

# “Sign exchanges”: characterization of phonological processes occurred during the Libras acquisition by deaf preschoolers

## “Trocas nos sinais”: caracterização de processos fonológicos ocorridos durante a aquisição de Libras por pré-escolares surdos

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### ABSTRACT

**Purpose:** To describe the characteristics of the phonological processes found in deaf preschoolers' sign language. **Methods:** Fifteen deaf children aged 3 to 7 years participated in the study. Data collection was conducted by filming the application of the FONOLIBRAS test, which requires participants to name 50 figures in Libras (Brazilian sign language). Transcription was performed on SignWriting; Libras signals with phonological processes were classified by type, parameter, and hand(s) involved. Finally, the data received statistical treatment. **Results:** All deaf children showed signs of linguistic variation in relation to the adult pattern, that is, phonological processes, confirming that these processes are a natural phenomenon of child development in sign languages as in spoken languages. The most frequent process was assimilation, while replacement, epenthesis, elision, and metathesis were also present. The hand configuration parameter was the most affected. The occurrence was greater in the passive hand. **Conclusion:** As phonological processes are part of the acquisition of sign languages and can be naturally suppressed or not, these phenomena deserve the attention of professionals who work in the area of deafness in order to optimize the communication development of users of these languages.

**Keywords:** Language development; Phonetics; Deafness

### RESUMO

**Objetivo:** Descrever as características dos processos fonológicos encontrados na língua de sinais de pré-escolares surdos. **Métodos:** Participaram da pesquisa 15 crianças surdas, com idade entre 3 e 7 anos. A coleta de dados ocorreu por meio de filmagem da aplicação do Instrumento de avaliação fonológica da língua de sinais brasileira: FONOLIBRAS, que propõe nomear, em Libras (Língua Brasileira de Sinais), 50 figuras. Foi realizada transcrição em SignWriting e os sinais de Libras com processos fonológicos foram classificados quanto ao tipo, parâmetro e mão(s) envolvida(s). Por fim, os dados receberam tratamento estatístico. **Resultados:** Todas as crianças surdas apresentaram produção de sinais com variações linguísticas, em relação ao padrão adulto, ou seja, processos fonológicos, confirmando que é um fenômeno natural do desenvolvimento infantil também nas línguas de sinais. O tipo mais frequente foi assimilação, também estando presentes substituição, epêntese, elisão e metátese. O parâmetro configuração de mão foi o mais afetado e a ocorrência maior, na mão passiva. **Conclusão:** De que modo os processos fonológicos fazem parte da aquisição das línguas de sinais, podendo ser naturalmente suprimidos, ou não, é um assunto que merece a atenção dos profissionais que atuam na área da surdez, de modo a aperfeiçoar o desenvolvimento da comunicação dos usuários destas línguas.

**Palavras-chave:** Desenvolvimento da linguagem; Fonética; Surdez

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## INTRODUCTION

In sign language, it is possible to observe a phenomenon similar to what is popularly called “speech exchanges” in oral language, more technically known as phonological processes.

From a more comprehensive view, a phonological process is any change observed in the phonological level of languages that may result in linguistic modification or variation<sup>(1)</sup>. Modification occurs when over time, an old form of language is substituted with a more present one; and variation occurs when this modification adjusts to the individual’s stylistic, social, or linguistic factors<sup>(2)</sup>.

In the literature, the emphasis of research has usually fallen on the phonological processes of the variation type that occurs in childhood, more specifically in oral-aural languages.

Although the interest of the present research relates to phonological processes occurring in visuomotor languages, the background studies in this area, even if in another modality, have served as a starting point.

In Classical Generative Theory, the definitions and possible causes of phonological processes in childhood have been described as a “[...] problem in the phonological functioning of one or more distinctive features [...]”<sup>(3)</sup>.

In Natural Generative Theory, Stampe was the pioneer of the term “phonological process” and defined it as:

[...] a mental operation that applies in speech to substitute, for a class of sounds or sound sequences presenting a specific common difficulty to the speech capacity of the individual<sup>(4;41)</sup>.

