

Residual Speech Errors – preliminary study on characteristics of phonetic/phonological systems in Brazilian Portuguese speakers

Erros Residuais de Fala – estudo preliminar sobre características dos sistemas fonético/fonológico em falantes do Português Brasileiro

Errores Residuales de Habla – estudio preliminar sobre las características de los sistemas fonético/fonológico en hablantes del Portugués Brasileño

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Abstract

Introduction: Residual Speech Errors can be characterized as remnants of an important previous speech delay. **Purpose:** To show preliminary data, related to the phonetic/phonological system of a group of subjects with Residual Speech Errors. **Methods:** This is a cross-sectional, retrospective and quantitative study based on medical records of 39 subjects with Residual Speech Errors, aged nine years or older. Information such as segmental speech changes, characterized by distortions and phonological processes, age and gender was investigated. The variables were entered in an Excel spreadsheet and submitted to statistical analysis. **Results:** The diagnosis of Residual Speech Errors was the most frequent

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in the sample, which had a prevalence of boys in the age group of nine and ten years old. There was a higher occurrence of phonological processes involving the fricatives /ʃ/ and /ʒ/, the liquid /r/ phoneme and consonant cluster reduction. In relation to the phonetic system, distortions involving phones [r], [s] and [X] were found. There was a significant statistically difference for the consonant cluster reduction involving phoneme /l/ by females and the substitution of the /s/ phoneme between the age groups, with a greater percentage of errors for the 11-12 age group. **Conclusion:** Residual Speech Errors occurred in a higher percentage in the age group of nine and ten years old, in boys. Such errors can be characterized by phonological processes and/or phonetic distortions, involving fricatives and liquids.

Keywords: Child; Child Development; Speech; Phonological Disorder; Speech Disorders

Resumo

Introdução: Erros residuais de Fala podem ser caracterizados como resquícios de um importante atraso de fala progressivo. **Objetivo:** Apresentar dados preliminares, relativos ao sistema fonético/fonológico de um grupo de sujeitos com Erros Residuais de Fala. **Métodos:** Estudo transversal, quantitativo, realizado a partir de um levantamento de dados de prontuários de 39 sujeitos com Erros Residuais de Fala, com idade igual ou superior a nove anos. Foram analisadas informações como alterações segmentais de fala, caracterizadas por distorções e processos fonológicos, idade e sexo. As variáveis foram organizadas em uma planilha do Excel e submetidas à análise estatística. **Resultados:** A amostra ficou formada predominantemente por meninos, na faixa etária dos nove e dez anos. Notou-se maior ocorrência de processos fonológicos envolvendo os fonemas fricativos /ʃ/ e /ʒ/, a líquida /r/ e redução de encontro consonantal. Em relação ao sistema fonético, identificaram-se, principalmente, distorções envolvendo os fones [r], [s] e [X]. Observou-se diferença estatisticamente significativa, para a redução de encontro consonantal, envolvendo o fonema /l/ pelo sexo feminino e substituição do fonema /s/ entre as faixas etárias, com porcentagem de erros maior para a faixa etária dos 11-12 anos. **Conclusão:** Os Erros Residuais de Fala ocorreram em maior porcentagem na faixa etária dos nove e dez anos, em meninos. Tais erros podem ser caracterizados por processos fonológicos e/ou distorções fonéticas, envolvendo fricativas e líquidas.

