Original Article

Use of repair strategies for fricative phonemes in phonological disorder

Emprego de estratégias de reparo para os fonemas fricativos no desvio fonológico

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ABSTRACT

Purpose: To verify and compare the occurrence of repair strategies used in the fricative consonants of Brazilian Portuguese, and to analyze the strategies applied for each fricative according to the severity of phonological disorders. **Methods:** Participants were 87 subjects of both genders, with ages between 4 years and 8 years and 11 months. All children used repair strategies involving at least one of the fricative consonants (/f/, /v/, /s/, /z/, /ʃ/, /ʒ/), with minimal occurrence of 40%. Data are from the phonological assessments conducted before phonological therapy, and the severity of phonological disorders was determined by the Percentage of Consonants Correct – Revised. Data were statistically analyzed. **Results:** There was progression in the use of repair strategies according to the production complexity of the phoneme. Repair strategies were found in all severities of phonological disorders, and the strategies that most affect speech intelligibility were found in more severe degrees. **Conclusion:** The more complex the fricative, the more repair strategies are used, and the more severe the phonological disorder, the more occurrences these strategies have.

Keywords: Language development; Speech disorders; Speech-language pathology; Child language; Speech

INTRODUCTION

It is known that during phonological acquisition, either normal or deviant, children present substitutions to some phonemes that, for them, are difficult to produce. These substitutions are named repair strategies or phonological processes[1].

Among the phoneme classes of Brazilian Portuguese, the fricatives are acquired relatively late and its substitutions involve, in general, the features [+/-anterior], [+voice] and [+continuant]. Therefore, there are several studies about this phoneme class in Brazilian Portuguese[2-4].

Studies in other languages also show the late acquisition of these phonemes. In German, for example, the fricatives and the liquids present constant regressions during the phonological development, and children have more difficulties acquiring velar fricatives[5]. In English, it was verified that 3-year-old children have phonetic inventories without some fricatives, affricates and the liquid /r/, and the predominant repair strategies, involving fricatives, were stopping, fronting and omission[6].

Recently, it was created a severity classification of phonological disorder (PD) based on distinctive features. This classification presents four categories. Children who present right productions of fricative phonemes would belong to category 3, which corresponds to a medium-high level of contrasts and would be indicative of moderate deviations[7]. This datum shows the complexity of the production of these phonemes.

Regarding the repair strategies that affect fricative consonants, two studies have shown that one of the most frequent processes during the phonological development is devoicing of fricatives[8,9]. Another research, about phonological acquisition in children with history of malnutrition, showed high occurrence of phonological processes involving velar fricatives[10].

In a research about the acquisition of the fricative phonemes /s/ and /z/ by children with PD, it was verified that the /s/ was only acquired by the age of nine, and the phoneme /z/ by the age of ten[3]. Complementary study involving the fricatives /f/, /v/, /ʃ/ and /ʒ/ evidenced that most repair strategies used by children with PD is, in general, the same applied by subjects with typical acquisition in the beginning of phonological development[4].

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Hence, it is verified the importance of conducting further studies involving the fricative consonants class, especially regarding deviant phonological acquisition, as aids for more successful therapeutic practices.

Thus, the purpose of this study was to verify and compare the occurrence of repair strategies used in fricative consonants of Brazilian Portuguese, and to analyze the strategies applied for each fricative according to the severity of phonological disorders.

METHODS

In this study, it was analyzed the permanent database of a research project linked to the Universidade Federal de Santa Maria (UFSM). This project was approved by the Research Ethics Committee of the institution under number 052/04. The database is composed by 198 subjects that presented the diagnosis of PD and were submitted to speech therapy. Pre-therapy speech data from 87 subjects who presented the inclusion and exclusion criteria adopted in this study were selected from this database.