Lamprecht defined the term “repair strategies” as:

[...] strategies adopted by children to tailor the achievement of the target system - the language spoken by the adults of their social group - to their phonological system. Basically, it refers to what children do in place of the segment and/or the syllabic structure that they do not know yet or whose production they do not dominate<sup>(4;28)</sup>.

According to the Autosegmental Theory, it is the “[...] exchange of one segment for another that already integrates the child’s system [...]”<sup>(3)</sup>

In the view of the Optimality Theory, this is an inappropriate ordering of the target language constraints hierarchy<sup>(5)</sup>.

Studies indicate that the number of phonological processes or repair strategies is directly proportional to the degree of difficulty of acquisition and production of the minimal linguistic units involved, as well as to the degree of phonological deviation present<sup>(6,7)</sup>.

Thus, it can be concluded that in general, phonological processes manifested in childhood are usually related to the restrictions of immaturity in the capacity needed to reproduce the adult pattern, resulting in phonetic-phonological simplifications, allowing an approximate production of the target linguistic system.

In other words, the child communicates even if full maturity has not been reached. Consequently, the child’s vocabulary will present modifications/simplifications in the signifier (form) of the sign (word or sign), compared to the adult standard.

Phonological processes can be classified as<sup>(8)</sup>:

- Substitution processes, manifested in the paradigmatic axis of the sub-lexical units’ contrasts. These processes are characterized by the composition of traces. Simplification

occurs by replacing members of a class with members of another natural class\*. Example: “tapo” instead of “sapo”;

- Structural modifier processes, manifested in the syntagmatic axis of the sequences of the sub-lexical units. These processes are characterized by the combination of phonemes for the formation of morphological and lexical units. Example: “rávore” instead of “árvore”;
- Context-sensitive processes, manifested in the paradigmatic and syntagmatic axes, influenced by contextual factors. These processes are characterized by the substitution of features or segments by others more similar to the near phonological context. Example: “pepeta” instead of “chupeta.”

Returning attention to sign language, the Natural Phonology Theory argues that phonological processes are innate, natural, and universal<sup>(10)</sup>. Thus, they can be found in both oral-aural and visual-spatial language modalities<sup>(11)</sup>.

In sign languages, such changes in the phonetic-phonological level are manifested as alterations in one or more constitutive parameters of the sign<sup>(1)</sup>. As such, it can be affirmed that a sign contains phonological process(es) when observed, in relation to the target language, and articulated differences are manifested in hand configuration, point of articulation, movement, orientation, number of hands and/or non-manual markings.

The literature indicates that Liddel and Johnson were probably the first authors to study the occurrence of phonological processes in sign languages, in relation to American Sign Language (ASL), and classified the processes as: epenthesis of the movement, deletion of the prehension, metathesis, twinning, assimilation, reduction, perseveration and anticipation<sup>(12)</sup>.

In Brazil, Lodenir Karnopp was one of the pioneers of studies on the subject.

In 1994, when investigating the acquisition of Libras in four deaf children of deaf parents between the ages of 2 years and 8 months and 5 years and 9 months, it was observed that the highest substitution rate occurred in the hand configuration parameter, when compared to the movement and point of articulation, and these substitutions were systematic<sup>(13)</sup>. In 1999, when conducting a longitudinal study on the phonological acquisition of Libras by a deaf girl with deaf parents and sisters, a higher occurrence of substitutions in this parameter was confirmed<sup>(14)</sup>.

When the “phonological awareness assessment instrument, configuration parameter for deaf children using Brazilian Sign Language” was applied to 15 deaf children aged between 6 years and 11 years and 1 month, it was found that the signs classified as “expected modified denomination” (phonological processes) occurred less frequently in children with a longer period of linguistic exposure to Libras<sup>(15)</sup>.

In longitudinal observation of spontaneous productions in a deaf child of deaf parents, between the ages of 1 year and 6 months and 2 years and 6 months, processes classified as substitution were identified, affecting more than one parameter in the same sign, and more than half involved the hand configuration parameter<sup>(16)</sup>.