Palavras-chave: Criança; Desenvolvimento infantil; Fala; Transtorno fonológico; Distúrbios da fala

Resumen

Introducción: Los Errores Residuales de Habla pueden caracterizarse como remanentes de un retraso importante en el habla anterior. **Objetivo:** Presentar datos preliminares relativos al sistema fonético/fonológico de un grupo de sujetos con Errores Residuales de Habla. **Métodos:** Estudio transversal, cuantitativo, realizado a partir de una recogida de datos de registros médicos de 39 sujetos con Errores Residuales de Habla, con edad igual o superior a nueve años. Se han analizado informaciones como las alteraciones segmentales de habla caracterizado por distorsiones y procesos fonológicos, edad y sexo. Las variables fueron organizadas en una hoja de cálculo de Excel y sometidas a análisis estadístico. **Resultados:** La muestra se ha formado mayoritariamente por niños del sexo masculino, en la franja etaria de nueve a diez años. Se ha observado una ocurrencia más grande de procesos fonológicos con relación a los fonemas fricativos /ʃ/ y /ʒ/, la líquida /r/ y reducción de grupo consonántico. Respecto al sistema fonético, se han identificado, principalmente, distorsiones involucrando los fonos [r], [s] y [X]. Se ha notado diferencia estadísticamente significativa para la reducción de grupo consonántico, involucrando el fonema /l/, por el sexo femenino y sustitución del fonema /s/ entre franjas etarias, con porcentaje de errores más grande para la franja de edad de los once y doce años. **Conclusión:** Los Errores Residuales de Habla han ocurrido en mayor porcentaje en la franja etaria de los nueve y diez años, en los niños del sexo masculino. Tales errores se pueden caracterizar por procesos fonológicos y/o distorsiones fonéticas, involucrando fricativas y líquidas.

Palabras clave: Niño; Desarrollo Infantil; Habla; Trastorno Fonológico; Trastornos del Habla

Introduction

The literature uses the term “Residual Speech Errors” to describe cases of subjects who have changes in the production of speech segments of unknown origin, which persist beyond nine years of age, even in cases that have undergone speech-language therapy¹⁻⁴. Residual Speech Errors are characterized by speech disorders that are produced by older children or adults, and can be understood as remnants of a speech delay, involving fricatives and liquids⁵.

Shriberg, et.al. proposed the Speech Disorders Classification System (SDCS) in order to classify speech disorders, including Residual Speech Errors¹. SDCS is based on aspects such as the typology and etiology of speech disorders. As for typology, the SDCS divides speech disorders into four categories: Normalized Speech Acquisition (NSA); Speech Delay (SD); Motor Speech Disorder (MSD) and Speech Errors (SE), which can occur in children aged three to nine years. All of these categories are called Residual Speech Errors for children nine years of age or older, being differentiated by the nature of the disorder¹.

This classification places Residual Speech Errors in the context of speech disorders and is widely reported in the literature^{1-3,5-8}. This study focused on errors resulting from speech delay (SD) and speech errors (SE), which may be derived from cognitive-linguistic processing; auditory-perceptual processing or issues related to affectivity, or characterized by distortions involving fricatives and/or liquids respectively¹.

Subjects with Residual Speech Errors have been neglected by researchers in the field of speech, with a limited number of studies on this topic^{3,6}. Although this term is reported in some studies⁷⁻⁹ in the national literature, only one study that specifically investigated aspects related to the written language of this population was found.

Studies on speech and language disorders allow speech-language pathologists to recognize and characterize the difficulties presented by their patients and, thus, manage to develop therapeutic planning and therapeutic strategies promoting language development, as a whole⁹. It is believed that the residual errors observed for Brazilian Portuguese speakers in this preliminary study will be similar to those observed in English speakers.

Thus, this study aimed to show preliminary data related to the phonetic/phonological system of a group of subjects with Residual Speech Errors.

Methods

This cross-sectional, retrospective and quantitative study was carried out based on data collection in medical records of subjects with speech disorders at a Speech-Language Pathology care provided in Caxias do Sul, Rio Grande do Sul. This study is part of a larger project that was approved by the Research Ethics Committee of the Higher Education Institution where it was developed, under the no. 54143916.3.0000.5523.

