN algorithm in both phases, and with the fourier data in both classification algorithms. In addition, it seems that the validation phase is biased by the sample size of each set (Patients and Control).

Conclusion and Significance: Despite more data is needed in order to validate different classification algorithms, the previous results indicate that it is possible to identify if a babbling corresponds to an infant control or patient during the training of classification algorithms phase. Furthermore, the classification of the fourier data seem to have patterns which are lost during the signal processing. Therefore, future projects should explore bigger data bases and extract features which can explain better the babbling's patterns that represent the infant development.

Biography

Ana Catalina Muñoz Arbelaez has her expertise in neurodevelopment, classification models and deep learning. She has been working on a proposed model to classify babblings according to acoustic patterns. She has built this model base on her experience in evaluation and intervention of neurodevelopmental diseases, and research in cognitive functions. Currently, she is a neurodevelopmental psychologist and a fellow of the research group on Sistemas aplicados a la Industria in the Master of Engineering at the Universidad Pontificia Bolivariana, with emphasis on artificial neural networks and speech development in young infants. The approach of the proposed methodology consists on an acoustic pattern recognition problem.

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