



Brazilian Sign Language phonetic-phonological and semantic-lexical performance among linguistically deprived deaf children and adolescents

Desempenho fonético-fonológico e semântico-
lexical em Libras de crianças e adolescentes
surdos em contexto de privação linguística

Actuación fonético-fonológica y semántico-
léxica en Libras de niños y adolescentes
sordos en un contexto de privación linguística

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Abstract

Introduction: Sign language development is known to follow a similar path to spoken languages. Language assessments as part of speech-language-hearing practice can identify delays in cases of linguistic deprivation. **Objective:** To evaluate the phonetic-phonological performance and expressive vocabulary in deaf children and adolescents with different levels of Brazilian Sign Language (Libras) exposure. **Method:** This is a cross-sectional study with 12 participants. Data were collected by filming the application of two instruments: the ABFW Children's Language Test – Vocabulary and the Sign Language

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PS: study conception; methodology; data collection; article design; orientation.

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and Cognition – Phonetic-Phonological Screening (Lisco). The responses were analyzed as proposed by their authors and statistically treated. **Results:** All participants performed below the expected level in the expressive vocabulary test. The categories with the best performance were “animals” and “shapes and colors”. The most frequently used substitution processes were “substitution and/or complement of verbal semiotics by correct nonverbal semiotics” and “complement of verbal semiotics by an indicative gesture”. Children failed more than adolescents in the phonetic-phonological screening. The associative analysis of the phonetic-phonological screening under the employed variables did not show significantly different performances. On the other hand, the associative analysis showed that the time of contact with Libras, the family’s use of Libras, and the school’s use of Libras differed in the expressive vocabulary assessment. **Conclusion:** All participants performed below the expected level, suggesting their linguistic deprivation may have influenced the results.

Keywords: Language Development Disorders; Vocabulary; Phonetics; Deafness

Resumo

Introdução: Sabendo-se que o desenvolvimento das línguas de sinais segue um percurso semelhante ao das línguas orais, avaliações da linguagem como prática fonoaudiológica podem identificar atrasos em situações de privação linguística. **Objetivo:** Avaliar o desempenho fonético-fonológico e do vocabulário expressivo em crianças e adolescentes surdos com diferentes perfis de contato com Libras. **Método:** Trata-se de um estudo transversal com 12 participantes. A coleta de dados ocorreu por meio de filmagem da aplicação de dois instrumentos: o Teste de Linguagem Infantil ABFW – Vocabulário e a triagem fonético-fonológica do Lisco (Língua de Sinais e Cognição). As respostas foram analisadas segundo proposta dos autores e foram submetidas a tratamento estatístico. **Resultados:** Na prova de vocabulário expressivo, todos os participantes mostraram desempenho abaixo do esperado. As categorias que obtiveram melhores desempenhos foram “animais” e “formas e cores”. Os processos de substituição utilizados com maior frequência foram “substituição e/ou complementação de semiótica verbal por não verbal correta” e “complementação de semiótica verbal por gesto indicativo”. Na triagem fonético-fonológica houve maior ocorrência de falhas em crianças do que em adolescentes. A análise associativa da triagem fonético-fonológica sob as variáveis empregadas não demonstrou diferença significativa no desempenho das respostas. Por outro lado, na avaliação do vocabulário expressivo houve diferença na análise associativa sob as variáveis tempo de contato com a Libras, uso da Libras pela família e uso da Libras na escola. **Conclusão:** Todos os participantes do estudo apresentaram desempenho abaixo do esperado, sugerindo que a privação linguística ao qual estão submetidos pode ter influenciado os resultados obtidos.