Regarding the creation and application of the “Instrument of phonological evaluation of Brazilian Sign Language:

\* Natural class “[...] is the set of segments that share similar traces and undergo common phonological rules [...]”<sup>(9;27)</sup>. In the example, both the /s/ and /t/ phonemes are produced by the tongue in contact with the alveolar region without vocal fold vibration, but they are differentiated by the trace relative to the breath support /s/ is [+continuous] and /t/ is [-continuous].

FONOLIBRAS”, four deaf children of hearing parents, aged between 6 and 12 years, presented phonological processes classified as epenthesis, elision, metathesis, and assimilation<sup>(17)</sup>.

In another application of the “phonological awareness assessment instrument, configuration parameter, for deaf children using the Brazilian Sign Language,” the presence of phonological processes was observed in the sign language of a deaf girl with neurological comorbidity aged 5 years and 10 months, and it was noted that the parameter that had the most changes in relation to the target language was the hand configuration<sup>(18)</sup>.

The occurrence and disappearance of the phonological processes must obey certain chronology, and consequently, the persistence of these beyond the expected age constitutes a delay in the development process and possible atypicity<sup>(8)</sup>.

Atypical phonological development can be classified as<sup>(19)</sup>:

- Delayed development: the production identifies with earlier stages of acquisition;
- Variable development: production with overlapping stages (delayed or advanced, in relation to the normal production);
- Different development: production with processes not found in the normal acquisition.

The investigation and distinction of each phonological process in sign languages, with regards to normality and atypia, are still a challenge<sup>(17)</sup>. That is to say, it is still necessary to establish parameters on the phonetic-phonological acquisition of sign languages that specify which phonological processes are part of the development and until what age they usually occur (typical x age processes) and also, which processes are not common in the development (atypical processes).

The aim of the present study was to describe the characteristics of the phonological processes found in the sign language of deaf preschoolers.

## METHODS

This research is part of a master’s thesis project approved by the Research Ethics Committee of the Fluminense Federal University under the n° 57068916.6.0000.5243. All those responsible for the subjects involved signed the Free and Informed Consent form.

This article focused on the phonological processes that occurred during the naming task carried out by the students of the Primary Education sector in a teaching institution for the deaf.

A total of 25 deaf students of both genders from the EI 3, EI 4, and EI 5 groups and of either deaf or hearing parents were invited to participate in the study, regardless of whether they were newcomers to the institution, and including those with multiple disabilities.

Excluded from the sample were the students whose parents or guardians did not authorize their participation (one student), those who refused to participate (three students), those who dropped out of the test (three students), and those who did not attend on the dates scheduled for data collection (three students). Thus, the total sample size was 15 deaf preschoolers (n=15).

Data collection was carried out in the facilities of the Primary Education sector itself, in the year 2016, in the months of October (first collection) and December (second collection).

The dissertation investigated a mini-course of continuous professional training that proposed that teachers incorporate cognitive and psychomotor stimulation in their classes, aiming to improve the acquisition of Libras by their students. However, in this paper, only the data from the first stage (October 2016) is presented in order to demonstrate the natural behavior of this group, that is, free of such specific interventions.

The evaluation instrument used was the FONOLIBRAS test<sup>(17)</sup>, in which participants are required to name 50 figures in sign language. The individual evaluation time did not exceed 15 minutes.

Filming was carried out by means of a Sony Xperia Z3 mobile phone while the researcher interacted with the children, showing them the binder of figures.

As predicted by the author of the FONOLIBRAS test, due to the social linguistic variations, the signs on the answer sheet needed to be adjusted to the Libras used in that deaf community.

The videos were analyzed and the students’ responses were transcribed in SignWriting (using the SW-Edit program). As anticipated by the author of the test, the answers were classified as: expected name, name in the same semantic field, absent name, or home sign.

When phonological processes occurred in Libras signs (expected name and name in the same semantic field), these were classified as: assimilation, substitution, epenthesis, elision, or metathesis and the parameters (hand configuration, point of articulation, movement, orientation, and number of hands\*\*) and the hand(s) involved (passive, active, or both) were specified.