Initially, all medical records from 2007 to 2016 of patients with “speech changes” as main complaint and age equal to or above nine years were selected for data collection. Inclusion and exclusion criteria were applied after this first selection. The following inclusion criteria were followed so that patient data were included in this study: Informed Consent Form (ICF) of the speech-language pathology care duly signed and attached to the patient’s medical record; speech-language complaint, such as changes in speech, speaking incorrectly, exchanges of letters, difficulties in speech and writing and difficulties in the pronunciation of certain speech sounds; speech-language diagnosis of phonological disorders, phonetic disorders or phonetic/phonological disorders; and age equal to or above nine years. Medical records that had conditions such as, for example, dyspraxia, disfluency, learning disabilities or lack of information required to carry out this study were excluded from the analyzes.

According to these criteria, four of the 43 medical records previously selected were excluded as they did not have the relevant data for this study or because they had inconsistent and confusing information, making it difficult to interpret and compile the information, totaling a sample of 39 medical records.

Then, the patient’s history (age and gender) and, especially, the evaluation and summaries of the initial phonetic/phonological system, before starting the speech therapy intervention, were observed for the analysis of the speech data of the 39 selected medical records. The phonological processes and/or distortions performed by the patient, as well as the percentage of occurrence, are

recorded in the summaries of the evaluations, in the medical records. Thus, it is possible to identify the phonological processes and/or phonetic distortions produced by each subject.

After being collected, these data were analyzed, entered in an Excel spreadsheet and submitted to statistical treatment using the SAS (Statistical Analysis System) version 9.2.

The sample profile was described using frequency tables for categorical variables, with absolute (n) and percentage (%) frequency values, and

descriptive statistics for continuous variables, with mean, standard deviation, minimum and maximum values and median. Fisher's exact test was used to compare categorical variables and a significance level of 5% ($p < 0.05$) was adopted for all analyzes.

Results

Table 1 contains information on the age and gender of the 39 study subjects, with a prevalence of boys, aged 10.85 years.

Table 1. Characterization of study subjects according to age group and gender

	Mean (SD)	Median (Min-Max)	N (%)
Age	10.85 (1.74)	11.00 (9.00-15.00)	-
Age group			
9-10 years old	-	-	19 (48.72)
11-12 years old	-	-	13 (33.34)
13-15 years old	-	-	7 (17.94)
Gender (M)	-	-	27 (69.23)

Legend: SD=standard deviation; M=male; N=number.

A greater number of boys was found in the three age groups. The sample included eleven boys between 9-10 years old, ten boys between 11-12 years old, and six boys between 13-15 years old.

Table 2 shows the Residual Speech Errors observed in the speech of the study subjects, considering the phonetic system and the phonological system.

Table 2. Descriptive data of Residual Speech Errors reported in the sample

Phonological processes	N	(%)
Substitution of / j /	11	29.7%
Substitution of / ʒ /	12	32.4%
Substitution of / z /	5	13.5%
Substitution of / s /	5	13.5%
Substitution of / f /	2	5.4%
Substitution of / v /	6	16.22%
Substitution of / λ /	2	5.4%
Substitution of / l /	2	5.4%
Substitution of / r /	9	24.3%
Omission of / X /	1	2.7%
Omission of / r /	11	29.7%
Omission of / l /	1	2.7%
Omission of / ɲ /	1	2.7%
CCR of / r /	11	29.7%
CCR of l /	3	8.1%
Substitution of / b /	4	10.8%
Substitution of / p /	1	2.7%
Substitution of / d /	4	10.8%
Substitution of / t /	1	2.7%
Substitution of / k /	1	2.7%
Substitution of / g /	6	16.2%
Phonetic distortions		
Distortion of [j]	2	5.4%
Distortion of [ʒ]	2	5.4%
Distortion of [z]	2	5.4%
Distortion of [s]	3	8.1%
Distortion of [r]	6	16.2%
Distortion of [X]	1	2.7%

N: number of occurrences. Legend: CCR=Consonant cluster reduction.