Palavras-chave: Atraso da Linguagem; Vocabulário; Fonética; Surdez

Resumen

Introducción: Sabiendo que el desarrollo de las lenguas de signos sigue un camino similar al de las lenguas orales, las evaluaciones del lenguaje como práctica fonoaudiológica pueden identificar retrasos en situaciones de privación lingüística. **Objetivo:** Evaluar el desempeño fonético-fonológico y el vocabulario expresivo en niños y adolescentes sordos con diferentes perfiles de contacto con Libras. **Método:** Se trata de un estudio transversal con 12 participantes. Los datos fueron recolectados filmando la aplicación de dos instrumentos: ABFW Test de Lenguaje Infantil - Vocabulario y Lisco (Lengua de Señas y Cognición) screening fonético-fonológico. Las respuestas fueron analizadas de acuerdo con la propuesta de los autores y recibieron tratamiento estadístico. **Resultados:** En la prueba de vocabulario expresivo, todos los participantes rindieron por debajo de lo esperado. Las categorías con mejores resultados fueron «animales» y «formas» y colores. Los procesos de sustitución más utilizados fueron «sustitución y/o complementación de semiótica verbal con no verbal correcta» y «complementación de semiótica verbal con gestos indicativos». En la exploración fonético-fonológica, hubo más fallos en los niños que en los adolescentes. El análisis asociativo del screening fonético-fonológico bajo las variables utilizadas mostró que no había diferencias en el rendimiento de las respuestas. En la evaluación del vocabulario expresivo, hubo diferencia en el análisis asociativo de las variables tiempo en contacto con





Libras, uso de Libras por la familia y uso de Libras en la escuela. **Conclusión:** Todos los participantes en el estudio rindieron por debajo de lo esperado, lo que indica que la privación lingüística a la que fueron sometidos puede haber influido en los resultados obtenidos.

Palabras clave: Retraso del Lenguaje; Vocabulario; Fonética; Sordera

Introduction

Sign languages develop similarly to spoken languages, depending on the communicative context¹. Speech-language-hearing (SLH) practice encompasses communicative processes and the development and use of Brazilian Sign Language (Libras), promoting linguistic health, preventing communicative disorders, and intervening in linguistic processing changes^{2,3,4}.

Despite the achievements in public policies for the deaf community in Brazil⁵, linguistic development, especially of deaf children from hearing families (more than 90% in Brazil), has a high incidence of linguistic deprivation with academic, social, emotional, and neuroanatomical consequences^{6,7}. The predominance of SLH and health practices prioritizing oralism is seen as its main risk factor⁸. These practices and the difficulty in implementing bilingual education for the deaf result in late and low-quality contact with Libras^{6,8}.

Studies on different aspects of Libras grammar development show that different acquisition contexts impact this process. Examples include deaf children of hearing parents, deaf children with cochlear implants, and bilingual bimodal acquisition in hearing children of deaf parents⁹. Most of the time, hearing families start their contact with Libras and deepen it through a learning process rather than acquisition, where the phonological and lexical levels of the language predominate in both teaching and usage¹⁰. Typically, deaf children in communicative contexts where the oral language predominates (hearing families) have late and limited contact with either deaf or hearing speakers highly proficient in Libras⁶.

SLH intervention focuses on late language development, which leads to primary changes in Libras development, with cognitive impacts^{1,11}. Libras assessment based on typical bilingual acquisition parameters¹² is essential to monitor development and intervene in changes effectively^{1,3,4}. However, there is still a noticeable lack of studies on visuo-spatial (sign) language disorders¹³, especially in Brazil¹⁴.

A study compared the expressive vocabulary of 32 hearing children with that of 32 deaf children, aged 5 to 8 years, indicating similarities in the development of both modalities¹⁵. Another study investigated the naming task performance of 15 deaf children attending a bilingual school, aged 3 to 7 years, children of either deaf or hearing parents; it showed that age and schooling did not correlate with performance, suggesting instead the influence of their linguistic-environmental context¹⁶. An observational British study analyzed semantic fluency in deaf children aged 7 to 14 years, sign language users, with and without developmental language disorder (DLD). Although the lexical organization was similar between the groups, lexical access was less efficient in the DLD group¹⁷.

It has been recognized that sign language users can likewise think in sublexical units, characterized as phonological awareness. This ability is related to deaf people's acquisition of both sign language as a first language and the written second language (alphabetic code of a spoken language)¹⁸. A study assessed the phonological processes performed by 12 deaf children, aged 3 to 7 years, and showed that linguistic variations and their processes were natural development phenomena¹⁹.

Another study developed a Libras screening to assess various linguistic levels (including the phonetic-phonological one) and applied it to 69 deaf participants from a bilingual school, with a mean age of 15 years, both with and without language issues²⁰. The screening proved to be sensitive to language complaints, and the greatest difference in responses between children and adults was at the phonetic-phonological level. This screening used handshape and movement parameters to classify the phonetic-phonological complexity of the signs. Handshape markers, commonly observed in L1 acquisition, determine hierarchies of complexity based on the human hand anatomy – marked handshapes are more complex than unmarked ones¹⁰.

