

OCCURRENCE OF REPAIR STRATEGIES FOR THE STOPS CONSIDERING THE SEVERITY OF THE PHONOLOGICAL DISORDER

Ocorrência das estratégias de reparo para os fonemas plosivos, considerando o grau do desvio fonológico

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ABSTRACT

Purpose: to check the occurrence of repair strategies for the phonemes /b/, /d/, /k/ e /g/ and their relation to the severity of phonological disorder. **Method:** 54 subjects were selected with a diagnosis of phonological disorder who had repair strategies for the stops / b /, / d /, / k / and / g / in the onset positions (initial and / or medial), with 40% of employment in their phonological systems. Data were statistically analyzed using the Statistical Analysis System program, version 8.02, and using the Fisher Test. The level of significance was 5% ($p < 0.05$). **Results:** there was a significant difference for / b / with greater frequency of devoicing in children from moderate-severe and severe degrees, and backing and use of two or more strategies in the severe degree. Statistically significant difference for /d/ with greater frequency of backing in the subjects with mild degree, of devoicing and use of two or more strategies in patients with moderate-severe degree, and devoicing in those with severe degree. **Conclusion:** the more complex in terms of acquisition and production are the stops, most repair strategies are used. And yet, the greater is the degree of phonological disorder, the greater is the number of times where these strategies are used, showing that the child has less phonological knowledge.

KEYWORDS: Child; Child Language; Speech

■ INTRODUCTION

The process of acquisition and development of phonological knowledge occurs by the age of 5:0, in a gradual, non-linear, and individual variation process¹. At this moment several events happen at the same time and the child needs to coordinate them in order to produce sound associating to the

phonological code of her/his language². However, some have changes in their oral language, which is called phonological disorders. This consists of a speech difficulty, characterized by inappropriate use of sounds, according to the age and regional variations, which may involve errors in production, perception and organization of sounds³. The same has been the subject of various studies, which mostly focus on the analysis of the effectiveness of phonological therapy models⁴⁻⁸.

The consonants can be analyzed by the articulation point as bilabial, labiodental, dental, alveolar, palatal alveolar, palatal, velar and glottal, by the manner of articulation as plosive, nasal, fricative, affricate, tap, vibrant, retroflex and lateral and the laryngeal activity as sound and soundless⁹.

The class of plosive consonants consists of the following: /p/, /b/, /t/, /d/, /k/, /g/, and are classified into: bilabial /p/ and /b/, alveolar /t/ and /d/ and velar

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/k/ and /g/. In the production of these phonemes speech organs form a total blockage of the air passage, with the acoustic record of an interval of silence, which can be filled by a voicing caused by vibration of the vocal folds in the case of sound segments (/b/, /d/ and /g/), which is not present in the soundless segments (/p/, /t/ and /k/)¹⁰.

According to Autosegmental Phonology, there is a hierarchy between the traits and the segments consisting of layers. Based on this theory of traces, it was proposed a hierarchy for Portuguese, the Implicational Model of the Complexity of Traces (*Modelo Implicacional de Complexidade de Traços* – MICT). The MICT predicts the possibilities for the segmental acquisition under paths to be covered during acquisition. From the complexity zero state formed by the phonemes /p, t, m, n/ paths which lead to marked traces and combinations of traces. In the hierarchy, the first feature is specified to be [-ant] (/∅/), which has the lowest complexity (N1), followed by the trace [+voice], leading to the representation of /b/ and/or /d/, which is the second level (L2) and the traces [dors] (/k/), which is at level three (L3). At level four (N4), is the combination of traces [dors, + voice], which will appear in the /g/¹¹.

One study claims that the plosive and nasal consonant segments are the first to be acquired by children with normal phonological development, both being acquired before 2 years of age¹. Another study reported that at the age of three the phonemes /p/, /b/, /t/, /d/, /k/, /g/, /m/ and /n/ were already acquired and stabilized in the phonological system of this study's children¹².

The repair strategies represent the resources used to adjust the performance of the target system to the phonological system of children. Children use these resources in place of the segment and/or syllable structure which they do not know, or whose production they do not dominate. As the process of phonological acquisition takes place, resources used also change because of the proximity of the phonological system for children and adults. In any normal acquisition as well as in the deviating, there can be noted the presence of repair strategies¹³.