The following inclusion criteria were adopted in this study: signature of the Free and Informed Consent Term by parents or legal guardians authorizing participation in the study, diagnosis of PD, age between 4 years and 8 years and 11 months, and occurrence of substitutions (devoicing, stopping, fronting, backing, affrication) and/or omission of some fricative consonants of Brazilian Portuguese (/f/, /v/, /s/, /z/, /ʃ/, /ʒ/) in initial and/or medial onset position, with 40% or more of occurrence of the repair strategy in the phonological system[11]. It's emphasized that, although the authors of this paper use the autossegmental phonology in most of their researches, in this study the Natural Phonology was used to classify the repair strategies (phonological processes) used by children. Hence, the outlined strategies are illustrated below:

- Devoicing: it's the substitution of a voiced consonant by its devoiced pair, such as /v/ → /f/ or /z/ → /s/;
- Stopping: substitution of a fricative by a plosive, such as /s/ → /t/;
- Fronting: substitution of a consonant produced in the posterior region of the oral cavity by a consonant produced in the anterior region of the oral cavity, such as /ʃ/ → /s/ or /s/ → /f/;
- Backing: it's the opposite of fronting, like /v/ or /f/ → /z/ or /s/ or /z/ → /ʒ/;
- Affrication: substitution of a fricative by an affricate, like /ʒ/ → /dʒ/;
- Omission: non-production of the consonant.

The exclusion criteria were: having undergone speech therapy before the first phonological evaluation, lack of consent from the parents/guardians, presence of other speech-language pathology alterations besides PD, and evident neurological, emotional and/or cognitive impairments.

Pre-therapy speech data were considered for analysis. The instrument *Avaliação Fonológica da Criança* (AFC)[12] was used to obtain the speech data. Speech samples were phonetically transcribed and afterwards the contrastive analysis was carried out. Data were judged separately by three judges with experience in phonetic transcription and auditory-perceptual analysis.

The severity of PD was determined based on the results of the contrastive analysis, by using the Percentage of Consonants Correct – Revised (PCC-R) classification[13]. The PCC-R does not consider the distortions produced by the subjects in the phonological errors score, and it is based on the Percentage of Consonants Correct (PCC) classification[14]. According to the PCC, PD severity can be mild (MD), mild-moderate (MMD), moderate-severe (MSD) and severe (SD). The calculation of PCC is based on the division of the number of correct consonants produced by the total number of consonants produced (correct + incorrect). The authors established that MD have PCC between 86 and 100%, MMD, PCC between 66 and 85%, MSD, PCC between 51 and 65%, and SD, PCC lower than 50%.

In this paper, the analysis subjects were the occurrence of repair strategies for the six studied consonants (/f/, /v/, /s/, /z/, /ʃ/ and /ʒ/), and the relationship of these strategies for each phoneme, according to PD severity. If a subjects used more than one repair strategy for the same consonant, another category, named "use of two or more repair strategies" was established, showing that the use of one strategy does not exclude the possibility of another one for the same phoneme.

Data were statistically analyzed through the program *Statistica,* version 7.0, using Pearson's Chi-square test to compare the consonants. For the comparison of the types of repair strategies used for each fricative consonant in relation to PD severity, the statistical program SAS *(*Statistical Analysis System), version 8.02 and Pearson's Chi-square test or Fisher's Exact test were used.

The significance level adopted for the statistical tests was 5% ($p<0,05$).

RESULTS

Regarding the comparison between the use or not of repair strategies among the six studied consonants, a progression in the use of substitutions/omissions (/f/ < /v/ < /s/ < /z/ < /ʃ/ < /ʒ/) was observed. Statistical significance were found for all consonant correlations ($p<0,05$).

Moreover, the prevalence of correct production was verified for the phonemes /f/, /v/ and /s/; in other words, more children used these consonants correctly rather than employed repair strategies. From the total sample of 87 subjects, the number of children that did not use repair strategies was 70 for the consonant /f/, 57 for /v/ and 52 for /s/. On the other hand, for the phonemes /z/, /ʃ/ and /ʒ/ the number of children who used repair strategies exceeded the number of children who produced the consonant correctly, for only 39, 37 and 15 children produced the phonemes /z/, /ʃ/ and /ʒ/ correctly, respectively.

