

WORD ACQUISITION IN CHILDREN WITH COCHLEAR IMPLANTS

Aquisição de vocábulos em crianças usuárias de implante coclear

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ABSTRACT

Purpose: to analyze word acquisition in early oral language development of a group of children with cochlear implants. **Methods:** this consisted on a clinical, prospective and longitudinal study. Five mothers of children with cochlear implants participated. The mothers reported the words that were spontaneously produced by their children. The Language Development Survey adapted to Brazilian Portuguese was administered once a month, totaling six moments per child. The paired t-test was used on the longitudinal data analysis. **Results:** the mean number of words spontaneously produced by the group of children gradually increased from the first to the sixth month: 38 to 58.8 words. There were significant differences in the number of words produced on Moment 1 and Moment 5 ($p = 0.016$) and between Moment 1 and Moment 6 ($p = 0.010$). The categories with the greatest number of words produced by children were other, people, modifiers and actions. The categories with the greatest increase were modifiers, body parts and other. **Conclusions:** the group of children with cochlear implants showed a gradual increase in the number of words spontaneously (mainly other, modifiers, people and actions) produced over a period of six months, being significant after the fifth month of Speech-Language therapy. The number of words produced increased with higher significance with longer intervention periods. It is suggested that Speech-Language Pathologists apply the formulary on a six-month interval as this is an ideal period to evidence lexical acquisition.

KEYWORDS: Vocabulary; Child; Cochlear Implantation; Language Development

■ INTRODUCTION

One of the indices that monitor language development is the lexical production^{1,2}. Studies have shown that language delays, both in normal hearing children and in hearing impaired children users of hearing aids (HA) and/or cochlear implants (CI), are related to lexical development^{1,3-5}.

The auditory sensory deprivation undermines the development of language, especially when the hearing loss is severe or profound and established before two years of age⁶⁻⁸. With the deterioration of the speech signal, there is loss of linguistic information (form, content and use) and hence the delay in language development.

Children with severe or profound hearing loss who are hearing aid users receive little or no acoustic information to meet the spectrum of speech, limiting the development of oral language skills with only the support of auditory skills⁹. In these cases, cochlear implants offer an alternative to assist in the audiology pediatric (re)habilitation.

The cochlear implant is a device that electrically stimulates the auditory nerve providing sound information, including information of the speech spectrum. The gradual changes in the linguistic performance of the child after activation vary and depend on several factors, such as: the age at the activation, duration

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of sensory deprivation, cognition, motivation of the child/family, socioeconomic and cultural status of the family, time of device use and other individual factors¹⁰. When the residual hearing is prioritized through such technology, the hearing impaired children can develop oral language, following the stages of typical language development¹¹.

The technological advances in the electronic device of the cochlear implant and the validation and standardization of hearing and language assessment protocols offer great benefits in the area of audiological (re)habilitation for science and clinical setting.

Several instruments are used to monitor the development of auditory and language skills of children who have cochlear implants. Among these, the use of questionnaires administered to parents is highlighted. There is scientific evidence that parents are good informants about the development of their children^{12,13}.

Regarding the lexical development, some questionnaires have been adapted to Brazilian Portuguese, among them is the American Language Development Survey (LDS)¹⁴ validated and considered as a tool of rapid application to identify possible delays in lexical development in children¹⁵. The LDS version adapted to Brazilian Portuguese was published, translated and standardized by Capovilla and Capovilla in 1997¹⁶, termed as *Lista de Avaliação de Vocabulário Expressivo* (LAVE): a questionnaire that assesses expressive vocabulary of normal hearing children from the perspective of those responsible for the children. According to that study, normal hearing children between 22 and 36 months of age produced an average of 195 words and the most reported categories were: people, body parts, actions, home and adjectives. The results with normal hearing children between three and five years of age showed higher LAVE scores: average of 252 words produced (minimum 110 and maximum 307 words).

The analyzes of lexical performance of children with cochlear implants with the LAVE was conducted to verify the effectiveness of an orientation program for parents with a four-weeks duration. The results indicated a significant different performance between the pre-and post-orientation program, with an average production increase of 11 words¹⁷.

Given the importance of the use of instruments to monitor the lexical acquisition and the fact that children with cochlear implants may experience delays in the development of oral language, the present study aimed to analyze the lexical production of a group of children with cochlear implants who were in the early stages of oral language. This study aims to answer the following questions:

Is there an increased number of words spontaneously produced by children using cochlear implants within six months?