In the literature, some studies have analyzed the occurrence of repair strategies in the speech of children^{3,14-16}. Among the strategies most commonly found in children with phonological disorders is desonorization of plosive and fricative phonemes¹⁵. Another study also indicates the desonorization strategies as one of the most prevalent and most difficult in clinical evolution^{17,18}.

As mentioned above, the plosive consonant class is considered of initial acquisition. Still, there are repair strategies that apply to this class, as often observed in the speech clinic. Therefore, knowledge

about children's phonological system provides the clinical data to help in the best way to conduct the therapeutic process.

The aim of this study was to verify the occurrence of repair strategies for the four studied phonemes (/b/, /d/, /k/ and /g/) and the relationship of these strategies for each of the phonemes, according to phonological disorder.

■ METHOD

In this study we analyzed the database of a research project that is linked to a higher education institution. The database consists of 199 subjects diagnosed with phonological disorders who underwent phonological therapy. For this study we selected 54 subjects who presented the inclusion and exclusion criteria for the research, through the analysis of the pre-therapy data.

The adopted inclusion criteria for the subjects' participation in the study were the following: they are authorized by their parents or guardians to participate in the study by signing the Informed Consent Form (ICF), present the speech disorder, being within the ages of four and eight years, and to perform strategy (ies) of substitution (desonorization, anteriorization, posteriorization, fricativization, glottalization) and/or omission of any of plosive consonants from Brazilian Portuguese (/b/, /d/, /k/ and /g/) in positions of onset initial and/or medial, employing 40% or more of the repair strategy in their phonological system¹⁹.

The established exclusion criteria were: having received any speech therapy before the first evaluation of the phonological system, not signing the consent form, the presence of speech-language disorders beyond phonological changes and alteration evidence in neurological, cognitive and psychological areas.

Data were analyzed before the phonological therapy. The speech sample obtained by applying the Phonological Assessment of Children (*Avaliação Fonológica da Criança* – AFC)²⁰ was then phonetically transcribed following contrastive analysis. Then, it was reviewed by two more judges with experience in phonetic and perceptual analysis.

According to the results of the contrastive analysis, we determined the severity of phonological disorder, through the Calculation of the Perceptual of Correct Consonants – Revised “*Cálculo do Percentual de Consoantes Corretas*” (PCC-R)²¹ which does not consider the distortions produced by the subjects in the counting of phonological errors and is based on the classification of the Percentage of Correct Consonants (PCC)²². According to the PCC, the severity of phonological disorder can be classified into: Mild (MD), Mild-Moderate (MMD),

Moderate-Severe (MSD) and Severe (SG). One can calculate the PCC by dividing the number of consonants produced correctly by the total number of consonants produced (correct + incorrect). Thus, the authors have established that the MD PCC is from 86% to 100%, MMD PCC from 66 to 85%, MSD PCC from 51 to 65% and SD PCC less than 50%.

This research was approved by the Ethics and Research Committee under the number 052/04.

The study data were statistically analyzed using the Statistical Analysis System, version 8.02, using the Fisher exact test. The adopted significance level for statistical tests was 5% ($p < 0,05$).

■ RESULTS

From a descriptive analysis regarding repair strategies for the phonemes /b/, /d/ and /k/ it was not possible to observe the predominance of any strategy, respectively 59.26%, 50% and 57.41 % of cases. The desonorization repair strategy was predominant in the phoneme /g/ with a percentage of 38.89%.

Even showing no statistically significant result, it was possible to note that the glottalization repair strategy was found in all the researched phonemes, but only in subjects with SD. A similar situation occurred in relation to the use of more than one strategy that has been seen only in children with MSD and SD.

Tables 2 and 3 show the comparisons between the severity variable of phonological disorder and the repair strategies presented by the subjects for the phonemes /b/ and /d/.

From the results, there was a significant difference between the degrees of phonological disorders for the following variables:

1. Repair strategies of the /b/: higher frequency of desonorization in children with MSD and SD, posteriorization and two or more strategies with the SD.
2. Strategies repair of the /d/: high frequency posteriorization in subjects with MD, desonorization and two or more strategies in MSD, and desonorization with SD.