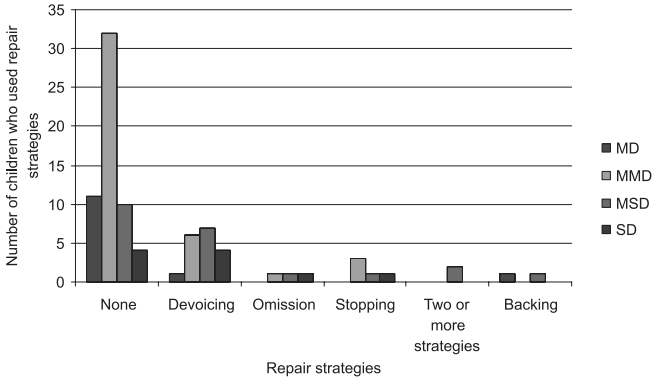
With regards to the use of repair strategies in the different PD severities, for the consonants /v/ and /ʃ/, the results showed statistical balance, with p-values 0.052 and 0.065, respectively (Figures 1 and 2). This means that it was not found a predominance of any repair strategy in the different severity degrees of PD.

In the comparison between the variable PD severity and the repair strategies presented by the individuals for the consonants /f/, /s/, /z/ and /ʒ/, statistical differences were observed:

- For consonant /f/, higher frequency of correct productions in children with MMD, backing in children with MD and MSD, stopping in children with MSD and SD, and omission in children with SD (Table 1).
- For consonant /s/, higher frequency of correct productions in individuals with MD and MMD, backing and stopping in children with MSD and SD (Table 2).
- For consonant /z/, higher frequency of correct productions in children with MD, devoicing in children with MMD and MSD, stopping and omission in children with MSD, two or more repair strategies in children with SD, and backing in children with MMD (Table 3).
- For consonant /ʒ/, higher frequency of fronting in individuals with MD and MMD, devoicing in children with MSD, two or more strategies in children with MSD and SD, stopping and omission in children with MSD, and affrication in SD (Table 4).

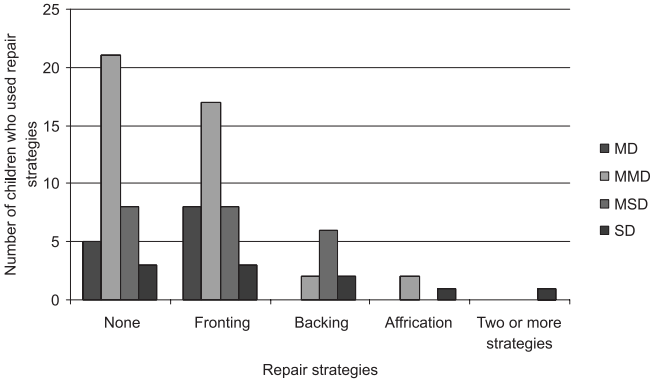
DISCUSSION

In the comparison between the use or not of repair strategies for fricative phonemes, an association with the chronology of acquisition of these sounds was observed, since the acquisition of the phoneme indicates its correct production. Using this variable as parameter, data in this research disagree with other studies on normal acquisition that have evidenced the emergence of voiced consonants before their devoiced pairs.



Note: MD = mild disorder; MMD = mild moderate disorder; MSD = moderate severe disorder; SD = severe disorder

Figure 1. Repair strategies used for the consonant /v/ *versus* severity of phonological disorder



Note: MD = mild disorder; MMD = mild moderate disorder; MSD = moderate severe disorder; SD = severe disorder

Figure 2. Repair strategies used for consonant /ʃ/ *versus* severity of phonological disorder

Table 1. Comparison between severity of the phonological disorder and repair strategies used for the phoneme /f/

Strategies	MD	MMD	MSD	SD	p-value
	n (%)	n (%)	n (%)	n (%)	
None	11 (84.62)	38 (90.48)*	16 (72.73)	5 (50.00)	0.006**
Omission	0 (0.00)	0 (0.00)	0 (0.00)	2 (20.00)	
Stopping	0 (0.00)	3 (7.14)	3 (13.64)*	3 (30.00)	
Backing	2 (15.38)*	1 (2.38)	3 (13.64)*	0 (0.00)	

** Significant values (p<0.05) – Fisher's Exact test

Note: MD = mild disorder; MMD = mild moderate disorder; MSD = moderate severe disorder; SD = severe disorder; * = results in which there was statistical significance

Table 2. Comparison between severity of the phonological disorder and repair strategies used for the phoneme /s/

