

PHONOLOGICAL THERAPY WITH THE USE OF COMPUTERS: CASE REPORT

Terapia fonológica com uso de computador: relato de caso

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ABSTRACT

The purpose of this study is the phonological changes through phonological therapy with the use of computers in cases of phonological disorders. We carried out a case study on four subjects (S1, S2, S3 and S4) with ages between 4:7 and 5:3 year old, male and female, with phonological disorders, that took part in this research. The subjects were submitted to the Phonological Evaluation of the Child, Repetitive-Articulator Test, Stomatognathic System Evaluation, Phoneme Discrimination Picture Test, Stimulability Test, and audiological evaluation. The subjects were organized in pairs according to the similarities of their phonological systems. One subject of each pair was treated with traditional phonological therapy and the other with a computer as the main therapeutic resource (experimental therapy). The evaluation data were analyzed, and after that, the results of the subjects submitted to the traditional therapy (S1 and S2), and the results of the subjects submitted to the experimental therapy (S2 and S3) were compared through the Fisher's exact test, considering a statistical significance level of 5% ($p < 0.05$). We verified that the improvements of the subjects S3 and S4 submitted to the experimental therapy was higher when compared to the subjects S1 and S2, submitted to the traditional therapy. In addition, the result was statistically significant. The results of this research showed that the use of the experimental therapy was positive when treating children with phonological disorders. However, there is a need for further studies in order to increase the sample to confirm the findings. Thus, the computer can be used as an instrument for the phonological therapy.

KEYWORDS: Speech-Language Pathology; Rehabilitation of Speech and Language Disorders; Software; Computer-Assisted Instruction; Speech; Child

■ INTRODUCTION

A study¹ shows that the majority of children, from birth to age five, has the maturation of phonological knowledge in a gradual process, not linear and individual variations, resulting in the establishment of a system consistent with the target-adult. However, there are kids whose phonological system differs

on the path followed, and the same different of the phonology of the language of their environment and therefore inappropriate in relation to this, characterizing the Phonological Disorders.

The phonological disorder is defined as a disorder manifested by the use of abnormal linguistic patterns in the middle of spoken language, in which the pronunciation difficulties include a significant number of speech sounds, especially consonants, as well as changes in syllable structure. In phonological disorder it is not detected organic pathology underlying the disorder² thus the difficulty is in the phonology domain³.

Once diagnosed with phonological disorder, phonological therapy is the means used to accomplish this reorganization of the child's phonological system, which is based on various therapeutic models. Among these models it can be pointed out the therapy with Modified Maximum Opposition

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Model⁴ whose goal is to make the child perform the reorganization of her/his phonological system through auditory perception, imitation and spontaneous production of the target words. As in the first stage the child must imitate the model given by the therapist, and achieve a higher percentage than or equal to 80% of correct productions in order to pass to the next stage of spontaneous production. In the second stage, the targets must be produced without the immediate model of the therapist⁵.

In speech therapy sessions are held several activities in order to stimulate certain sounds, so-called target sounds. Among the main therapeutic strategies are the sets of rules, the use of pictures and games in general, working in a playful manner, in order to install and automate the target sounds. This is the traditional form of therapy activities, aiming to make it, besides stimulating, interesting to children.

Based on the interest that children demonstrate, each day earlier, in the computer, the therapists have sought to broaden their strategies so that therapy becomes something attractive to the child, seeking solutions to obtain viable means of interaction and stimulation. Because of this search, the specific *softwares* are a good way to innovate speech therapy, which are used as a complement to standard therapy form, aiming to make it more suitable to the children's current interests.

The use of *softwares* in speech and language therapy has grown tremendously in recent years, with the aid of new and exciting technological tools. It must be considered that the use of this feature can make a better use of the time duration of a therapeutic process, enabling a quicker development of the child. Despite all the benefits described, it must be also pointed out the need to prove the effectiveness of the *softwares* for speech therapy⁶.

In some countries, like the United States, the *softwares* with therapeutic purposes are widespread in many areas of the Phonoaudiology. In Brazil, there is the *FonoSpeak software*, supervised by Claudia M. Speech Braun, with is directed for speech and language therapies, which focus on the acquisition, training, and automation of phonemes. The *software* offers visual and auditory resources, interactive games that encourage the acquisition and production of phonemes that are being treated by the therapist⁷.