Table 1 – Descriptive analysis of the strategies employed to repair the /b/, /d/, /k/ and /g/ phonemes

| | None | Glottalization | Desonorization | Posterioriz. | Fricatization | Anteriorization | Two or + |
|-------------|--------|----------------|----------------|--------------|---------------|-----------------|----------|
| Phoneme /b/ | 59,26% | 1,85% | 33,33% | 3,70% | - | - | 1,85% |
| Phoneme /d/ | 50% | 1,85% | 31,48% | 12,96% | - | - | 3,70% |
| Phoneme /k/ | 57,41% | 3,70% | - | - | 1,85% | 37,04% | - |
| Phoneme /g/ | 18,52% | 3,70% | 38,89% | - | 1,85% | 24,07% | 12,96% |

Table 2 – Comparison between the severity of the phonological disorder and repair strategies employed for the /b/ phoneme

| Strategies | | MD | LMD | MSD | SD | p-value |
|------------------|---|--------|-------|--------|--------|------------------|
| None | n | 3 | 20 | 8 | 1 | p = 0,015 |
| | % | 100,00 | 71,43 | 53,33 | 50,00 | |
| Glottalization | n | 0 | 0 | 0 | 1 | |
| | % | 0,00 | 0,00 | 0,00 | 12,50* | |
| Desonorization | n | 0 | 8 | 5 | 4 | |
| | % | 0,00 | 28,57 | 40,00* | 50,00* | |
| Posteriorization | n | 0 | 0 | 1 | 1 | |
| | % | 0,00 | 0,00 | 6,67 | 12,50* | |
| Two or more | n | 0 | 0 | 0 | 1 | |
| | % | 0,00 | 0,00 | 0,00 | 12,50* | |

Caption 1: n: number of subjects; Mild Disorder (MD), Mild-Moderate Disorder (MMD), Severe-Moderate Disorder (SMD) and Severe Disorder (SG). * Results with statistical significance. Statistical test used: *Fisher's exact test*, with $p < 0.05$.

Table 3 – Comparison between the severity of the phonological disorder and repair strategies employed for the /d/ phoneme

| Strategies | | MD | MMD | MSD | SD | p-value |
|-------------------------|---|---------------|------------|---------------|---------------|------------------|
| None | n | 2 | 19 | 6 | 0 | p = 0,003 |
| | % | 66,67 | 67,86 | 40,00 | 0,00 | |
| Glottalization | n | 0 | 0 | 0 | 6 | |
| | % | 0,00 | 0,00 | 0,00 | 75,00 | |
| Desonorization | n | 0 | 6 | 5 | 4 | |
| | % | 0,00 | 21,43 | <u>33,33*</u> | <u>50,00*</u> | |
| Posteriorization | n | 1 | 3 | 2 | 1 | |
| | % | <u>33,33*</u> | 10,71 | 13,33 | 12,50 | |
| Two or more | n | <u>0</u> | 0 | <u>2</u> | 0 | |
| | % | <u>0,00</u> | 0,00 | <u>13,33</u> | 0,00 | |

Caption 1: n: number of subjects; Mild Disorder (MD), Mild-Moderate Disorder (MMD), Severe-Moderate Disorder (SMD) and Severe Disorder (SG). * Results with statistical significance. Statistical test used: *Fisher's exact test*, with $p < 0.05$.

Through the figures 1 and 2, it was observed that both in the phoneme /b/ and in /d/, no strategy was seen more frequently in MD decreasing its occurrence with the increasing severity of phonological disorder. The glottalization strategy and the use of more than one strategy occurred only in MSD and SD and the employment of the desonorization strategy increased with the degree of the phonological disorders.

There was no statistically significant difference for the phonemes /k/ and /g/ among the four degrees of phonological disorders. This happens because the distribution of repair strategies in each grade displays similar percentages.

■ **DISCUSSION**

The results show that there is no predominance of any repair strategy about the phonemes /b/, /d/ and /k/ in research subjects. This can be explained by the fact that these phonemes are acquired early, and the phonemes /b/ and /d/ occur with 1:6 months, the phoneme /k/ with 1:7 months and phoneme /g/ a little later, with 1:8 months¹. Likewise a study found that as the pivot point, the most common is the acquisition in the following order: lip > dental and alveolar > velar and palatal (e.g.: /p, b/ > /t, d, s, z/ > /k, g/)²³.