As for changes involving the phonological system, the fricative phonemes /j/ and /ʒ/, the liquid /r/ and the consonant cluster /r/ were reported as the most affected segments and syllable in the sample, with substitution and omission and consonant cluster reduction, respectively. Phonological processes involving the fricatives /f/ (substitution)

and /X/ (omission), the liquid /λ/ and /l/ (substitution); the liquid /l/ and the nasal /ɲ/ (omission) and the plosives /p,t,k/ (substitution) were observed in lower percentages. Regarding the phonetic system, the phoneme [r] had the most changes, with distortions, in relation to the other phonemes.

Table 3. Residual Speech Errors reported in the sample, according to gender*

Phonological processes	Female N (%)	Male N (%)	p-value
Substitution of / j /	2 (18.18)	9 (34.62)	0.445
Substitution of / ʒ /	4 (36.36)	8 (30.77)	1.000
Substitution of / z /	1 (9.09)	4 (15.38)	1.000
Substitution of / s /	1 (9.09)	4 (15.38)	1.000
Substitution of / f /	1 (9.09)	1 (3.85)	0.512
Substitution of / v /	3 (27.27)	3 (11.54)	0.335
Substitution of / λ /	0 (0.00)	2 (7.69)	1.000
Substitution of / l /	2 (18.18)	0 (0.00)	0.083
Substitution of / r /	1 (9.09)	8 (30.77)	0.229
Omission of / X /	0 (0.00)	1 (3.85)	1.000
Omission of / r /	3 (27.27)	8 (30.77)	1.000
Omission of / l /	1 (9.09)	0 (0.00)	0.297
Omission of / ɲ /	0 (0.00)	1 (3.85)	1.000
CCR of / r /	2 (18.18)	2 (34.62)	0.445
CCR of l /	3 (27.27)	0 (0.00)	0.021*
Substitution of / b /	2 (18.18)	2 (7.69)	0.567
Substitution of / p /	0 (0.00)	1 (3.85)	1.000
Substitution of / d /	2 (18.18)	2 (7.69)	0.567
Substitution of / t /	0 (0.00)	1 (3.85)	1.000
Substitution of / k /	0 (0.00)	1 (3.85)	1.000
Substitution of / g /	3 (27.27)	3 (11.54)	0.335
Phonetic distortions			
Distortion of [j]	0 (0.00)	2 (7.69)	1.000
Distortion of [ʒ]	0 (0.00)	2 (7.69)	1.000
Distortion of [z]	0 (0.00)	2 (7.69)	1.000
Distortion of [s]	0 (0.00)	3 (11.54)	0.540
Distortion of [r]	2 (18.18)	4 (15.38)	1.000
Distortion of [X]	1 (9.09)	0 (0.00)	0.297

*Fisher's exact test $p \leq 0.05$.

N: number of occurrences. Legend: CCR=Consonant cluster reduction.

Table 3 shows the Residual Speech Errors of the subjects in the sample, according to gender.

Table 3 also shows that there is a prevalence of males with phonological processes or distortions. The result was significant for females only for the consonant cluster reduction with /l/.

The changed segments in the subjects' speech were analyzed according to the established age groups, as shown in Table 4. It was noted that phonological or phonetic errors decrease as the age group increases.