Considering the possibility of using *software* in speech-language therapies, the importance of this work should be in the possibility of expanding therapeutic strategies for the treatment of phonological disorders. The aim of this case study was to investigate the phonological changes from the phonological therapy with the use of computer in cases of phonological disorder.

■ CASE REPORT

The study of the case has many applications and can be used both in educational practice and in research mode, with qualitative and quantitative approaches, aiming at the investigation of the specific case. The importance of the case study is due to the exploration of new discoveries, as it is able to make hypotheses and build theories. Furthermore, it is important to explore atypical or extreme cases allowing a better understanding of the typical processes. Still, the case report is important in exploratory and comparative research, when the purpose is to understand behavior and conceptions in different subjects⁸.

This case report, an exploratory and comparative study with qualitative and quantitative approach, came from the speech data of four subjects (S1, S2, S3 and S4) aged from 4:7 and 5:3 with phonological disorder. The research was conducted in two locations, a Service of Phonoaudiology from an institution of higher education, and a private speech therapy clinic. The recruitment of subjects was carried out in a school in the northeast region of the state of Rio Grande do Sul, and in speech screening from a health clinic in the central region of the state, where they were evaluated 16 and 13 subjects respectively.

Inclusion criteria were normal hearing for speech-tone average, be monolingual speakers of Brazilian Portuguese (BP) and have at least two missing phonemes in the phonological system; the matched phonological systems of subjects should be as similar as possible and involve changes in the class of fricatives and liquids.

Exclusion criteria of the study were change of stomatognathic system that harmed the correct production of speech or caused some distortion (featuring a phonetic disorder), hearing disorders, suggestive behaviors of mental retardation, language delay, and emotional changes that could influence the therapy, and also have done speech therapy.

Every subject underwent the following evaluations: phonological through the Phonological Assessment of Children instrument: *Avaliação Fonológica da Criança* (AFC)⁹, stomatognathic system¹⁰, repetitive articulatory exam, Figures Test for Phonemic Discrimination¹¹, stimulability proof¹² and audiological evaluation. Besides this, the severity of phonological disorder was classified according to the Percentage of Correct Consonants – Revised (PCC-R)¹³.

The subjects were selected by convenience sampling and matched by the degree of phonological disorder and similarity between the phonological

systems. Figure 1 presents the characterization of the subject, the gender, age, severity and general phonological system. As to the condition of phonemes it was considered, as early study¹⁴ states that the acquired phoneme is characterized with

80% or more correct productions, partially acquired phonemes had correct productions from 40 to 79%, and non acquired phoneme had correct production inferior to 40%.

Subject	Gender	Age	Severity of the PD	Phonological System		
				Acquired	Partly Acquired	Non Acquired
S1	F	4y 7m	MMD	Ol: /p/, /b/, /t/, /d/, /k/, /g/, /m/, /n/, /ɲ/, /f/, /v/, /s/, /z/, /ʃ/, /dʒ/, /l/	OM: /k/	Ol: /ʃ/, /z/, /R/
				OM: /p/, /b/, /t/, /d/, /k/, /g/, /m/, /n/, /ɲ/, /f/, /v/, /s/, /z/, /ʃ/, /dʒ/, /l/		OM: /ʃ/, /z/, /r/, /R/
				CM: /s/		CM: /r/
				CF: /s/		CF: /r/
S2	F	5y	MSD	Ol: /p/, /t/, /g/, /m/, /n/, /f/, /ʃ/, /dʒ/, /l/, /R/	Ol: /b/, /d/, /v/, /ʃ/	Ol: /k/, /s/, /z/, /z/
				OM: /p/, /t/, /d/, /m/, /n/, /ɲ/, /f/, /z/, /l/, /R/	OM: /k/, /v/, /s/, /ʃ/, /dʒ/	OM: /b/, /g/, /z/, /r/, /k/, /r/
				CM: /s/		CM: /r/
						CF: /s/, /r/
S3	M	5y 1m	MMD	Ol: /p/, /b/, /t/, /d/, /k/, /g/, /m/, /n/, /f/, /v/, /s/, /z/, /l/	OM: /k/	Ol: /ʃ/, /z/, /R/
				OM: /p/, /b/, /t/, /d/, /k/, /g/, /m/, /n/, /ɲ/, /f/, /v/, /s/, /z/, /l/		OM: /ʃ/, /z/, /r/, /R/
				CM: /s/		CM: /r/
				CF: /s/		CF: /r/
S4	F	5y 3m	MSD	Ol: /p/, /t/, /d/, /v/, /m/, /n/, /f/, /s/, /ʃ/, /dʒ/, /l/	Ol: /b/, /k/, /f/	Ol: /g/, /s/, /z/, /ʃ/, /z/, /R/
				OM: /p/, /t/, /d/, /m/, /n/, /ɲ/, /f/, /s/, /ʃ/, /l/	OM: /b/, /k/, /v/, /ʃ/	OM: /g/, /z/, /z/, /k/, /r/, /R/
					CM: /s/, /dʒ/	CM: /r/
						CF: /r/, /s/

