Case Report

Relato de Caso

Phonological changes after the application of therapy approach based on distinctive features in the treatment of phonological disorder

Mudanças fonológicas após aplicação de abordagem terapêutica baseada em traços distintivos no tratamento do desvio fonológico

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Keywords

Speech
Speech disorders
Articulation disorders
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ABSTRACT

This study aimed to compare the phonological changes due to the application of a speech therapy approach based on distinctive features, using two types of target sounds (the ones which emphasize the contrast, and others which reinforce the distinctive features) in the treatment of phonological disorder. The sample was constituted by seven children with phonological disorder (four boys and three girls), with ages between 3 years and 10 months and 6 years and 9 months. The children were classified according to the severity of the phonological disorder and then underwent treatment based on the Modified Maximal Oppositions Model. Two subjects were grouped for each degree; one subject was treated by "contrast" and the other one by "reinforcement" of the distinctive features in which they showed difficulties. The moderate-severe degree was the only one to include only one subject. After 20 therapy sessions, the phonological changes before and after the treatment were analyzed, considering the type of stimulus presented ("contrast" or "reinforcement"). All subjects, either treated by "contrast" or "reinforcement", showed an increase in their Percentage of Consonants Correct (PCC), in the number of acquired sounds and of generalizations in their phonological inventories. It was verified that both groups presented changes in their phonological inventories. On the comparative analysis between the groups, it was observed that both groups, treated by "contrast" and by "reinforcement", demonstrated differences regarding the types of generalizations studied.

Descritores

Fala
Distúrbios da fala
Transtorno da articulação
Fonoterapia
Criança

RESUMO

Este estudo teve como objetivo comparar as mudanças fonológicas decorrentes da aplicação de uma abordagem de terapia fonoaudiológica baseada em traços distintivos, utilizando dois tipos de sons-alvo (que enfatizam o contraste e que enfatizam o reforço de traços distintivos) no tratamento do desvio fonológico. A amostra foi constituída por sete crianças (quatro meninos e três meninas) com desvio fonológico, com idades entre 3 anos e 10 meses e 6 anos e 9 meses. As crianças foram classificadas de acordo com o grau do desvio fonológico e posteriormente, foram submetidas ao tratamento por meio do Modelo de Oposições Máximas Modificado. Em cada grau foram agrupados dois sujeitos, sendo que um foi tratado pelo "contraste" e o outro pelo "reforço" dos traços distintivos que apresentavam dificuldade. Somente o grau moderado-severo foi composto por apenas um sujeito. Após 20 sessões terapêuticas foram analisadas as mudanças fonológicas pré e pós-tratamento, considerando-se a forma de apresentação do estímulo ("contraste" e "reforço"). Todos os sujeitos tratados pelo "contraste" e pelo "reforço" apresentaram aumento no Percentual de Consoantes Corretas, no número de sons adquiridos e nas generalizações em seus inventários fonológicos. Verificou-se que ambos os grupos apresentaram mudanças em seus inventários fonológicos. Na análise comparativa entre os grupos foi observado que os dois grupos, tratados pelo "contraste" e pelo "reforço", demonstraram diferenças em relação aos tipos de generalizações apresentadas.

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INTRODUCTION

Most children develop phonological aspects of their mother tongue without difficulties. Nevertheless, there are children who present difficulties in this process. The etiologic factors of these children are not known, thus they suffer from what is called phonological disorder.

One of the means that have showed to be efficient for the treatment of phonological disorder is the application of phonology-based therapy models. This type of treatment is a language therapy whose objective is to promote the reorganization of the phonological inventory through phonological chances, aiming the generalization[1] and, consequently, an improvement on the intelligibility of the children's speech.

The generalization is an expansion of the learning process, and it leads to the success of the therapy, being considered an important criterion to measure the efficacy of the therapy[2,3]. This expansion is related to an improvement regarding the substituted phonemes pre and post-treatment, not only regarding the sounds trained, in the positions trained, but also in what refers to non-target sounds in positions that haven't been trained[4,5]. Several studies analyzed the generalization after the application of different models of phonological therapy[2,4,6-9].