At what assessment the spontaneous production of words is most significant?

What are the first lexical categories children spontaneously produce?

■ METHODS

This clinical, prospective and longitudinal study was conducted at the Laboratory of Hearing Research in Educational Audiology (Laboratório de Investigação Fonoaudiológica em Audiologia Educacional - LIFAE), Universidade de São Paulo (USP). The study was approved by the Ethics Committee for Analysis of Research Projects of HCFMUSP (Cappesq) under protocol number 0290/2010. Those responsible for each study participant signed a consent form.

The study included five children with unilateral cochlear implants (Table 1) who met the following inclusion criteria: intervention at LIFAE during the period of data collection, early stage of oral language development (structures with one or two words), regular use of cochlear implants (more than 10 hours a day) and device activation between 10 and 28 months. Children with associated disabilities related to hearing impairment (auditory neuropathy spectrum, visual impairment, motor impairment or psychiatric disorder) were excluded. The ages of the children ranged from 68 months to 101 months (mean 79 months) and three of them were girls and two were boys. The average age at activation of the device was 20 months and the mean hearing threshold was 32.1 dB (Figure 1). It is noteworthy that the chronological ages of the children who participated in this study did not correspond to their hearing ages (activation of cochlear implant) and, consequently, they had delayed language development.

Table 1 – Demographic information of the five children users of cochlear implants

Children	Gender	Chronological age at first data collection years (months)	Time of activation ate first data collection (months)	Mean 500 to 4000Hz with cochlear implant (dB)	Etiology
1.	F	5 (8)	22	47	Hyperbilirubinemia
2.	M	8 (5)	28	18,75	Ototoxic and meningitis
3.	F	6 (11)	19	31	Cytomegalovirus
4.	F	6 (2)	19	41	Congenital unknown
5.	M	6 (12)	10	22,5	Congenital unknown

Legend: F = Female, M = Male

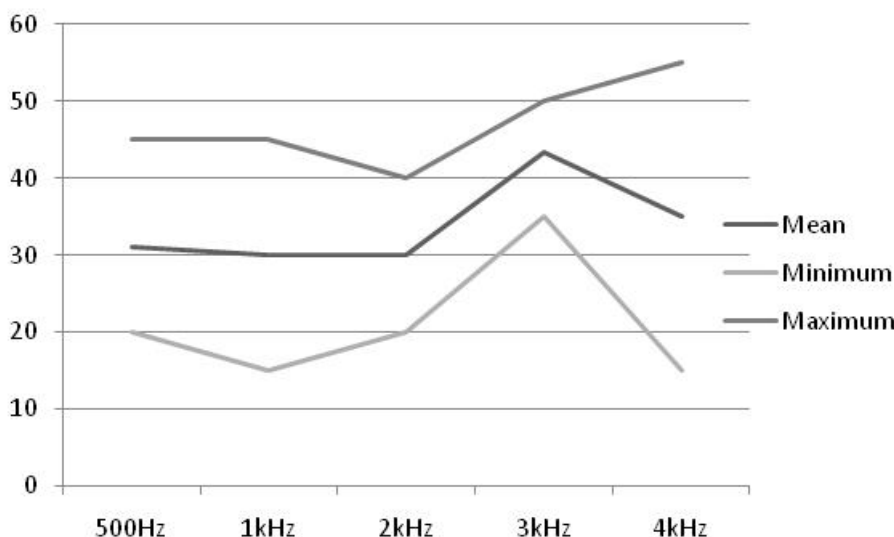


Figure 1 – Mean, minimum and maximum values of hearing thresholds of the children with cochlear implants

The socio-demographic profile of the five mothers who responded to the LAVE questionnaire (Table 2) and whose children participated in the cochlear implant program via public health system (Sistema Único de Saúde - SUS) is characterized by a mean age of 33 years with complete high school educational level and family income of 2.2 minimum wages on average.

The therapeutic approach used at LIFAE for hearing impaired children users of hearing aids and/or cochlear implants in the pre-linguistic stage is oral and aural, which aims at the development of auditory, communicative and linguistic skills of oral language, with support from orofacial reading¹⁸. The children attended Speech-Language therapy twice

a week with 50-minute sessions. In these sessions, the time is scaled so that structured and natural activities are conducted to achieve specific goals, and at the end of the session, a few minutes are dedicated to mothers for guidance and exchange of information through the diary (“notebook”) of the child.