Legend: PD: Phonological Disorders; MMD: Mild Moderate Deviation; MSD: Moderate Severe Deviation.

Figure 1 – Characteristics of the subjects pre-treatment

The matched subjects were treated in accordance to the Modified Maximum Opposition Model¹⁴. For S1 and S3 the target phonemes were /r/ and /z/ and the target words were: /ma'ziCE/ (“magia”) X /ma'riCE/ (“maria”) ; /fe'r«w/ (“feirão”) X /fe'Z«w/ (“feijão”); /'NARA/ (“Nara”) X /'NAZA/ (“naja”); /es'toro/ (“estouro”) X /es'toZo/ (“estojo”); /'bera/ (“beira”) X /'beZa/ (“beija”). For S2 and S4 the target phonemes were /r/ and /z/ and the target words were: /'kara/ (“cara”) X /'kaza/ (“casa”); /'mara/ (“Mara”) X /'maza/ (“Maza”); /pi'r«w/ (“pirão”) X /

pi'z«w/ (“pisão”); /'t ra/ (“tora”) X /'t za/ (“tosa”); /'vara/ (“vara”) X /'vaza/ (“vaza”).

The selection of subjects to be treated with speech therapy with the aid of computer was performed by random drawing among the selected pairs. S1 and S2 received standard phonological therapy without the use of the computer. S3 and S4 received experimental therapy, with the aid of the computer, for this, we used the *FonoSpeak software's* activities and activities designed in the Microsoft Office *PowerPoint* 2007 program, which

involved mainly discrimination tasks, imitation and naming of targets, all following the same structure of the treatment.

After being matched, for the subjects reside in distinct regions of the state of Rio Grande do Sul, S1 and S3 were treated by a PhD Phonoaudiologist from an institution of higher education at a private practice, while S2 and S4 were treated by an academic from the eighth term of the Phonoaudiology course from an Institution of Higher Education, at the teaching clinic of a speech therapy service.

In the standard therapy, the therapist-patient interaction was used as a way of phonological stimulation, with the aid of recreational activities which encouraged the production of target phonemes. In experimental therapy, there was also interaction between patient and therapist, but the computer was used as the primary means for this interaction, allowing the subject to have this as the main support for the treatment of phonological disorders during the session.

To collect data for this research, it was conducted ten individual sessions, lasting 35 minutes each twice a week. Always at the beginning and at the end of each session was performed auditory bombardment. Prior to treatment it was performed at baseline as well as at the end of each therapeutical cycle; surveys were conducted in order to evaluate the therapeutic evolution⁴.

The base line and the surveys were conducted using six words for each phoneme that was partially acquired or not acquired in different syllabic positions as recorded in AFC⁹. The selected words to test the target sounds treated were different from those used in the treatment. For S1 and S3 it was probed 60 words and for S2 and S4 132 words. The collection of the baseline and surveys were recorded and transcribed phonetically.