The intervention process of phonological disorder should begin with an evaluation and complete analysis of the children's phonological inventory, in order to facilitate the choice of the targets, which can lead to a reorganization or re-structuring of the phonological inventory, due to the generalization[1,4,6,10].

The Modified Maximal Oppositions Model[1] is a model of intervention based on phonology that contrasts two words that differ in only one phoneme, which is different from the other because of various distinctive features.

Different variables have been studied regarding the selection of target-segments to be contrasted in the minimal pairs and their efficiency, such as the number of distinctive features which are different among the segments, the type of contrast among the features that compose the phonemes (major or non-major class features), and in relation to the phonological inventory of the children (new or known phoneme). One variable that can contribute for the choice of the target-segments is related to the distinctive features that are present on the contrastive sounds, as the same ones can "contrast" or "reinforce" the values of the features in which children have difficulty.

In the relevant literature, studies approaching specifically the contrastive or reinforced distinctive features in phonological models have not been found. This research aimed to concentrate on these aspects, in order to contribute to the choice of a more effective therapy approach when the distinctive features are focused on the treatment of the disorder. Therefore, the objective of this study was to compare the phonological changes due to the application of a phonological therapy approach based on distinctive features, using two types of target-sounds (which emphasize the "contrast" or "reinforcement" of the distinctive features) in the treatment of children with phonological disorder who have been treated according to the Modified Maximal Oppositions Model.

CLINICAL CASES PRESENTATION

The sample comprised seven children (four boys and three girls), aged between 3 years and 10 months and 6 years and 9 months. The children participated on the research after their parents or guardians signed the Informed Consent Term, authorizing their participation on the study. All the children were treated in a Speech and Language Study Center (Centro de Estudos de Linguagem e Fala – CELF) of the Universidade Federal de Santa Maria (UFSM). The study was registered in the Project Office and was approved by the Research and Ethics Committee of the same university under number 052/2004.

The participants selected had been indicated for therapy in the Speech and Language Study Center, under the diagnostic hypothesis of phonological disorder. In order to confirm the diagnosis of phonological disorder, all the subjects underwent speech therapy evaluations (anamnesis**,** receptive and expressive language, stomatognathic system, auditory and phonological discrimination) and complementary assessment (neurological, ENT, audiological and psychological). This way, the criteria of inclusion in the study were that the subjects needed to have a diagnosis of phonological disorder and present different degrees of severity of phonological disorder.

The children were classified according to the severity of phonological disorder and, afterwards, underwent the treatment through the Modified Maximal Oppositions Model. For each severity degree, two subjects have been gathered except for the moderate-severe degree, for which there was only one subject (S3). One of the subjects (S4) was not included in the research, due to the fact that the subject's phonological inventory did not allow the selection of target-segments that were compatible with the research purpose, making it impossible to draw any comparisons. S3 was maintained in the research because, since it was treated by "contrast", it could be important for the comparisons regarding PCC, acquired segments and types of generalizations performed by the subjects of Group 1. The subjects were distributed in the following manner: two subjects with severe disorder (SD), one with moderate-severe (MSD), two with mild-moderate (MMD) and two subjects with mild disorder (MD), comprising a total of seven subjects.

To each degree of the phonological disorder, one subject was treated by "contrast" and the other by "reinforcement" of distinctive features in which they presented difficulties. As for the "contrast" approach, it was considered the use of target--segments that had opposite values for the same feature (e.g. /l/ [+voice] and /s/ [-voice]). To the "reinforcement" approach, the use of target-segments with identical values for the same feature was considered (e.g. /ʒ/ [+voice] and /g/ [+voice]).

In order to facilitate the comprehension and characterization of the subjects, those who were treated by "contrast" (Group 1) were identified with odd numbers, and those treated by "reinforcement" (Group 2), with even numbers. Hence, S1, S3, S5 and S7 (Group 1) received phonological intervention by "contrast" and S2, S6 and S8 (Group 2) by "reinforcement".