A recent literature review with studies from different countries on sign language phonological awareness pointed out that most assessment instruments for this skill only evaluate partial aspects





– e.g., minimal pair discrimination, sign reproduction proficiency, and only some parameters, with a predominance of handshape, movement, and articulation point or location¹³.

Hence, this study aimed to evaluate the phonetic-phonological performance and expressive vocabulary of deaf children and adolescents with different profiles of contact with Libras, characterized by linguistic deprivation, who attended SLH clinics at two public Brazilian universities.

Methods

This cross-sectional study included 12 participants – five children (6 to 11 years old) and seven adolescents (12 to 15 years old) – with bilateral severe to profound sensorineural hearing loss, including hearing technology users and nonusers. All participants come from hearing families. The exclusion criterion was blindness or low vision. Three participants have a disability associated with deafness, with motor and movement impairments caused by cerebral palsy, affecting the musculoskeletal structures and the elbow, forearm, hand joints, and lower limbs. They have preserved gait with mild disability. Upper limb changes involve functions related to the control of voluntary movements, negatively impacting activities such as writing and fine hand movements for handling objects.

Two participants have these impairments on the right and left sides, and the other one only has them on the left side. The study identified no significant intellectual or mental changes, such as memory, attention, or visuospatial perception. The research data were obtained from bilingual SLH therapy services for the deaf at two public university-affiliated clinics in the state of Rio de Janeiro, Brazil.

The study took place between March and October 2023. Participation was consented as parents/guardians signed an informed consent form and participants capable of understanding signed an informed assent form in Libras. Both institutions' Research Ethics Committees (CEP) approved the study through evaluation reports number 5.570.162 and 5.458.603.

The evaluation used the Sign Language and Cognition – Phonetic-Phonological Screening (Lisco, in Portuguese)²⁰ and the vocabulary test from the ABFW Child Language Test²¹. The par-

ticipants' responses were video recorded and then transcribed and analyzed by the researchers.

The phonetic-phonological screening evaluated the use of Libras parameters through a naming task with a list of figures, giving an example for them to repeat. The signs in the screening are categorized into four phonetic-phonological complexity groups: 1. Unmarked handshape (HS) with simple movement (M); 2. Marked HS with simple M; 3. Unmarked HS with internal hand M; 4. Marked HS with internal hand M. "Satisfactory" responses (meaning the phonological parameters were presented correctly) scored 1, and "unsatisfactory" responses scored 0²⁰. Subjects under 15 years old with four or more "unsatisfactory" responses failed the screening, as well as those over 15 years old with one or more "unsatisfactory" responses.

The expressive vocabulary was assessed through the ABFW vocabulary test, which verifies the vocabulary knowledge in nine conceptual fields (clothing; animals; food; means of transportation; furniture and utensils; professions; places; shapes and colors; toys and musical instruments) of oral Brazilian Portuguese²¹. This study conducted the test in Libras. The responses were classified as usual word designation (UWD), no designation (ND), and substitution process (SP). The SPs were also classified according to the typology proposed by the authors, using the 6-year-olds' quantitative parameters, as this is the largest age group whose parameters are defined in the original test.

The results were analyzed, highlighting the performance in both tests and relating them to the participants' linguistic and communicative context. The quantitative variables were recoded into nominal qualitative variables, using totals and means. The association analyses used Fisher's exact test, considering statistically significant associations when the p-value ≤ 0.05 .

Results

The participants' mean age at the time of the study was 10.9 years – 10 of them were males. Regarding the linguistic context, nine participants had hearing families with beginner-level sign language users, meaning they could recognize simple signs and expressions, as long as the speaker used clear and slow signing with simple expressions and sentences in familiar contexts²². Both the mean age at first contact with Libras and the mean



Libras exposure time were 5.4 years. Out of the 12 participants, six attended regular schools with a Libras interpreter, four attended bilingual schools, and two attended regular schools without a Libras interpreter. Besides hearing loss, three participants also had motor and movement disabilities.

All participants performed below expectations in the expressive vocabulary test, using the original test's 6-year-olds' parameters as a reference²¹. Of the nine categories assessed, participants achieved an average of expected UWD responses in 2.5 categories, with children scoring 1.4 and adolescents scoring 3.28, showing an age-related developmental vocabulary progression.