The material used in this study was the LAVE questionnaire, which consists of a list of 309 words, divided into 14 semantic categories (food, toys, environment, animals, body parts, places, actions, house, objects, people, clothing, vehicles, modifiers, and others) and a field to fill in additional words that are not in the list. In its original version¹⁴, the questionnaire is answered by the parents

Table 2 – Demographic information of mothers of participants

Mother of child	Age (years)	Educational level	Family income (1 minimum wage = R\$545,00)
1	22	Complete high school	1,7
2	36	Complete high school	0,6
3	49	Incomplete elementary school	1
4	30	Complete high school	1,5
5	28	Complete high school	6,4

or guardians of the children who are oriented to highlight the words the children spontaneously use. In this study, the mother was asked to answer which of the words mentioned by the Speech-Language Pathologist were spontaneously used by the child in a natural situation, in recent weeks. This instrument was administered once a month, on average, for six months at the therapy sessions totaling six assessments (A) per child.

The number of words spontaneously produced by the five children users of cochlear implant in six months was descriptively analyzed by group; mean, standard deviation, minimum and maximum values were calculated. Subsequently, the paired t-test was applied to compare the results between

the assessments. The level of significance was set at 5% and significant results are marked with an asterisk and appear in bold italics.

■ RESULTS

The mean number of words produced by the group of children gradually increased from the first to the sixth assessment from 38.0 to 58.80 words. However, there was a decrease in the minimum and maximum number of words produced, respectively, in the assessments A3/A4 and A4/A5; at the following assessments, the number of words increased again (Table 3).

Table 3 – Descriptive means of the number of words produced by the five participants at each assessment

	N	Minimum	Maximum	Mean	Standard deviation
A1	5	4	72	38,00	24,85
A2	5	9	75	45,20	26,39
A3	5	16	76	46,60	24,76
A4	5	10	105	52,00	37,18
A5	5	17	96	55,60	31,10
A6	5	22	104	58,80	31,36

Note: N = number of children; A1 = first LDS assessment, A2 = second LDS assessment, A3 = third LDS assessment, A4 = fourth LDS assessment, A5 = fifth LDS assessment, A6 = sixth LDS assessment.

There was a significant difference between the number of words produced at A1 and A5 ($p < 0.05$), and between A1 and A6 ($p < 0.01$). There was a trend toward significance between A1 and A3 ($p = 0.053$) (Table 4). This difference was more significant with the increase in the number of months of Speech

and Language intervention. Thus, on average, in A1 the group scored poorer (mean = 38 words) than in A3 (mean = 46.6 words) than in A5 (mean = 55.6 words), and than in A6 (mean = 58.8). There was no significant difference among the remaining assessments.

Table 4 – Paired t-test for comparison among the questionnaire application at the six assessments

	A1 t (4) (p-valor)	A2 t (4) (p-valor)	A3 t (4) (p-valor)	A4 t (4) (p-valor)	A5 t (4) (p-valor)
A2	-2,493 (0,067)				
A3	-2,711 (0,053)	-0,953 (0,395)			
A4	-2,228 (0,090)	-1,104 (0,332)	-0,853 (0,442)		
A5	-3,990 (0,016*)	-2,288 (0,084)	-1,889 (0,132)	-0,885 (0,426)	
A6	-4,589 (0,010*)	-2,369 (0,077)	-2,091 (0,105)	-1,592 (0,187)	-1,573 (0,191)

Note: A1 = first LDS assessment, A2 = second LDS assessment, A3 = third LDS assessment, A4 = fourth LDS assessment, A5 = fifth LDS assessment, A6 = sixth LDS assessment.

The most frequently spontaneously produced words by category in descending order at A6 were: others (9.8 words); modifiers and people (8.2 words) and actions (6.6 words). However, the categories

that showed higher incidence of lexical acquisition in the period were: modifiers (4.2 words), body parts (3.8 words) and other (3.6 words) (Figure 2).