The speech data was obtained through the application of the Phonological Assessment of Child Speech[11], in which the naming of pictures enables the assessment of all the sounds in

the child's phonological inventory , in different positions of the syllable and of the word.

The data was analyzed referring to the distinctive features and the contrastive analysis. According to the contrastive analysis, it was possible to determine the Percentage of Consonants Correct (PCC)[12] and to obtain the phonological inventory of each subject. In the phonological inventory, a sound was considered present when it was correctly produced in 80% of the words or more.

The analysis of the phonological inventory and of the distinctive features in which the children had difficulties enabled the selection of the target-segments. The distinctive features of higher difficulty were those involving substitutions present in a superior number of phonemes. The target-segments chosen should be different in at least two distinctive features, in order to obtain segment pairs with maximal oppositions. Upon the selection of the target-segments, the subjects underwent treatment through the Modified Maximal Oppositions Model, with different approaches of distinctive features.

In order to compare the changes in the phonological inventories of the subjects treated by "contrast" and by "reinforcement" considering the different severities of the phonological disorder, a comparison of their initial (IPE) and final (FPE) phonological evaluations has been carried out. These data have been analyzed and, whenever possible, they have been submitted to the Wilcoxon test ($p<0.05$). To verify if there was any difference among the subjects treated by "contrast" (Group 1) and the ones approached through "reinforcement" (Group 2), the Kruskal-Wallis non-parametric test ($p<0.05$) was employed.

The distribution of the phonological inventories of the children prior to the phonological therapy can be visualized in Chart 1.

It is possible to observe that the more severe the phonological disorder is, the higher the number of absent segments presented by the subject. The subjects with mild disorder did not present any absent segments, only partially acquired segments.

The target-sounds focused on during the therapy, the type of stimulus selected and the distinctive features on which the children had difficulties before the phonological treatment can be seen on Chart 2.

The subjects were treated by the Modified Maximal

Chart 1. Inventory phonological before the treatment

Degrees	Subject	p	b	t	d	k	g	f	v	s	z	ʃ	ʒ	m	n	ɲ	l	ʎ	r	R
SD	S1	p	___	t	___	k	___	f	___	___	___	ʃ	___	m	___	ɲ	___	___	___	___
	S2	p	___	t	___	k	___	f	___	(s)	___	ʃ	___	m	n	___	___	___	___	___
MSD	S3	p	b	t	d	___	___	f	v	(s)	(z)	ʃ	ʒ	m	n	ɲ	___	___	___	___
MMD	S5	p	b	t	d	k	g	f	v	___	___	ʃ	ʒ	m	n	ɲ	l	ʎ	___	R
	S6	p	(b)	t	(d)	k	___	f	___	s	(z)	ʃ	___	m	n	ɲ	l	ʎ	r	R
MD	S7	p	b	t	d	k	g	f	v	s	z	ʃ	ʒ	m	(n)	ɲ	l	ʎ	r	R
	S8	p	b	t	d	k	g	f	v	(s)	(z)	ʃ	ʒ	m	n	ɲ	l	ʎ	r	R

Note: SD = severe disorder; MSD = moderate-severe disorder; MMD = mild-moderate disorder; MD = mild disorder; ( ) = partially acquired segment; ___ = no acquired segment

Chart 2. Altered distinctive feature pre- treatment, target-sound focused on the therapy and the kind of stimulus selected

Degrees of PD	Subjects	Difficulty with feature	Target segment	Contrastive or reinforced distinctive features	Type of stimulus
SD	S1	[+voice],[-voc], [cor/+ant], [+cont]	/s/ x /ʎ/	Contrast [+/-voice], [cor+/- ant], [+/-cont] reinforcement [-voc].	"Contrast"
	S2	[+voice], [-voc], [cor/+ant], [+cont]	/r/ x /z/	Reinforcement [+voice], [cor/+ant], [+cont], [-voc]	"Reinforcement"
MSD	S3	[-voc], [dors], [+/-cont], [cor/+-ant]	/R/ x /ʎ/	Contrast [dors/cor], [+/-cont], reinforcement [-voc]	"Contrast"
MMD	S5	[cor/+-ant], [+cont], [-voc]	/z/x /ʎ/	Contrast: [+/-cont] e [cor+/-ant] reinforcement: [-voc]	"Contrast"
	S6	[+voice]	/ʒ/ x /g/	Reinforcement [+voice]	"Reinforcement"
MD	S7	[-aprox], [-voc]	*/n/x/r/	Contrast [-aprox], Reinforecement [-voc]	"Constrast"
	S8	[-cont], [cor/+-ant]	*[tʃ]x/ʎ/	Reinforcement [-cont] e [cor/-ant].	"Reinforcement"

