



## Electrophysiological Assessment of Hearing in Child Language Disorders: Case-control

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### Abstract

**Introduction:** Communication disorders are some of the most prevalent childhood complaints, manifesting as delay or atypical development involving functional components of hearing, speech and/or language at varying levels of severity.

**Objective:** To characterize short (BAEP) and long latency (P300) auditory evoked potentials in children with language disorders, comparing them to children with typical language development.

**Method:** Case-control, observational and descriptive study. Children aged between 7 and 14 years of both sexes participated in this study. The sample was divided into 2 groups: case and control. All subjects were evaluated with the following tests: audiometry, impedance, ABR and P300. This research was developed at the Clinic School of Speech Therapy at UNIPLAN in Brasília - DF.

**Results:** As for the ABR in relation to the means of absolute latencies, interpeak latencies and the laterality of the ears, it was observed that both groups presented results within the normality parameters. In the P300, of the 8 subjects of the evaluated case group, 7 presented alterations in the latency and/or amplitude of the responses. The results show that there is a difference between the responses obtained in the case group compared to the control group.

**Conclusion:** A trend of altered electrophysiological responses at P300 was observed in individuals with childhood language disorders.

**Keywords:** Hearing; Language; Electrophysiology

### Introduction

Language is one of the most special and significant abilities of human beings, understood as a two-faced sign system - signifier and meaning. The signifier refers to the formal aspect of language and is constituted by the hierarchical junction of elements - phonemes, words, sentences and discourse. Phonemes integrate words, words combine into sentences, and sentences fit into speech. Meaning, on the other hand, refers to the functional aspect of language, considered responsible for communication in the social environment [1].

Communication disorders constitute some of the most prevalent childhood complaints, manifesting as delay or atypical development involving functional components of hearing, speech and/or language at varying levels of severity [2]. Most of the time these disorders are perceived by parents, who report that the child has difficulty speaking or the absence of speech, being difficult to understand and, in some cases, unable to pronounce some sounds correctly [3]. Another relevant aspect is the fact that children with delayed language development will possibly present, at school age, important and persistent neuropsychological abnormalities, including specific learning disorders [4].

Due to the great relationship between language development and the integrity and functionality of the auditory system, audiological diagnostic tests such as auditory evoked potentials (AEP) have been used in the assessment of individuals with communication disorders, as they are objective tests and do not require of the patient's verbal responses [5].

Researchers have used AEP to assess and monitor the auditory pathway in individuals with language disorders, however, the results found vary in terms of findings. Thus, it is important to characterize hearing in this population, through AEP, in order to clarify possible correlations between auditory aspects and language disorders. Therefore, the aim of the present study is to characterize short (BAEP) and long latency auditory evoked potentials (cognitive potential - P300) in individuals with language disorders, comparing them to individuals with typical language development [6].

## Methods

This work consists of a case-control, observational and descriptive study and was submitted to the ethics and research committee in human beings with approval under the registration CAAE 30234719.5.0000.8927. The evaluations were carried out after the signing of the Informed Consent Form by the parents or guardians of the children.

Subjects aged between 7 and 14 years participated in this study and were divided into 2 groups: case group and control group. The case group consisted of individuals diagnosed with language impairment and the control group of typically developing female and male children. The subjects in the control group were matched with those in the case group regarding sex and age. All participants, from both groups, had normal results in the conventional audiological assessment (audiometry and impedance testing). They had no complaints or clinical history of head trauma, ear diseases, seizures, dyslexia, neurological or psychiatric disorders and did not use medication.

### Inclusion criteria for the case group:

- Present a diagnosis of language disorder.
- Present normal results in conventional audiological assessment.

### Inclusion criteria for the control group:

- Have adequate performance in the ABFW Phonology and Fluency tests (Child Language Test).
- Present normal results in conventional audiological assessment.

The research was carried out at the UNIPLAN School of Speech Therapy Clinic in Brasília - DF. The materials and equipment used to carry out the assessments were: the patient's clinical history; Heine brand otoscope, for inspection of the external acoustic meatus; middle ear analyzer (impedanciometer) model AZ7, to perform acoustic immittance measurements; audiometer model AD 29, brand interacoustics and supra-aural headphones model TDH-39; acoustic booth for audiological evaluation; Masbe equipment, contronic brand, for capturing auditory evoked potentials.

Participants underwent audiological assessments, consisting of behavioral and electrophysiological tests. All procedures performed will be described below, in the order in which they were performed.

After collecting the individual's clinical history, the external acoustic meatus was inspected in order to check for possible obstructions due to the presence of cerumen or foreign bodies that could impede the assessments.

Conventional Audiological Assessment: Acoustic Immittance measurements were performed (tympanometry and investigation of ipsilateral acoustic reflexes, at frequencies of 500, 1000, 2000 and 4000 Hz). The criterion for normality adopted was type "A" curve and acoustic reflexes present bilaterally. Pure tone audiometry was performed at frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz. The criterion for normality adopted was up to 25 dB of hearing threshold at all tested frequencies. In speech audiometry, the Speech Recognition Threshold (SRT) and the Speech Recognition Index (IRF) were investigated.