Table 4. Residual Speech Errors reported in the sample, according to age group

Phonological processes	9-10 years old N (%)	11-12 years old N (%)	13-15 years old N (%)	p-value
Substitution of / ʃ /	3 (16.67)	7 (53.85)	1 (16.67)	0.066
Substitution of / ʒ /	7 (38.89)	3 (23.08)	2 (33.33)	0.726
Substitution of / z /	2 (11.11)	2 (15.38)	1 (16.67)	1.000
Substitution of / s /	0 (0.00)	4 (30.77)	1 (16.67)	0.034*
Substitution of / f /	0 (0.00)	2 (15.38)	0 (0.00)	0.257
Substitution of / v /	3 (16.67)	2 (15.38)	1 (16.67)	1.000
Substitution of / λ /	1 (5.56)	0 (0.00)	1 (16.67)	0.419
Substitution of / l /	2 (11.11)	0 (0.00)	0 (0.00)	0.649
Substitution of / r /	4 (22.22)	4 (30.77)	1 (16.67)	0.723
Omission of / X /	0 (0.00)	1 (7.69)	0 (0.00)	0.514
Omission of / r /	6 (33.32)	2 (15.38)	3 (50.00)	0.307
Omission of / l /	0 (0.00)	1 (7.69)	0 (0.00)	0.514
Omission of / ɲ /	0 (0.00)	1 (7.69)	0 (0.00)	0.514
CCR of / r /	6 (33.33)	4 (30.77)	1 (16.67)	0.893
CCR of l /	2 (11.11)	1 (7.69)	0 (0.00)	1.000
Substitution of / b /	3 (16.67)	1 (7.69)	0 (0.00)	0.639
Substitution of / p /	0 (0.00)	1 (7.69)	0 (0.00)	0.514
Substitution of / d /	2 (11.11)	1 (7.69)	1 (16.67)	1.000
Substitution of / t /	0 (0.00)	1 (7.69)	0 (0.00)	0.514
Substitution of / k /	0 (0.00)	1 (7.69)	0 (0.00)	0.514
Substitution of / g /	4 (22.22)	1 (7.69)	1 (16.67)	0.723
Phonetic distortions				
Distortion of [ʃ]	1 (5.56)	1 (7.69)	0 (0.00)	1.000
Distortion of [ʒ]	1 (5.56)	0 (0.00)	0 (0.00)	1.000
Distortion of [z]	1 (5.56)	1 (7.69)	0 (0.00)	1.000
Distortion of [s]	1 (5.56)	2 (15.38)	0 (0.00)	0.744
Distortion of [r]	5 (27.78)	1 (7.69)	0 (0.00)	0.272
Distortion of [X]	1 (5.56)	0 (0.00)	0 (0.00)	1.000

*Fisher's exact test $p \leq 0.05$.

Legend: N: number of occurrences. CCR=Consonant cluster reduction.

There was a significant difference between the age groups only for the phonological substitution process involving the phoneme /s/, with a higher percentage of error for the 11-12 year old age group. The substitution of /ʃ/ was the most frequent process in this same age group.

Discussion

The use of phonological processes and/or phonetic distortions, beyond the age of seven, has been widely investigated in international literature under the term “Residual Speech Errors”^{1-3,11}. On the other hand, phonetic distortions are called “phonetic deviations” in Brazil, regardless of the age of the subject. In turn, the use of the term “phonological disorder” has been avoided in cases

of older children and adolescents who use phonological processes^{9,10}.

According to the classification used in the SDCS¹, which is supported by studies developed for English^{3,11,12}, both phonetic and phonological errors were considered for the characterization of Residual Speech Errors observed in the oral production of the subjects of this study. The most frequent errors observed in this sample involved the phonological system including fricatives (/ʒ,ʃ/) and the non-lateral liquid (/r/). Errors involving the phonetic system included mainly the phones [r] and [s].

The same errors were also observed in English-speaking subjects, characterized by distortions of the phones [s], [z], [ʃ], [ʒ], [r], [X], [l] and [λ], with

possible phonological processes, characterized by omissions and/or substitutions^{1,2,5,11,13}.

Although in a reduced percentage, the study sample showed errors involving the plosive phonemes /p/, /b/, /t/, /d/, /k/, /g/; the nasal /ɲ/ and the fricative /f/. The errors in the case of plosives and in the fricative /f/, in which the substitution process was perceived, could be related to the distinctive trait [voice]. In this context, desonorization is commonly found in studies of children with phonological disorders, with difficulty in stabilizing the referred trait^{14,15}, especially in plosives¹⁵.