This research is part of the "Therapy of the Phonological Disorders" Project which was approved by the Ethics and Research Committee of the Higher Education Institution under number 0210.0.243.000.10. It is noteworthy that every parent and/or guardian by the participants in

theresearch signed the Informed Consent Form (ICF), according to Resolution 196/96, and the subjects orally consented to their participation in the research. Furthermore, those responsible for school and health clinic, where the subjects were recruited, as well as the teaching clinic where two subjects were treated, signed the Institutional Authorization.

Then, we compared the percentage of correct productions of phonemes from the baseline and of the second survey for all subjects. Finally, we compared the production of words, the second survey, among subjects undergoing standard therapy without computer use (S1 and S2), with matched subjects undergoing experimental therapy with the aid of the computer (S3 and S4) by means of the Fisher exact test, considering statistical significance of 5% ($p < 0,05$).

■ RESULTS

Figure 2 illustrates the acquired, partially acquired and not acquired phonemes in the phonological system of subjects S1, S2, S3 and S4 in the baseline survey and in the second survey after two cycles of treatment. It can be observed that S1 acquired only /Z/ on initial *onset*, S2 acquired only the phoneme /s/ on initial *onset*, while S3 acquired /S/ and on initial and medial *onset*; /R/ on initial *onset* and /r/ on medial *onset* and /r/ on medial and final *coda*, and S4 acquired the phonemes /b/ /s/ /f/ on initial *onset* and /b/ on medial *onset*.

One can verify that when comparing S1 and S2, treated with standard phonological therapy, both acquired only one phoneme in the phonological system. By comparing S3 and S4 treated with experimental therapy, S3 acquired a greater number of phonemes in the phonological system in relation to S4. Furthermore, by comparing the evolution of S1 and S2 to S3 and S4 it is observed that the S3 and S4 subjects who underwent experimental therapy had a higher evolution for the acquisition of phonemes than S1 and S2 who underwent standard therapy.

	Baseline			After 2 cycles		
	Acquired	Partly Acquired	Non Acquired	Acquired	Partly Acquired	Non Acquired
Subject 1	OM: /λ/		OI: /ʒ/, /ʃ/, /χ/ OM: /ʒ/, /ʃ/, /R/, /r/ CM: /r/ CF: /r/	OI: /ʒ/ OM: /λ/	OI: /ʃ/ OM: /ʃ/, /ʒ/	OI: /R/ OM: /R/, /r/ CM: /r/ CF: /r/
Subject 2	OI: /b/, /d/ OM: /b/, /ʃ/	OI: /s/, /ʃ/	OI: /k/, /v/, /z/, /ʒ/ OM: /k/, /g/, /v/, /s/, /z/, /r/, /λ/, /dʒ/ CM: /r/, /s/ CF: /r/	OI: /b/, /d/, /s/ OM: /b/, /ʃ/	OI: /v/, /ʃ/	OI: /k/, /z/, /ʒ/ OM: /k/, /g/, /v/, /s/, /z/, /r/, /λ/, /dʒ/ CM: /r/, /s/ CF: /r/
Subject 3	OM: /λ/		OI: /ʒ/, /ʃ/, /R/ OM: /ʒ/, /ʃ/, /R/, /r/ CM: /r/ CF: /r/	OI: /ʒ/, /ʃ/, /R/ OM: /λ/, /ʃ/, /ʒ/ CM: /r/	CF: /r/	OM: /χ/, /r/
Subject 4	OM: /ʃ/, /dʒ/	OI: /b/, /f/, /s/, /z/ OM: /b/, /v/, /z/	OI: /k/, /g/, /ʃ/, /ʒ/, /χ/ OM: /k/, /g/, /ʒ/, /r/, /λ/, /R/ CM: /r/, /s/ CF: /r/	OI: /b/, /f/, /s/, /t/ OM: /b/, /ʃ/, /dʒ/	OI: /z/, /ʃ/, /ʒ/ OM: /v/, /ʒ/	OI: /k/, /g/, /χ/ t OM: /k/, /g/, /z/, /r/, /R/, /λ/ CM: /r/, /s/ CF: /r/

Figure 2 – Acquired, partially acquired and non acquired phonemes in the phonological system of the subjects S1, S2, S3 and S4 at baseline and after two cycles of treatment

Table 1 shows the comparison of correct and incorrect productions between s1 and s2, subjected to standard therapy, and S3 and S4, who underwent experimental therapy, the 2nd Survey, i.e. after two

cycles of therapy. It can be observed that S3 and S4 had a higher percentage of correct production than S1 and S2, and this difference was statistically significant.