Note: PD = phonological disorder; SD = severe disorder; MSD = moderate-severe disorder; MMD = mild-moderate disorder; MD = mild disorder; * partially acquired segment in the initial evaluations, considered as news

Table 1. Phonological changes in subjects treated by "contrast" (Group 1)

Subject and severity degree	PCC		AS		Generalizations average (%)							
	IE	FE	IE	FE	Lexical items non used during treatment		Other word positions		Inside a sound class		Other sound classes	
					IE	FE	IE	FE	IE	FE	IE	FE
S1-SD	46.69	68.08	7	9	11.25	48.57	0	20.95	11.04	43.76	12.95	29.82
S3-MSD	52.68	88.32	11	17	0	75	0	90	0	93.75	42.17	80.60
S5-MMD	75.83	92.85	16	19	0	100	50	100	1.85	87.50	-	-
S7-MD	95.54	97.52	18	19	33.33	87.50	77.27	83.33	-	-	-	-
p-value	0.067		0.067		0.027*		0.042*		0.017*		0.017*	

* Significant values (p<0,05) –Wilcoxon Test

Note: SD = severe disorder; MSD = moderate-severe disorder; MMD = mild-moderate disorder; MD = mild disorder; PCC = Percentage of Consonant Correct; AS = acquired segments; IE = initial evaluation; FE = final evaluation

Oppositions Model[1] . For this paper, only the 20 first therapy sessions were considered, except for S7, who underwent ten therapy sessions and was discharged from speech therapy.

Table 1 shows the values of PCC, the acquired segments and the average of generalization pre and post-therapy, in the subjects treated by "contrast" of the distinctive features (Group 1)

It is possible to observe that the subjects treated by "contrast" showed an increase on PCC and on the number of acquired segments. Nonetheless, the difference between these variables, comparing the IPE and the FPE, was not significant (p=0.067). All the subjects treated by "contrast" showed generalization to items which had not been used during the treatment for other positions in the word, inside a sound class and also on other sound classes.

The values of PCC, the acquired segments and the average of generalizations pre and post-treatment of the subjects treated by "reinforcement" of the distinctive features (Group 2) are shown on Table 2.

It can be perceived that the subjects treated by "reinforcement" had an increase on PCC and on the number of acquired segments, as well as on the types of generalization (in regard to items that were not used in the treatment, other positions of the words and inside a sound class), even though there were no significant differences on the initial and final evaluations. Only the generalization to other sound classes was significant (p=0.017).

Table 3 shows the values of PCC, the acquired segments and the average of generalization pre and post-therapy,

Table 2. Phonological changes in subjects treated by "reinforcement" (Group 2)

Subject and severity degree	PCC		AS		Generalizations average (%)							
	IE	FE	IE	FE	Lexical items non used during treatment		Other word positions		Inside a sound class		Other sound classes	
					IE	FE	IE	FE	IE	FE	IE	FE
S2-SD	48.38	70.54	7	10								
S6-MMD	82.03	95.19	13	16	0	83.33	14.28	66.66	60.41	83.33	40	85.71
S8-MD	91.13	97.43	17	19	50	87.50	-	-	16.66	40	62.50	93.75
p-value	0.108		0.108		0.067		0.067		0.126		0.017*	

* Significant value (p<0,05) –Wilcoxon Test

Note: SD = severe disorder; MMD = mild-moderate disorder; MD = mild disorder; PCC= Percentage of Correct Consonant; AS = acquired segments; IE = initial evaluation; FE = final evaluation