In order to verify the influence of the gender variable on the production of Libras signs with phonological processes, the t-Test was applied for independent samples, and to verify the influence of the age and class variables, ANOVA tests were implemented.

The quantitative data was arranged in Excel spreadsheets and analyzed by a professional statistician.

## RESULTS

Regarding the influence of the gender variable on the production of Libras signs with phonological processes, there was no evidence that female preschoolers (mean= 40.8 and deviation= 17.8) presented more deviations than male preschoolers (mean= 27.7 and deviation= 6.4) ( $p = 0.111$ ). Similarly, with regards to the influence of the age and class variables, there was no evidence of differences in the percentages among the ages ( $p = 0.554$ ) nor among the groups ( $p = 0.207$ ) (Table 1). In other words, it was not possible to predict the performance against the gender, age, or class groups to which deaf children belonged.

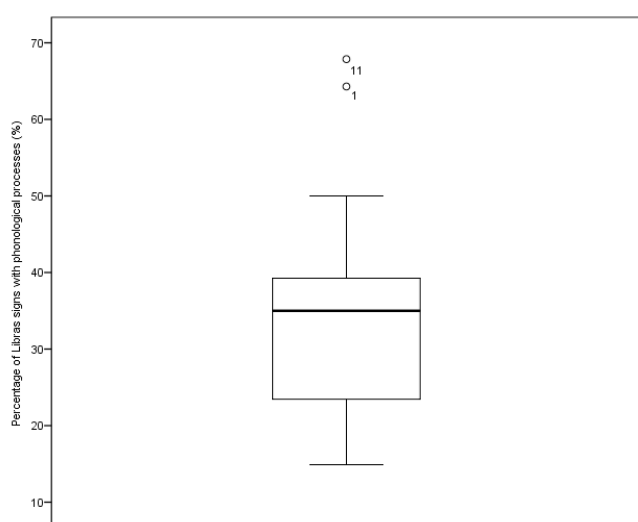
Concerning the group’s behavior (n= 15), the average percentage of signs with phonological processes was 35.53%, standard deviation 15.50%, minimum 14.89%, maximum 67.86%, and median 35.00%, drawing attention to the fact that all subjects presented phonological processes in the signs (Figure 1).

\*\*Being an appointment task, the facial and/or corporal expression parameter was not evaluated and the “number of hands,” also called “hand configuration,” despite being less recognized as a parameter, was included, since it was relevant to the purposes of this study.

**Table 1.** Characteristics of the subjects of the sample, with their respective performances

Subject	Class	Gender	Age	Number of Libras signs produced	Number of signs with phonological process(es)	Percentage of signs with phonological process(es) (%)
Student 1	EI 3A	F	3	14	9	64.29
Student 2	EI 3A	F	3	40	14	35.00
Student 3	EI 3A	F	3	24	10	41.67
Student 4	EI 3B	F	4	38	14	36.84
Student 5	EI 3B	M	3	21	5	23.81
Student 6	EI 4	F	5	30	6	20.00
Student 7	EI 5A	F	5	47	7	14.89
Student 8	EI 5A	M	7	8	2	25.00
Student 9	EI 5A	F	6	33	12	36.36
Student 10	EI 5A	M	7	40	9	22.50
Student 11	EI 5B	F	7	28	19	67.86
Student 12	EI 5B	M	6	40	14	35.00
Student 13	EI 5B	M	6	30	11	36.67
Student 14	EI 5B	M	6	39	9	23.08
Student 15	EI 5B	F	6	20	10	50.00

**Subtittle:** EI 3A and EI 3B = Third Period of Primary Education; EI 4 = Fourth Period of Primary Education; EI 5A and EI 5B = Fifth Period of Primary Education; F = Female; M = Male



**Figure 1.** Percentage distribution of Libras signs with phonological process(es) (n=15)

Substitution, epenthesis, elision, metathesis, and assimilation types of phonological processes were found (Chart 1).

It was observed that the hand configuration parameter was the most frequently affected by phonological processes, followed by point of articulation, movement, orientation, and finally, number of hands (Figure 2).