Table 1 – Analysis of production of the targets probed from S1 and S2 (standard therapy) and S3 and S4 (experimental therapy) after two cycles of therapy

	Correct Production % (n)	Incorrect Production % (n)	p
S1 and S2 (standard therapy)	33,72% (58)	66,28% (154)	0,0001
S3 and S4 (Experimental therapy)	51,16% (88)	48,84% (84)	

Note: Static analysis Fisher's exact test, p <0.05

Table 2 shows data from the subjects separated in pairs as they were treated. These results indicate that the fact of each pair received different

treatment by therapists did not influence the evolution of phonological systems of the subjects.

Table 2 – Analysis of production of the targets probed from S1 and S2 and S3 and S4 after two cycles of therapy

	Correct Production % (n)	Incorrect Production % (n)	p
S1	33,33 (20)	66,67 (60)	
S3	88,33 (53)	11,67 (7)	0,0001
S2	28,79 (38)	71,21 (94)	
S4	41,67 (55)	58,33 (77)	0,0296

Note: Static analysis Fisher's exact test, $p < 0.05$

Legend: S1: subject 1; S2: subject 2; S3: subject 3; S4: subject 4.

■ DISCUSSION

In Figure 2 we can observe the changes in the phonological systems of the subjects after two cycles of therapy. Studies^{5,15-23} define that these changes occur because of the generalizations that are an important criterion for measuring the progress achieved with the treatment. In phonological therapy there are two essential concepts: structural and functional generalization^{5,15-23}.

The structural generalization can occur when a child uses the pattern learned in other words that were not targeted in therapy; when she/he learns a sound in a word position and performs correctly in the other positions; when learning extends to other sounds belonging to the same class sound which had been learned, or when extending to other classes of sounds^{5,15-23}.

The structural generalization refers to the way in which each child rearranges her/his phonological system^{5,15-21,23}. After 10 sessions of therapy it was observed that S1 and S2, who underwent standard therapy phonological, obtained changes due to generalization in the phonological system, S1 treated with the target sounds /r/ X /Z/, acquired the phoneme /b/ on initial onset, generalizing the treatment to another class of sounds. In the case of S2 who just acquired the phoneme/s/ on initial onset, generalization occurred within the same class of sounds, as one of the sounds was the target phoneme/z/ also belonging to the class of fricatives.

In S3 and S4 subjects who underwent experimental therapy, it can be observed an increased number of generalizations compared to S1 and S2. S3 who had as target sounds phonemes /r/ and /Z/ acquired phoneme /S/ which belongs to the class

of affricates on initial onset and phoneme /z/ belonging respectively to the fricative and plosive classes. Moreover, generalization occurred to another position in the word because it was acquired phoneme /z/ on initial onset and the same phoneme was treated in the medial onset position.

Finally for the S4 it was possible to observe the occurrence of generalization in another position of the word with the acquisition of phoneme onset and the same initial phoneme was treated in medial onset, and the occurrence of generalization to another class of sounds with the acquisition of phonemes /S/, /Z/ and belonging to classes of sounds that were not treated.

Table 1 shows that the subjects who underwent experimental therapy, S3 and S4, had more evolution when compared to S1 and S2, suggesting that the use of the computer can offer an effective therapy leading to changes in receptive and expressive language²⁴ as well as enabling further therapeutic evolution⁶.

However the findings disagree with a study⁶ which did not find statistically significant difference between therapeutic performance of children with speech and language disorders undergoing therapy with the use of computer and therapy without the use of the computer. The study⁶ considers that the result can be explained by the limited number of a therapy session per week which lasts 30 minutes during 8 weeks.

In contrast, other studies^{25, 26} have proved that best results are found in subjects who have used computers, or combined both types of therapy than when using only the standard therapeutic strategy.