Strategies	MD	MMD	MSD	SD	p-value
	n (%)	n (%)	n (%)	n (%)	
None	11 (84.62)*	29 (69.05)*	11 (50.00)	1 (10.00)	0.006**
Backing	2 (15.38)	7 (16.67)	5 (22.73)*	4 (40.00)	
Stopping	0 (0.00)	5 (11.90)	6 (27.27)*	3 (30.00)	
Affrication	0 (0.00)	1 (2.38)	0 (0.00)	1 (10.00)*	
Fronting	0 (0.00)	0 (0.00)	0 (0.00)	1 (10.00)*	

** Significant values (p<0.05) – Fisher's Exact test

Note: MD = mild disorder; MMD = mild moderate disorder; MSD = moderate severe disorder; SD = severe disorder; * = results in which there was statistical significance

Table 3. Comparison between severity of the phonological disorder and repair strategies used for the phoneme /z/

Strategies	MD	MMD	MSD	SD	p-value
	n (%)	n (%)	n (%)	n (%)	
None	12 (92.31)*	20 (47.62)	5 (22.73)	2 (20.00)	<0.001**
Devoicing	1 (7.69)	9 (21.43)*	8 (36.36)*	0 (0.00)	
Semivocalization	0 (0.00)	0 (0.00)	0 (0.00)	1 (10.00)*	
Stopping	0 (0.00)	4 (9.52)	3 (13.64)*	1 (10.00)*	
Fronting	0 (0.00)	0 (0.00)	0 (0.00)	1 (10.00)*	
Two or more strategies	0 (0.00)	2 (4.76)	2 (9.09)	5 (50.00)*	
Backing	0 (0.00)	7 (16.67)*	2 (9.09)	0 (0.00)	
Omission	0 (0.00)	0 (0.00)	2 (9.09)	0 (0.00)	

* = results in which there was statistical significance

** Significant values (p<0.05) – Fisher's Exact Test

Note: MD = mild disorder; MMD = mild moderate disorder; MSD = moderate severe disorder; SD = severe disorder

Table 4. Comparison between severity of the phonological disorder and repair strategies used for the phoneme /ʒ/

Strategies	MD	MMD	MSD	SD	p-value
	n (%)	n (%)	n (%)	n (%)	
None	3 (23.08)	9 (21.43)	2 (9.09)	1 (10.00)	0.005
Fronting	9 (69.23)*	19 (45.24)*	4 (18.18)	1 (10.00)	
Devoicing	1 (7.69)	9 (21.43)	6 (27.27)*	2 (20.00)	
Two or more strategies	0 (0.00)	3 (7.14)	6 (27.27)*	4 (40.00)*	
Stopping	0 (0.00)	2 (4.76)	3 (13.64)*	1 (10.00)	
Omission	0 (0.00)	0 (0.00)	1 (4.55)*	0 (0.00)	
Affrication	0 (0.00)	0 (0.00)	0 (0.00)	1 (10.00)*	

* = results in which there was statistical significance

** Significant values (p<0.05) – Fisher's Exact Test

Note: MD = mild disorder; MMD = mild moderate disorder; MSD = moderate severe disorder; SD = severe disorder

However, considering the complexity of production regarding articulatory place, the present study is similar to others (/f/ and /v/ < /s/ and /z/ < /ʃ/ and /ʒ/)[2,15].

On the other hand, in the presence of PD, fricatives /s/ and /z/ showed the same behavior observed in this study, i.e., more repair strategies employed for /z/ than for /s/[3]. For fricatives /f/, /v/, /ʃ/ and /ʒ/, the acquisition order was partially diverging, since /ʃ/ emerged first, followed by /f/, /v/ and, finally, /ʒ/[4].

As for the predominance of repair strategies, this research corroborates data from typical acquisition, in which there were more substitutions for the phonemes /ʃ/ and /ʒ/[15]. Furthermore, this result might be explained based on distinctive features hierarchy, since the consonants /ʃ/ and /ʒ/ have features acquired later and, therefore, are in a more complex level than the other fricatives[16-18].

The highest occurrence of repair strategies in the more severe PD degrees also occurred in other studies, since in this condition children show less phonological knowledge and still don't know the sound or don't dominate its production, presenting more sounds not-acquired in the phonological system. The same occurred for the use of two or more strategies for the same sound, as well as for the occurrence of omissions and stopping, which also indicate less phonological knowledge and results in greater impairment in speech intelligibility[19]. On the contrary, children with milder PD tend to present less repair strategies because they present a richer phonology than the others[20-23].