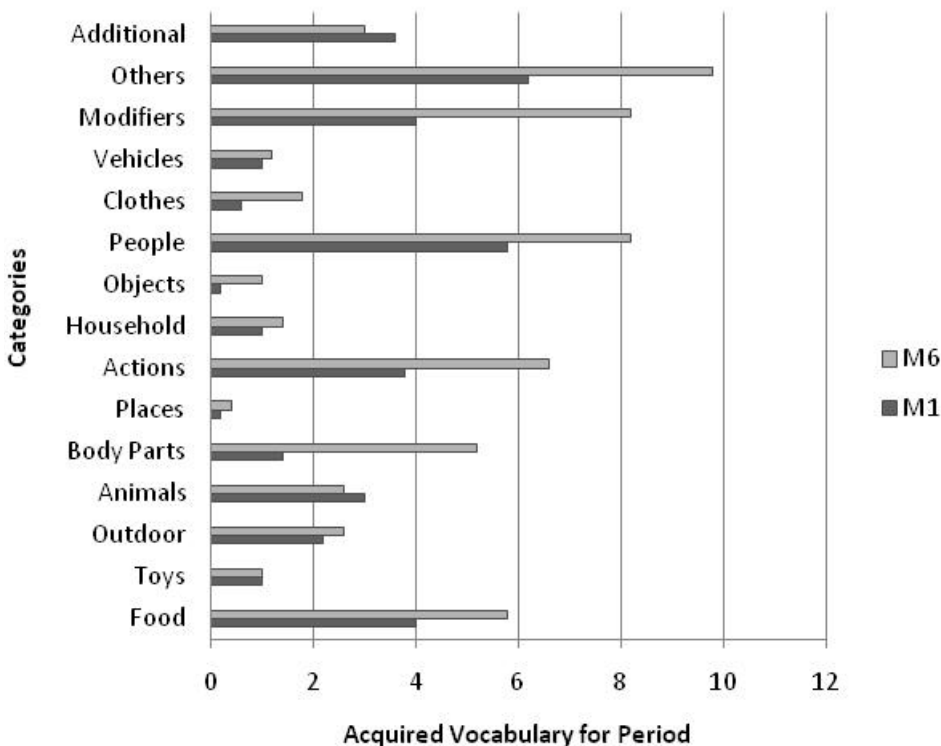


Figure 2 – Mean distribution of number of words acquired according to the categories from the first to the sixth assessment

■ DISCUSSION

This study aimed to answer the following questions: 1) Is there an increased number of words spontaneously produced by children using cochlear implants within six months? 2) At what assessment the spontaneous production of words is most significant? 3) What are the first lexical categories children spontaneously produce?

Regarding the first question, the results obtained with the LAVE questionnaire indicated a gradual increase in the number of words spontaneously produced by the children within six months.

It is known that around 18 months of age, children with typical development spontaneously produce approximately 50 words. During this period they begin to produce up to nine new words per day¹⁹. The group of children with cochlear implants from the present study produced at Assessment 1 (with 19.6 months of activation of the cochlear implant, on average) 38 words and, at assessment 6 (25.6 months of cochlear implant activation) 58.8 words. Therefore, during the period studied the spontaneous production of children increase over 20 words. This result demonstrates that in a short time of intervention, children spontaneously produced a significant number of words. These findings confirm that the longer the duration of cochlear implant use, the better the performance of hearing and language of the hearing impaired children in the intervention program. However, the lexical development is delayed when compared to the typical development of normal hearing children^{10,20,21}.

The acquisition of new words in normal hearing children occurs incidentally, i.e. it occurs naturally in situations experienced in their different environments. Moreover, the incidental acquisition collaborates with the generalization, allowing the child to master verbal concepts in various situations²². The use of cochlear implant favors this mode of learning, which greatly differs from children with severe and/or profound sensorineural hearing loss who use hearing aids. The acquisition of new words needs to be trained in context with highly structured activities and with lip reading support.

Therefore, even with the intervention considered late, this group of children who are part of a Speech and Language intervention program with an oral and aural approach showed positive developments.

Concerning the second question, there was a significant increase in the number of words spontaneously produced in Assessments 5 and 6, i.e. the longer the activation time of the cochlear implant and speech and language stimulation, more significant was the result. Therefore, it is suggested to the Speech-Language Pathologists that the interval

of six months for application of the LAVE questionnaire is ideal for highlighting the development of oral language.