The biggest therapeutic evolution, observed for S3 and S4, may have occurred because the computer is more attractive to children, causing

them to become more focused and motivated in what they are doing. Corroborating it a study²⁷ revealed that computer use in therapy is more attractive than therapy without this feature and that therapy with the use of the computer was generally preferred by both therapists and the children in the study. In addition, other studies^{6, 28} reported that motivation has been an influential variable for the evolution of phonological systems.

Still, when compared to subjects undergoing experimental therapy, S3 had a higher evolution, after 10 therapy sessions, than S4. This finding shows that the severity of Phonological Disorder may have influenced the changes in the phonological system of these kids²⁸⁻³⁰ as S3 had Moderate-Light

disorder, with fewer number of altered phonemes, while S4, which had Moderate-Severe disorder, with a larger number of altered phonemes.

■ CONCLUSION

The research findings indicate that the use of the computer as the main tool for the case study allowed changes in the phonological system; moreover, it was more favorable to changes in the phonological system than standard therapy. Thus, the computer can be used as a tool in phonological therapy. However, there is need for further studies increasing the sample to confirm the findings.

RESUMO

O tema desse artigo aborda as mudanças fonológicas a partir da terapia fonológica com o uso de computador em casos de desvio fonológico. Realizou-se estudo de caso de quatro sujeitos (S1, S2, S3 e S4) com idade entre 4:7 e 5:3, de ambos os gêneros, com desvio fonológico. Realizou-se a Avaliação Fonológica da Criança, Exame Articulatório Repetitivo, Avaliação do Sistema Estomatognático, Teste de Figuras para Discriminação Fonêmica, Prova de Estimulabilidade e avaliação audiológica. Os sujeitos foram divididos em duplas de acordo com a semelhança dos sistemas fonológicos, sendo que um sujeito de cada dupla foi tratado com terapia fonológica padrão e outro com uso de computador como principal recurso terapêutico (terapia experimental). Os dados das avaliações dos sujeitos foram analisados e, após, foram comparados os resultados dos submetidos à terapia padrão (S1 e S2), com os pareados submetidos à terapia experimental, com auxílio do computador, (S3 e S4) por meio do teste Exato de Fisher, considerando significância estatística de 5% ($p < 0,05$). Verificou-se que a evolução dos sujeitos S3 e S4 submetidos à terapia experimental foi maior em relação à evolução de S1 e S2 submetidos à terapia padrão, sendo este resultado estatisticamente significativo. Os achados da pesquisa demonstram terem sido favoráveis o uso da terapia experimental no tratamento de crianças com desvio fonológico. Contudo, há necessidade de realização de outros estudos com ampliação casuística para confirmação dos achados.

DESCRITORES: Patologia da Fala e Linguagem; Reabilitação dos Transtornos da Fala e da Linguagem; Software; Instrução por Computador; Fala; Criança

■ REFERENCES

1. Lamprech RR. Aquisição Fonológica do Português. Porto Alegre: Artmed, 2004.
2. Grunwell, P. The nature of phonological disability in children. London: Academic Press, 1981.
3. Mota HB. Terapia fonoaudiológica para os desvios fonológicos. Rio de Janeiro: Revinter, 2001. 109p.
4. Bagetti T, Mota HB, Keske-Soares M. Modelo de Oposições Máximas Modificado: uma proposta de tratamento para o desvio fonológico. Rev Soc Bras Fonoaudiol. 2005;10(1):36-42.
5. Ceron MI, Keske-Soares M. Terapia fonológica: a generalização para outra posição na palavra. Rev. CEFAC [online]. 2009;11(2):199-206.
6. Wren Y, Roulstone S. A comparison between computer and tablestap delivery of phonology therapy. Internatioanl Journal of Speech-Language Pathology. 2008; 10(5):346-63.
7. Software FonoSpeak: descrição e domonstração. Disponível em: <http://www.ctsinformatica.com.br/#fonospeak.html{paginaProduto!10&2>
8. Ventura, MA. O Estudo de Caso como Modalidade de Pesquisa. 2007;20(5):383-6.