Table 3. Comparison of phonological changes between the groups treated with "contrast" and the group treated with "reinforcement"

Treatment	PCC		AS		Generalizations average (%)							
	IE	FE	IE	FE	Lexical items non used during treatment		Other word positions		Inside a sound class		Other sound classes	
					IE	FE	IE	FE	IE	FE	IE	FE
C	70.16	86.69	13	16	9.30	72.44	25.26	63.68	7.13	61.72	25.93	52.35
R	73.84	87.72	12.33	15	10	56.54	5.71	56.66	36.15	57.69	26.35	73.42
p-value	0.723		0.853		0.461		0.508		0.264		0.122	

Kruskal-Wallis non-parametric test (p<0,05)

Note: C = contrast; R = reinforcement; PCC = Percentage of Correct Consonants; AS = acquired segments; IE = initial evaluation; FE = final evaluation

comparing Group 1, treated by "contrast", to Group 2, treated by "reinforcement".

There was also a similar increase on Groups 1 and 2, regarding PCC, on the number of acquired segments with therapy and on the number of types of generalization. No significant differences were observed among the subjects treated by "contrast" or "reinforcement" of distinctive features.

DISCUSSION

In this study, several phonological changes were observed, such as acquisition on the phonological inventories after therapy, what was possible due to the occurrence of generalizations.

In the selection of target-segments approached by "contrast", the choice of segments that contrasted as many distinctive features in which the subjects had difficulties as possible was preferred. S1, for instance, showed difficulties in the distinctive features [+voice], [-voc], [cor/+ant] and [+cont]. The target-segments selected for the treatment were /s/ and /l/, which contrasted the majority of the distinctive features in which the subject had difficulties ([+/-voice], [cor+/-ant], [+/-cont]). Regarding the selection of target-segments addressed by ''reinforcement'', the distinctive features in which the subjects showed difficulties were stimulated in two segments, that is to say that they had a ''reinforced'' stimulation. In this case, it is possible to use S2 as an example, who had difficulties in the features [+voice], [-voc], [cor/+-ant], [+cont] in the initial evaluation. The target-segments /r/ and /z/ were selected for the treatment, since both of them present the majority of the distinctive features in which the subject had difficulties ([+voice], [cor/+ant], [+cont]). This way, the target-segments chosen for all subjects had maximal opposition of distinctive features and approached most distinctive features which the subjects had difficulties in, preferably by contrast or reinforcement.

A study[8] indicates that it is important to consider the initial phonological inventory and the distinctive features that are altered more frequently in order to choose the therapy target, as this is what enables the generalization. Nevertheless, studies analyzing the ''contrast'' or ''reinforcement'' of these altered distinctive features have not been found in the literature.

In this study, it was possible to observe that not only the subjects treated by ''contrast'', but also the ones treated by ''reinforcement'' showed an increase on PCC and on the number of acquired segments. Studies[3,13] about phonological disorder therapy verified superior values of PCC on the final evaluation. The major increase of PCC of the subjects treated by ''contrast'' of features occurred for MSD, whilst on subjects treated by ''reinforcement'' the major increase occurred for SD. Another study[14], which was developed on a phonological basis using the Modified Cycles Model, found an increase of PCC for subjects with MMD.

Regarding the number of acquired segments, it was observed that on the group treated by ''contrast'', the subject with MSD was the one who showed a larger number of acquired segments[6] , followed by the subject with MMD[3] , the subject with SD[2] and, finally, the subject with MD[1]. Therefore, the children with intermediate phonological alterations (MSD and MMD) were the ones to achieve a superior number of acquired segments with the therapy. The subjects with SD and MMD treated by ''reinforcement'' were the ones to show a higher number of segment acquisitions with the therapy, as long as each subject acquired three sounds along the therapy process. The subject with MD acquired only two segments, and, therefore, continued to have a complete phonological inventory. Another study[14] verified that there was an increase on the number of acquired segments on the final phonological inventory of children with MMD, followed by MD and, finally, MSD. The acquisition of sounds after the applications of phonological models is also observed by other authors[2-6,8-10,15] .