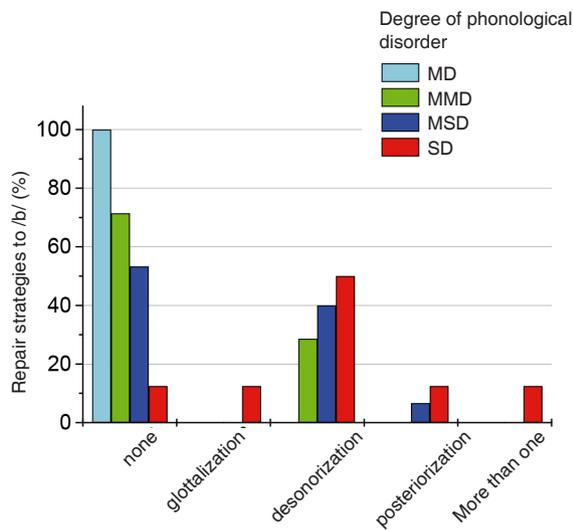


Figure 1 – Graph of repair strategies employed for the /b/ phoneme versus phonological disorder

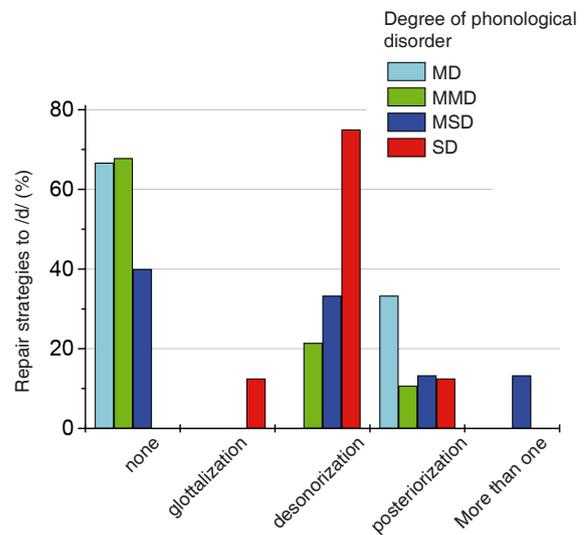


Figure 2 – Graph of repair strategies employed for the /d/ phoneme versus phonological disorder

Among the class of plosives, there was a predominance of desonorization repair strategy for the phoneme /g/, this is due to the fact this is a plosive more complex in terms of acquisition and production. As previously mentioned, the /g/ is a phoneme that fits in the class of velar consonants, and the later acquisition. One study claims that the desonorization strategy represents the difficulty in coordinating events and glottal supraglottic^{24, 25}. A delay in the onset of the sound makes the occlusive sound like soundless, demonstrating an impediment in the temporal-spatial organization of the movements of the articulators²⁶.

A study found the influence of some factors in overcoming the articulatory desonorization strategy and the consequent acquisition of voiced plosives. The factors mentioned by the author are: way of articulation (the sounding trace is established earlier in plosives than in the fricatives), the point of articulation (obstruent `sound [+ anterior] are acquired earlier), the position in the syllable and in the word (plosives with abnormal feature [voice] are more observed in the position of onset medial) and the pitch of the vowel following voiceless consonant (higher occurrence of desonorization in consonants preceding non-high vowels) and, finally, the influence of syllable stress (predominantly desonorization in unstressed syllables)²⁷.

From a study on the speech of children between 2:9 and 5:5, we observed the occurrence of desonorization repair strategies for the class of plosives²³. Another study also reports that one of the most common strategies for plosives was desonorization preferably in dorsal point²⁸. The research also studied the desonorization strategy in the plosive and fricative phonemes through acoustic and perceptual speech evaluation of children²⁹.

A study that researched 77 subjects in order to characterize the degree of severity of phonological disorder from the analysis of substitution and omission rates, also performing the analysis of the used repair strategies, it was found that in all degrees of severity the desonorization strategy was among the highest in incidence in the speech of children³⁰.