9. Yavas M, Hernandorena CLM, Lamprecht RR. Avaliação Fonológica da Criança: reeducação e terapia. Porto Alegre: Artes Médicas, 1991. 148p.
10. Marchesan IQ. Fundamentos em Fonoaudiologia: aspectos clínicos da motricidade oral. Rio de Janeiro: Guanabara Koogan, 1998.
11. Carvalho BS, Mota HB, Keske-Soares M. Teste de Figuras para Discriminação Fonêmica: Proposta e Aplicação.[dissertação] Santa Maria-RS, Universidade Federal de Santa Maria, 2007.
12. Castro MM. Descrição da estimulabilidade e da consciência de fala em crianças com transtorno fonológico.[dissertação] São Paulo-SP, Faculdade de Medicina da Universidade de São Paulo, 2009.
13. Shriberg L, Austin D, Lewis B, McSweeney J, Wilson D. The percentage of consonants correct (PCC) metric: extensions and reliability data. *J Speech Lang Hear Res.* 1997;40:708-22
14. Bernhardt, B. The application of nonlinear phonological theory to intervention with one phonologically disorders child. *Clin. Linguist. Phon.* 1992;6(1-2):123-45.
15. Mota HB, Bagetti T, Keske-Soares M, Pereira LF. A generalização em sujeitos com desvio fonológico médio-moderado tratados pelo modelo de oposições máximas. *Rev Soc Bras Fonoaudiol.* 2004; 9:102-11.
16. Barberen, L, Keske-Soares M, Mota HB. Generalização no tratamento com o /R/ em um caso de desvio fonológico médio-moderado. *Rev Soc Bras Fonoaudiol.* 2004; 9:229-36
17. Elbert M, Gierut JA. Handbook of clinical phonology. London: Taylor & Francis Ltda; 1986.
18. Mota HB, Pereira LF. A generalização na terapia dos desvios fonológicos: experiência com duas crianças. *Pró-Fono.* 2001; 13(2):141-6.
19. Mota HB. Fonologia: Intervenção. In: Ferreira, LP; Befi-Lopes, DM; Limonge, SCO. Tratado de Fonoaudiologia. São Paulo: Roca; 2004. p. 787-814.
20. Donicht G, Plagiarin KC, Mota HB, Keske-Soares M. O tratamento com os róticos e a generalização obtida em dois modelos de terapia fonológica. *J. Soc. Bras. Fonoaudiol.* 2011;23(1):71-6.
21. Ceron MI, Keske-Soares M. Terapia fonológica: a generalização a itens não utilizados no tratamento (outras palavras). *Rev. CEFAC.*2007;9(4):453-60.
22. Masterson JJ, Rvachew S. Use of technology in phonological intervention. *Seminars in Speech and Language.* 1999;20(3):233-49.
23. Ceron MI, Keske-Soares M. Terapia fonológica: a generalização dentro de uma classe de sons e para outras classes de sons. *Rev. CEFAC,* 2008;10(3):311-20
24. Martins JS, Pinheiro MMC, Blasi HF. A utilização de um software infantil na terapia fonoaudiológica de Distúrbio do Processamento Auditivo Central. *Rev Soc Bras Fonoaudiol.* 2008;13(4):398-404.
25. Seferoglu G. Improving students' pronunciation through accent reduction software. *British Journal of Educational Technology.*2005; 36(2):303–16.
26. Shriberg L, Kwiatkowski J, Snyder T. Tabletop versus microcomputer-assisted speech management: Response evocation phase. *Journal of Speech and Hearing Disorders.* 1990;55:635–55.
27. Roulstone S, Wren Y. Investigation of theoretical models and therapy activities: Phonological difficulties. *International Journal of Language and Communication Disorders.* 2001;36:441–6.
28. Keske-Soares M, Brancalioni AR, Marini C, Pagliarin KC, Ceron MI. Eficácia da terapia para desvios fonológicos com diferentes modelos terapêuticos. *Pró-Fono R. Atual. Cient., Set* 2008;20(3):153-8.
29. Gonçalves GF, Keske-Soares M, Checalin MA. Estudo do papel do contexto linguístico no tratamento do desvio fonológico. *Rev. soc. bras. fonoaudiol.* [online]. 2010;15(1):96-102.
30. Williams AL. Multiple oppositions: theoretical foundations for an alternative contrastive intervention framework. *Am. J. Speech-Lang. Path.* 2000;9:282-8.

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