Electrophysiological Hearing Assessment: Auditory evoked potentials were obtained with the individuals lying down inside an acoustic and electrically treated room. The electrophysiological evaluation consists of obtaining the ABR with click stimuli and the LLAEP with tone burst stimuli. Acoustic stimuli were presented

through a supra-aural earphone. After cleaning the skin with an abrasive paste, electrolytic paste and microporous type adhesive were used to fix the electrodes. The electrode impedance values were checked before the beginning of each exam, and should be below 5 kOhms.

The parameters adopted for each electrophysiological evaluation will be described as follows: Brainstem auditory evoked potential with click stimulus: The click stimulus, alternating polarity, was presented in the right and left ears, at a speed of 17.1 stimuli per second and intensity of 80 dBNA. Two scans of 2000 stimuli each were performed. The recording window was 10 ms, using 100 Hz high-pass and 3000 Hz low-pass filters. The electrodes were positioned as follows: active (Fz) and ground (Fpz) electrodes arranged on the forehead, and the reference electrodes on the left (M1) and right (M2) mastoids. The normative values adopted for ABR in MASBE Contronic were.

I	III	V
1.43 ms	3.62 ms	5.47 ms
(1.27 - 1.7)	(3.24 - 4.0)	(5.09 - 5.85)

Table 1

I-III	III-V	I-V	V-V
2.00 ms	1.9 ms	4.00 ms	0.00
(1.6 - 2.4)	(1.5 - 2.3)	(3.5 - 4.5)	0.3

Table 2

Long latency auditory evoked potentials (P300): The stimuli were randomly presented at an intensity of 70 dBHL, at a speed of 0.8 stimuli per second. Subjects were instructed to count the rare stimuli whenever they were perceived. Tone burst stimuli were presented at frequencies of 1000 Hz (frequent stimulus) and 2000 Hz (rare stimulus).

The normative values adopted for the P300 (McPherson, 1996).

Amplitude was classified as adequate between 5 to 20 uV and low when less than 5 uV (Hall JW, 1992).

05 to 14 years	241 to 396 ms
17 to 30 years	225 to 365 ms
50 to 70 years	350 to 427 ms

Table 3

In this work, an analysis of quantitative data was performed, in which mean, median, standard deviation, minimum and maximum values were obtained for each variable studied, and the results of the case and control groups were later compared. The distributions of all studied variables were evaluated in order to verify if they were normal or not.

Results

Sixteen subjects were evaluated, 8 with language disorder belonging to the case group and 8 with typical language development belonging to the control group. As for characteristics, all participants were male and had ages ranging from 07 to 14 years.

When analyzing the ABR results in relation to the means of absolute latencies, interpeak values and ear laterality, it was observed that in both groups, all participants presented results within normality parameters, indicating integrity of the auditory pathway up to the brainstem in both the case and control groups.

Regarding the P300 test, the results show that there is a difference between the responses obtained in the case group when compared to the control group. In the case group, of the 8 subjects evaluated, 7 presented alterations in the P300. While in the control group, all evaluated subjects presented well-defined potential tracings, with amplitudes and latencies appropriate for their age, indicating good attention activity.

Discussion

The possibility of identifying an electrophysiological alteration of hearing in subjects with language impairment motivated this case-control study, as well as several scientists to research through the ABR and P300 tests whether or not there are differences in the responses found in the trunk auditory evoked potential brain and long latency auditory evoked potentials among individuals with language impairment and individuals with typical language.

One of the characteristics of this sample is that all participants are male. In agreement with a study [7] that affirms the prevalence of language disorders in males.

As for the BAEP results, the findings of this research were similar to those obtained by another study [8] in which no significant differences were observed. Regarding the P300, in this study, there is a difference in the responses when comparing the case and control groups. Other studies also found alterations in the electrophysiological findings of children with language complaints. A research carried out with the objective of evaluating the long latency auditory evoked potentials in children with phonological disorder revealed that among the alterations found, the low amplitude of the P300 wave stands out, corroborating the results obtained in the present research [9].

The relationship between the auditory pathway and childhood language disorder has long been investigated. In 2004, a study [10] suggested that children who failed school have evidence of a central hearing disorder. This research pointed out differences between the case and control groups, partially corroborating the results of the present study. In this study, in the research of long latency auditory evoked potential, the results of the case group, when compared to the control group, suggest differences in the level of auditory cortex between the groups, indicating a possible relationship between the difficulty in maintaining attention and the disorder of childish language.

Thus, the need for further research on this topic is emphasized, since there are many parameters present in the electrophysiological assessment, in addition to the complexity of the factors involved in childhood language disorders.

## Conclusion

Individuals with child language disorder did not present altered results in the brainstem auditory evoked potential, pointing out similar results to the control group, suggesting integrity of the auditory pathway up to the brainstem bilaterally in both groups. As for the cognitive potential - P300, it is concluded that children with language disorders have difficulties in maintaining attention, characterized by changes in P300 responses.

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