In a study that analyzed 197 records of subjects with phonological disorders, Mota, et.al.¹⁵ found that the process of desonorization occurred between 40-60% in the age group of seven and eight years. Although there was no significant difference between the age groups studied by the authors in the use of desonorization in plosives and fricatives, high percentages stand out in the highest age group, that is, eight years of age.

The occurrence of both phonological processes and difficulties in phonetic production involving the sound /r/ in the three age groups studied may be explained by the articulatory complexity required for the oral production of this segment. In other words, greater motor control is necessary for the articulatory production of this sound, and this difficulty is accentuated in the case of these children, as distorted articulation habits end up settling down in their speech^{2,11,16-18}. In order to characterize these errors, Byun and Preston³ found that many children with Residual Speech Errors have difficulty with the production of /r/ in the beginning of syllable and post-vowel positions.

The study also analyzed the gender variable and noted that, in general, the errors occurred mainly in the speech samples of males. This data is in line with the literature, which reports a higher occurrence of phonological disorders^{14,15,19,20} and Residual Speech Errors¹⁰ among males. In addition, it is noteworthy that the number of females decreases with increasing age.

The findings in this study are also in line with the literature to the extent that Residual Speech Errors are understood as remnants of phonetic/phonological deviations not overcome by the child⁵, since the number of subjects decreases with increasing age, as well as distortions and/or phonological processes.

When analyzing studies aimed at English speakers, it was noticed that some authors use the term “Residual Speech Errors” to characterize subjects who have changes in the production of speech segments from the age of seven¹¹, while others report that the characterization of these cases occurs from the age of eight²⁻⁴. Therefore, there is no consensus for the use of this term in relation to the subject’s age. In the proposed classification for speech disorders (SDCS¹) reported and assumed in this study, the age of nine years is accepted as the starting point for characterizing subjects with Residual Speech Errors, with emphasis on the 9-10 age group in number of subjects in the analyzed medical records. A recent study involving Brazilian Portuguese speakers aged 8-13 years also found a higher percentage of subjects between eight and ten years old, which decreased towards the age of thirteen¹⁰.

According to Flipsen⁵, some subjects tend to independently resolve their Residual Speech Errors by the end of “high school”, thus having regressions of these errors, according to the school progression of these subjects. This study found only a few subjects in the 13-15 age group, which corroborates the idea that Residual Speech Errors can be overcome without therapeutic intervention over the years. It is also believed that these subjects may not have been successful in previous speech-language pathology interventions or it could have been a late intervention.

Residual Speech Errors represent a challenging condition for speech-language pathologists, especially in cases where different approaches have been used and speech errors have not been completely overcome^{4,21}.

That study aimed to characterize a group of subjects with Residual Speech Errors, based on data available in its medical records, comparing them with results published in national and international literature. The data found related to speech sounds was similar to the data in the English language, which confirms the initial hypothesis of the study. However, the results of the study cannot be generalized due to some limitations, such as sample size and speech data exclusive to a geographic region of Brazil.

Given the scarcity of studies aimed at subjects with Residual Speech Errors, the contributions of this study should be recognized despite the limitations mentioned. The initiative to characterize this

group according to gender, age group and speech data is essential for understanding, identifying and proposing effective therapies in these cases. Further research are suggested with Brazilian Portuguese speakers involving not only the analysis and description of the speech characteristics of this population, but also investigating other skills, such as phonological processing, auditory processing and reading and writing skills in this population.

Conclusion

Residual Speech Errors were more frequent in the age group of nine and ten years of age in boys. Similarly to the findings for English speakers, these errors can be characterized by phonological processes and/or phonetic distortions, involving mainly fricatives and liquids.

This study did not intend to characterize the Residual Speech Errors cases for Brazilian Portuguese speakers, but, to initiate studies aimed at this population, which is a common demand in speech-language pathology clinic.

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