In regards to the /b/ phoneme, there was a statistically significant result in a posterior repair strategies and the use of two or more strategies in SD and desonorization in SD and in MSD. With this it can be inferred that children with SD have lower phonological knowledge therefore they have greater amount of repair strategies even phoneme being considered of earlier acquisition in the speech of children.

In more severe disorders, such as MSD and SD, glottalization strategies and the use of more than

one strategy occurred. One study noted the strategy of glottalization in the speech of a child for the class of plosives and fricatives, indicating the shutdown of the Node Point C for the mentioned classes. Still, this strategy determines unusual cases as deviant, as it is not observed in children with normal phonological development³¹. It is understood by Node Point C, the node of geometry of traces which regards to the traces of the point of articulation: [Lip], [coronal], [dorsal] and represents the place in the oral cavity where the phoneme is articulated¹¹.

A study emphasizes that the glottal functions as a *default* segment, without any complexity. Some children use the glottal to fill the skeletal space of other consonants which would be very complex. It was also noted the difficulty in noticing the glottal, which is often ignored in the phonetic transcriptions and analyzed as deletion of the segment¹¹.

In the /b/ phoneme there was a statistically significant difference for two or more strategies applied to the same phoneme in SD and in the /d/ phoneme; this fact was statistically significant in MSD. A study that researched the repair strategies of the liquids agrees with this, in which it was observed that the SD was the only one to present an association of more than one strategy applied to the same phoneme³².

As for the /b/ and /d/ phonemes it was observed that the desonorization strategy increased with the degree of phonological disorders. This is due to the fact that individuals who have SD show lower phonological knowledge and demonstrate greater number of repair strategies because its phonology is under construction. In a study that examined the relationship between repair strategies and presented phonological disorder, it was concluded that the greater the severity of the disorder, the more children use repair strategies, as they still do not know the segment or do not dominate its production³³.

In the /b/ and /d/ phonemes it was observed a higher occurrence of no strategy for the MD, decreasing as the degree of phonological disorders increased. A similar finding was found in a study on the repair strategies of the liquids, where there was a predominance of non-occurrence of strategies to repair the /l/, /l/ and /R/ phonemes for the MD. The authors of the study claim that in cases of MD it is observed a richer phonology, in which there are few repair strategies operating in the phonological system³².

The /k/ and /g/ phonemes showed no statistically significant difference between the four degrees of phonological disorders, as they demonstrated similar percentages in all of them, showing greater difficulty in performing velar plosive in this study group.

■ CONCLUSION

The more complex in terms of acquisition and production are the plosive, the more repair strategies

are used. Moreover, the higher the degree of phonological disorder, the greater the amount of times that this feature is used, demonstrating that the child has a minor phonological knowledge.

RESUMO

Objetivo: verificar a ocorrência ou não de estratégias de reparo para os fonemas /b/, /d/, /k/ e /g/ e a relação destas estratégias com a gravidade do desvio fonológico. **Método:** selecionados 54 sujeitos com diagnóstico de desvio fonológico que apresentavam estratégias de reparo para as consoantes plosivas /b/, /d/, /k/ e /g/ nas posições de *onset* inicial e/ou medial, com emprego de 40% em seu sistema fonológico. Os dados foram submetidos à análise estatística por meio do programa Statistical Analysis System, versão 8.02, utilizando-se o Teste Exato de Fisher. O nível de significância adotado para os testes estatísticos foi de 5% ($p < 0.05$). **Resultados:** verifica-se diferença estatisticamente significativa para o /b/ com maior frequência de dessonorização nas crianças com desvio moderadamente-grave e desvio grave, e de posteriorização, sendo utilizadas duas ou mais estratégias pelas crianças com desvio grave. Diferença estatisticamente significativa para o /d/ com maior frequência de posteriorização nos sujeitos com desvio leve, de dessonorização e duas ou mais estratégias naqueles com desvio moderadamente-grave e a dessonorização por aqueles com desvio grave. **Conclusão:** quanto mais complexos em termos de aquisição e produção são os fonemas plosivos, mais estratégias de reparo são utilizadas. E ainda, quanto maior o grau do desvio fonológico, maior é a quantidade de vezes que este recurso é usado, demonstrando que a criança possui um menor conhecimento fonológico.

DESCRITORES: Criança; Linguagem Infantil; Fala

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