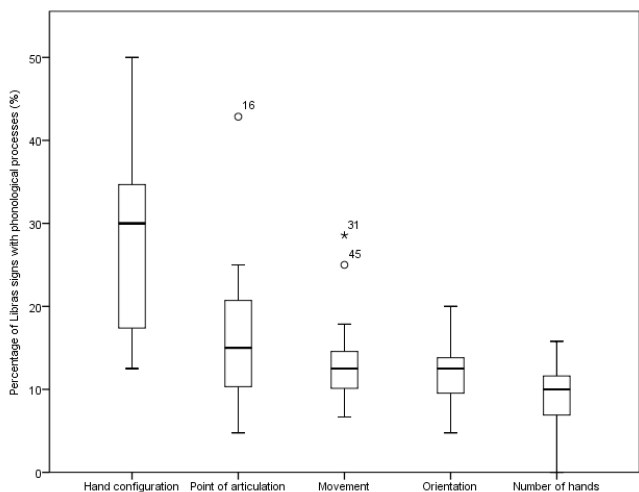
In some instances, the signs presented more than one type of phonological process in more than one parameter (Chart 2).

The phonological process of the assimilation type was the most frequent in the subjects' production, followed by substitution, epenthesis, elision, and metathesis (Figure 3).

In general, the phonological processes occurred more frequently in the passive hand, followed by the active hand, and less frequently, in both hands (Figure 4).

**Chart 1.** Classification of phonological processes, with respective definitions and sample examples

<b>(1) Substitution process</b>	<b>(a) Substitution:</b> content exchange of one or more sign parameters Ex.: GREEN
	 (substitution of point of articulation)
<b>(2) Structural modifier process</b>	<b>(a) Epenthesis:</b> segment addition to the sign. Ex.: WALK/GO
	 (epenthesis of number of hands, hand configuration, point of articulation and orientation)
	<b>(b) Elision:</b> omission of sign segment. Ex.: HAND
	 (elision of movement)
<b>(3) Context-sensitive process</b>	<b>(c) Metathesis:</b> inversion of sign segments. Ex.: FLIP FLOP
	 (metathesis of hand configuration)
<b>(3) Context-sensitive process</b>	<b>(a) Assimilation:</b> segment incorporation into the sign, influenced by adjacent structures. Ex.: BANANA
	 (assimilation of hand configuration)



**Figure 2.** Phonological processes characteristics: sign language parameter involved

**Chart 2.** Examples of sample signs with more than one type of phonological process, in more than one parameter

Phonological processes in the sign "HORSE"
Epenthesis of number of hands, Assimilation of hand configuration, point of articulation, movement and orientation
Phonological processes in the sign "SHIRT"
Substitution of hand configuration Epenthesis of number of hands Assimilation of hand configuration, point of articulation, movement and orientation

## DISCUSSION

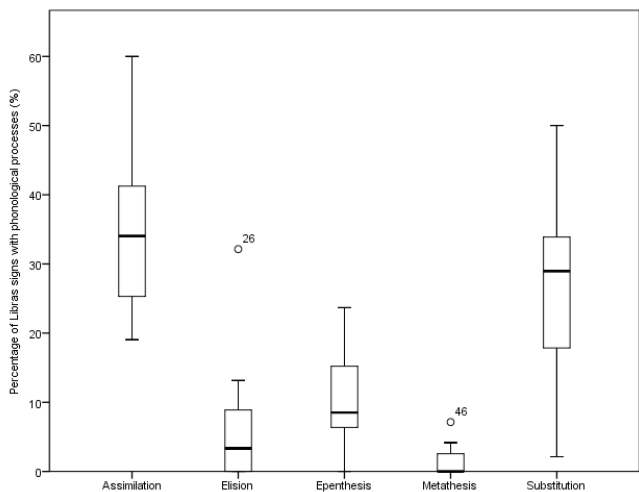
Based on the data obtained, it can be confirmed that phonological processes are universal, innate, and natural<sup>(10)</sup>, given that they appeared in the language sample of all 15 subjects of the research. Phonological processes are also manifested in the linguistic development of deaf children that use sign language<sup>(11)</sup>.