The repair strategies most frequently found in this research were similar to those of typical acquisition, namely, omission and substitutions involving the features [continuant], [voice] and [anterior]. Typical acquisition data showed prevalence of substitutions of the feature [continuant] for the sounds /f/ and /v/; however, in this research, only the fricative /f/ presented such behavior. As for fricatives /ʃ/ and /ʒ/, data were different from typical acquisition, because in another study there was prevalence of substitutions of the features [anterior] and [continuant][15]. For the phoneme /s/, only the occurrence of backing is similar to this research, which is different from the prevalence of omissions that occurred in typical acquisition. The substitutions of /z/ were similar to those found in this work (backing and devoicing)[2].

Further, the occurrence of omissions, fronting and backing agree with another research about typical acquisition[24].

In deviant acquisition, for the sound /s/, prevalence of backing and stopping were observed, besides low occurrence of sound omissions, data similar to those found in this research. Data regarding the phoneme /z/ are according to this work regarding the high occurrence of correct productions, devoicing, stopping and backing, but are different with regards to sound omission[3]. For the sound /f/ there was high occurrence of

correct productions, backing and stopping, which are partially different from the results of this research. For consonants /v/ and /ʃ/, it's not possible to establish relationships, since the results were statistically balanced. Finally, for /ʒ/, the prevalence of correct production found in another study is different from this one, and the high occurrence of fronting, devoicing and stopping was similar[4].

In the comparison of the strategies with the severity of PD, in general, data that presented statistical significance were similar to the results of a study about the use of repair strategies in the onset position related to PD severity, in which was observed backing and fronting in MD; devoicing and backing in MMD; backing and stopping in SD. Only in MSD data were different, since the authors found prevalence of fronting and devoicing, whereas in this study backing, stopping, devoicing and omission were the most found[23].

It is important to emphasize that, although the number of individuals in the sample was quite significant, it would be inappropriate to generalize the obtained results in this paper to all children with PD. Moreover, it is not possible to extend the results to other sound classes.

The results of this study can contribute to the elaboration of therapeutic approaches to treat children with alterations in fricative sounds, since they evidence differences regarding the use of repair strategies for fricatives in different severities of PD. Thus, intervention planning could be elaborated according to the severity of the PD presented by the child. Furthermore, our results could guide the choice of phonological processes to be approached during intervention, in the application of the Cycles Model, for example.

CONCLUSION

The results presented in this research show that, the more complex the fricatives in terms of acquisition and production, the more repair strategies are employed. Moreover, the higher the severity of the PD, the more times this resource is used, which shows less phonological knowledge by the child, such as the use of omission and stopping, or the use of two or more strategies for the same sound.

RESUMO

Objetivo: Verificar e comparar a ocorrência de estratégias de reparo empregadas nas consoantes fricativas do Português Brasileiro, além de analisar as estratégias aplicadas para cada fricativa em relação à gravidade do desvio fonológico. **Métodos:** Participaram do estudo 87 sujeitos de ambos os gêneros, com idades entre 4 e 8 anos e 11 meses. Todos apresentavam estratégias de reparo envolvendo pelo menos uma das consoantes fricativas (/f/, /v/, /s/, /z/, /ʃ/, /ʒ/), com ocorrência mínima de 40%. Os dados são provenientes de avaliações fonológicas pré-terapia, com a gravidade do desvio fonológico determinada pelo cálculo do Percentual de Consoantes Corretas – Revisado. Os dados foram analisados estatisticamente. **Resultados:** Houve progressão no emprego de estratégias de reparo conforme a complexidade de produção do fonema. As estratégias de reparo foram encontradas em todas as gravidades do desvio fonológico, estando as que mais comprometem a inteligibilidade de fala nos graus mais acentuados. **Conclusão:** Quanto mais complexa a fricativa, mais estratégias de reparo são empregadas e, quanto maior o grau do desvio fonológico, mais vezes estes recursos são utilizados.

Descritores: Desenvolvimento da linguagem; Distúrbios da fala; Patologia da fala e linguagem; Linguagem infantil; Fala

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