The disorder severity of the subject with SD, treated by "contrast" of features, decreased for MMD in the FPE, and the subjects with SMD and MMD also developed for MD. The subject with MD was the only one to remain with the same severity degree in the FE, even though the PCC of the subject reached approximately 100%. This result can suggest a possible failure in the classification process when the PCC is approximately 100%, because then the subject would generally present a phonological inventory that is virtually acquired, and it would not seem adequate to classify this subject as having a phonological disorder.

Concerning generalization, it can be verified that the subjects treated by "contrast" presented generalization on items that were not employed during the treatment. In addition, there was an increase on the generalization average, mainly for MMD, followed by SMD, then MD and, finally, SD. The subjects with intermediate severity (SM and MM) showed this type of generalization the most. The subjects treated by "reinforcement" also showed an increase of correct productions of the target-sounds in other words that have not been stimulated during the therapy. The subject with MMD was the one to show the highest number of generalizations on items which were not employed on the treatment, followed by the one with MD. Similar results regarding generalization to other words have been suggested in other researches[7,9].

In what regards to the generalization to other positions in a word, reported in several studies[7-9], it can be observed that in the group treated by "contrast" the subject with MSD showed an increase on the number of correct production of the segments in other positions of the word, followed by one with MMD and the one with SD. The subject with MD was the one that presented this type of generalization the least.

In the group treated by "reinforcement", there was also an increase on the correct production of target-segments in other positions of the word and for segments belonging to the same class as the target-segment. The generalization for other positions in the word occurred similarly on the subjects with MMD and the ones with SD. The increase of generalization for segments of the same class was similar among the subjects with MD, MMD and SD.

The generalization within a sound class and to another sound class was observed in subjects with different severities of the phonological disorder, either treated by "contrast" or by "reinforcement". These types of generalization support especially the acquisition of sounds in the phonological inventory

of children, and they have been verified in other studies as well[2,8,9].

Both the subjects treated by "contrast" and the ones treated by "reinforcement" showed generalization to items that had not been used along the treatment, for other positions of the word, for the same segment class and for other segment classes. These various types of generalization were addressed by several researches[2,7-9,14].

One element that may have intervened in the phonological changes is the characteristics that can be associated to the phonological disorder and to the functional aspects of generalization, that is, the intra-subject aspects, such as the phonological knowledge.

The fact that the subjects with SD did not show several changes in their phonological systems after therapy may be explained by a smaller phonological knowledge, considering the speaker's competence regarding the sound system of his/her language.

The subjects with MD were the ones that showed fewer phonological changes, related to the increase of PCC, to the number of acquired segments, and to generalizations. However, it must be considered that these subjects already had few alterations on the phonological system and, consequently, a lower possibility of generalization.

FINAL COMMENTS

In this research, the subjects obtained phonological changes after the application of the Modified Maximal Oppositions Model, characterized by an increase on PCC and on the number of acquired segments, and by the generalization on their phonological inventories.

It was possible to verify that, according to the comparison of the phonological changes on the group of subjects treated by "contrast" and on the one treated by "reinforcement", both groups showed changes in their phonological system. Some generalizations (to items that were not employed in the treatment and whithin a sound class) were greater for subjects treated by "contrast" and others (generalization for other word positions and other sound classes) were greater for the subjects treated by "reinforcement". The increase regarding the PCC and the number of acquired phonemes was similar in both groups.

The knowledge about the phonological inventory of the child that presents a disorder and of the types of possible generalizations can be useful to a more effective selection of the target-sound ("contrast" or "reinforcement"). Focusing on the distinctive features on which the children present major difficulties can enable a better selection of target-sounds in models that focus on the distinctive features. This way, they can also contribute to the acquisition of the phonological inventory by the subjects, consequently improving their speech intelligibility. Moreover, this focus can contribute to diminish the intervention period on the therapy process of children with phonological disorders.

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