The percentages of responses were higher for UWD (47.5%), followed by SP (36.8%) and ND (15.7%). The categories "animals" (seven children) and "shapes and colors" (six children) had more UWD responses than the other categories, according to the test parameters.

The most used SP types were "substitution and/or complement of verbal semiotics with correct nonverbal semiotics" (119 occurrences) – e.g., when the child uses a gesture of eating with a utensil to designate "fork," which does not correspond to the sign for "fork" in Libras; "substitution and/or complement of verbal semiotics with an indicative gesture" (36 occurrences) – e.g., when the child points to their own shirt to designate "shirt"; "emphasis on visual stimuli" (22 occurrences) – e.g., when the child signs "house" and "church" (components that stand out in the image of the test) to designate "city"; "near co-hyponym" (17 occurrences) – e.g., when the child signs "car" to designate "truck" (semantically close to a more

general and broader semantic term); "substitution by function designation" (six occurrences) – e.g., when the child signs "sleep" for the designation "bed."

The phonetic-phonological screening results showed a higher occurrence of "failure" for children (60%) than for adolescents (43%). The total participants' "satisfactory" responses decreased from group 1 (50) to group 2 (45), to group 3 (42), and to group 4 (35), which is related to these groups' increasing phonetic-phonological complexity.

An associative analysis was performed between the participants' performance in both evaluations and their linguistic-communicative context and characteristics (child or adolescent; with or without associated disability), as presented in Table 1. UWD responses in the vocabulary test were statistically significantly associated with 1 - the use of Libras at the school attended by the participants ($p = 0.0028$), including bilingual schools, regular schools with an interpreter, and regular schools without an interpreter; 2 - the use of Libras by the families ($p = 0.00048$), being either a signing or non-signing family; and 3 - the time of contact with Libras ($p = 0.00114$), with over 5 years and less than 5 years of contact with Libras.

The variables were not significantly associated with the phonetic-phonological screening results, although the age of contact with Libras ($p = 0.090909091$) (after 2 years old and before 2 years old) and the use of Libras by the family ($p = 0.090909091$) (signing families and non-signing families) had results close to $p \leq 0.05$.

Table 1. Associative analysis between "pass" and "fail" in the phonetic-phonological screening, number of usual word designations in the expressive vocabulary test, and selected variables of the participants' linguistic profile

	C	A	+ 2	- 2	BS	RSWI	RSNI	SF	NSF	- 5	+ 5	WD	ND
PASS	2	4	3	3	3	2	1	6	0	1	5	1	5
FAIL	3	3	6	0	1	4	1	3	3	4	2	2	4
Total	5	7	9	3	4	6	2	9	3	5	7	3	9
p-value*	0.3787878788		0.09090909091		0.1298701299		0.09090909091		0.1136363636		0.40909091		
UWD	7	22	19	10	12	16	1	29	0	5	24	11	18
p-value*	7.63		0.076		0.0028		0.00048		0.00114		0.148		

*Fisher's exact test

Caption: C = child; A = adolescent; +2 = contact with Libras after 2 years old; -2 = contact with Libras before 2 years old; BS = bilingual school; RSWI = regular school with an interpreter; RSNI = regular school with no interpreter; SF = signing family; NSF = non-signing family; -5 = contact with Libras for less than 5 years; +5 = contact with Libras for more than 5 years; WD = with associated disability; ND = with no associated disability; UWD = usual word designations



Discussion

All participants' responses in the expressive vocabulary test were below the expected level. It is important to note that the reference age for this test is 6 years²¹, which is below the participants' mean age (10.9 years). We believe that the results can be explained by the limited exposure to the language, linked to the statistical correlation between the exposure time and the use of Libras at school and home⁶. The relationship between the age of exposure to the language and the correlated factors is crucial for linguistic development^{1,4,6,7,9,11,16}.

The categories with the lowest UWD responses were “places”, “food”, and “clothing”, corroborating a previous study¹⁹. More commonly used vocabulary was expected to be named more frequently, but this did not occur. This suggests that daily activities are not sufficiently accompanied by verbalizations about events, such as comments, narratives, or even simple verbal commands.