Regarding the factors that influenced the results, although it is expected that older female children with greater level of schooling will perform better in language, with less number of phonological processes than their younger male counterparts, with lower level of schooling, this could not be confirmed. In view of this, it would be interesting to investigate what other factors could influence the phonetic-phonological performance of deaf children during the acquisition phases of sign language.

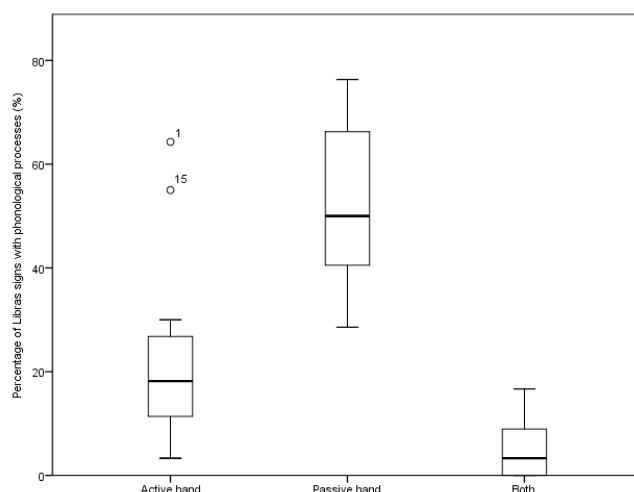
It should be remembered that, among the subjects of the research, there were children of both hearing parents and deaf Libras-using parents, as well as students who had recently joined the bilingual teaching institution. Consequently, it can be observed that these variables alone already promote an enormous heterogeneity of the linguistic-environmental realities relative to Libras communication that these children have been and are exposed to.

Researchers have stated that there is a relation between the initial linguistic experience (the moment/age of exposure to the language, the quality and quantity of the linguistic stimulus), the phonological work memory, and language acquisition results<sup>(20)</sup>. Therefore, one limitation of the present research was not to foresee the need to request the authorization of those responsible to disclose the variables that relate to the linguistic experience and thus, identify whether or not there was a correlation with the performance in the articulation of the signs.

Regarding the characteristics of the phonological processes manifested in the sample of deaf preschoolers, there were more difficulties (more phonological processes) in the hand configuration parameter, which confirms the information found in the scientific literature<sup>(13,14,16,18)</sup>. This fact could be explained by the high degree of development of cognitive (visual perception, attention, and memory) and psychomotor abilities (tone, balance, laterality, body motion, spatio-temporal structuring, and fine



**Figure 3.** Phonological processes characteristics: type



**Figure 4.** Phonological processes characteristics: hand(s) involved

and broad motor coordination) required for the reception and expression of this parameter.

As for the phonological processes classification types, all of those described in Libras were found, both by Bento (substitution)<sup>(16)</sup>, and by Costa (epenthesis, elision, metathesis, and assimilation)<sup>(17)</sup>. Since they fall within the classification proposed by Teixeira (substitution processes, structural modifier processes, and context-sensitive processes)<sup>(8)</sup>, they can be considered complementary.

The assimilation type was the phonological process with the highest incidence, which may be explained by the tendency of the non-dominant hand to mirror (imitate) the dominant hand, leading to preference for signs with equal parameters in both hands, a tendency of child motor coordination called “Complicity or solidarity”<sup>(21)</sup>. In other words, assimilation appears before the need to dissociate movements, modifying the sign to overcome this type of difficulty.

It was anticipated that the phonological processes would have a greater tendency to manifest in the passive hand, since this frequently corresponds to the non-dominant hand which, by definition, would be the non-favored hand for more complex actions and therefore, the less skilled.

## CONCLUSIONS

Considering that the phonological processes are manifestations observed during the acquisition of sign languages by the children, and which can be naturally suppressed or not, it is a matter that deserves to be given more attention with the aim of creating evaluative, preventive, and remedial actions for language acquisition by the users of these languages.

It is believed that the results of this research will contribute to the expansion of knowledge about sign languages, specifically with regards to the phonetic-phonological linguistic level, serving as a basis for future studies and practices in the area of deafness.

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