On the acquisition of categories constituting the LAVE questionnaire, young normal hearing children¹⁶ spontaneously produce words from the categories people, body parts and actions; different from the children in this study, who produced the categories others, people and actions. The intervention program developed during the study directed to the categories modifiers, body parts and others. The results will assist in directing future therapeutic planning on morphosyntactic and semantic categories that should be focused on.

The number of children participating in the current study was reduced due to the inclusion criteria: cochlear implant users, who were receiving intervention at the same location with the same approach, at early stage of oral language development, without other associated disabilities and activation between 10 and 28 months. It is suggested to reproduce the study with a larger sample.

In a study conducted in the United States, the mean age of children at time of implant activation was 30.5 months, and the results indicated that children showed expressive language performance very similar to that of their normal hearing peers of the same age²³. Other studies have demonstrated the effect of age at activation of the cochlear implant on speech development. In general, children who had their cochlear implant activated at up to 2 years of age have better linguistic performance in both receptive language and expressive language when compared to children implanted above this age range²⁴. In the present study, the mean age of the cochlear implant activation was equivalent to 79 months. Therefore, these children already had a significant delay in language acquisition. However, the results show that there is a significant development of language, albeit at a slower rate than normal hearing children, which must also be considered when interpreting the data in the clinical setting.

Another factor that must be emphasized is the form of administration of the LAVE. In the original version of this questionnaire, the mother takes the questionnaire home and is oriented to highlight the words from the list and write additional words that the child produced in spontaneous situation. She has time and several moments to observe the child after responding to the questionnaire. In this study, the mother answered which words mentioned by the Speech Language Pathologist were produced by the child in spontaneous situation, as well as which non-mentioned words (additional). This condition may have been unfavorable, since the mother had

to quickly remember if the child produced or not certain word at the moment of the assessment.

Another important aspect to be mentioned is the possibility of the child to have spontaneously produced a word in a given month, and have stopped producing it in another, and have returned to produce the word in following month. This may explain the decrease of number of words children produced at some assessments. It is suggested that in further studies, the mothers take the questionnaire home and that the diary (notebook) is more consistently used and in conjunction with LAVE.

■ CONCLUSIONS

The group of children with cochlear implants who participated in this study has gradually increased

the number of words spontaneously produced (categories: other people and actions) within six months.

From the fifth month of speech therapy and language intervention, there was a significant increase in the number of words spontaneously produced. And, as the time from activation of the cochlear implant and intervention increased, the number of words increased with stronger significance (after six months).

The categories of words that were most spontaneously produced after six months of intervention, in descending order, were: others, modifiers, people and actions.

RESUMO

Objetivo: analisar a aquisição de vocábulos em um grupo de crianças usuárias de implante coclear, na fase inicial do desenvolvimento da língua oral. **Métodos:** estudo do tipo clínico, prospectivo e longitudinal. Participaram cinco mães de crianças usuárias de implante coclear. As mães assinalaram os vocábulos produzidos espontaneamente pelas crianças, em situação natural, na Lista de Avaliação de Vocabulário Expressivo, adaptado do Language Development Survey. Esse instrumento foi administrado uma vez por mês, totalizando seis momentos por criança. Utilizou-se o teste-t pareado para realizar as comparações entre os momentos. **Resultados:** a média dos vocábulos produzidos espontaneamente pelo grupo de crianças do primeiro para o sexto momento aumentou gradativamente: de 38,0 para 58,8 vocábulos. Houve diferença significativa no número de vocábulos produzidos entre os Momento 1 e Momento 5 ($p=0,016$) e, entre Momento 1 e Momento 6 ($p=0,010$). As categorias mais produzidas pelas crianças foram: outros, pessoas, modificadores e ações. E, as categorias que mais se expandiram no período foram modificadores, partes de corpo e outros. **Conclusões:** o grupo de crianças usuárias de implante coclear que participaram deste estudo apresentou um aumento gradativo do número de vocábulos produzidos espontaneamente (principalmente outro, modificadores, pessoas e ações), num período de seis meses, sendo significativo após o quinto mês da intervenção fonoaudiológica e, conforme aumentou o tempo do programa de intervenção, o número de vocábulos aumentou com maior significância. Sugere-se aos fonoaudiólogos que administrem o formulário num intervalo de seis meses, por ser o ideal para evidenciar a aquisição lexical.

DESCRIPTORIOS: Vocabulário; Criança; Implante Coclear; Desenvolvimento de Linguagem

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