Visual forms characteristic of the deaf experience (homemade signs and pointing) predominated among SP types, which occurred in proportions like those of UWD. These are similar to what the literature categorizes as “homemade gestures or signs,” used by deaf people with no contact with sign language or the deaf community to communicate with the family²³. However, despite their similarities to sign languages (in terms of iconicity – i.e., the visual resemblance of the linguistic signifier to its object or action), they do not have the same developmental effect as the use of sign language, particularly in terms of grammatical complexity. This is because they do not share the morphosyntactic characteristics of language and socialization, as they are not intersubjectively shared with other members of the community^{6,9,11}. The other highly proportional SPs reveal the use of semantic (“cohyponym” and “designation of functions”) and visual (“emphasis on visual stimuli”) strategies to overcome vocabulary limitations.

Children failed more than adolescents in the phonetic-phonological screening, indicating the development of this level²⁰ – although both children and adolescents had deficits in the phonetic-phonological development process. This can be explained by late acquisition, which affects grammatical competence and limits the phonological processing of language, being more related to the age of exposure than to the duration of exposure²⁴.

Although no statistical significance was found, most participants with associated (motor) disabilities had greater difficulty, likely due to phonetic changes in signaling^{4,16}.

The difficulty with signs of greater phonetic-phonological complexity highlights similarities between the development of oral and sign languages^{19,20}. However, the screening considers only two parameters to determine complexity levels, and other assessments should be used in cases of “failure” for more accurate diagnoses²⁰.

A previous study showed that handshape is the most changed parameter in children's phonological processes in linguistic development¹⁹. However, it is necessary to establish how the other parameters (location, movement, orientation, and non-manual [body and facial] expressions) are associated with typical and atypical phonological development processes in sign language children¹³.

In addition to the phonological development of the first language, it has also been demonstrated that the phonological awareness of sign languages interferes with developing literacy in a second language¹⁸.

No linguistic policy in Brazil guarantees the right of hearing families to learn Libras and have the necessary support for their children's linguistic development, despite all the recognized advancements in deaf education. This remains the greatest factor inducing neglect and linguistic deprivation^{6,25}, leading to serious developmental language delay (like those identified in this study), which may even overlap with and mask cases of DLD in children who use sign languages, complicating diagnosis and intervention^{14,17}.

On the other hand, the development of bilingual SLH research and practices for the deaf (essential for qualified guidance, diagnosis, and intervention in the development of sign languages) will only be possible if the training programs foster the development of SLH competencies to understand and intervene in both typical and atypical acquisition of the visual-spatial modality and in educational bilingualism, in addition to other SLH needs of deaf sign language users^{4,25}.

Final considerations

This study assessed the phonetic-phonological performance and expressive vocabulary of deaf children and adolescents in Libras, considering



different profiles of contact with this language. The results revealed a performance far below the parameters proposed by the vocabulary test.

There was a higher incidence of participants who passed the phonetic-phonological screening, especially among adolescents compared to children, indicating a relationship between phonetic-phonological development and age. However, the results also highlight changes associated with delayed linguistic exposure.

A limitation of this study is that the phonetic-phonological evaluation was only a screening, requiring other supplemental assessments for diagnosis. Other limitations were the use of a vocabulary test standardized for spoken language and the small number of participants.

The study participants' communicative contexts and performance in expressive vocabulary and phonetic-phonological screening in Libras highlight their linguistic deprivation. This study contributes to the discussion on the need for more research focused on the atypical acquisition of Libras, encompassing the diversity of linguistic and communicative contexts of deaf children in Brazil^{4,6,14,17}.

Such research would be essential to develop SLH and linguistic assessments for Libras users, considering different age groups, and based on linguistic development without deprivation, an area still underexplored^{12,13,14}.

Similarly, there is a need for SLH intervention approaches to promote typical development and address processing disorders of visual-spatial languages^{4,14}, such as those for DLD¹⁷.

These studies are necessary both to minimize the cycle of deprivation and its educational and social consequences in pre-linguistic deaf individuals⁶ and to enable the diagnosis of disorders.

It is also a challenge to integrate the visual-spatial modality into the training of future professionals, promoting specific SLH competencies for this modality. Furthermore, the development and implementation of public policies in the country must focus on the hearing families' role of guiding and teaching Libras and on an appropriate linguistic-communicative context for early language development.

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