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Metaphonological skills among children with speech sound disorder: the influence of age and disorder severity

Habilidades metafonológicas em crianças com transtorno fonológico: a interferência da idade e da gravidade

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ABSTRACT

Purpose: The objective of the present study is to assess the metaphonological skill levels of children with speech sound disorders as a function of age and disorder severity as assessed by the Lindamood Auditory Conceptualization Test (LAC-3 adapted to the Brazilian Portuguese language). **Methods:** Fifty children with speech sound disorder between the ages of five years and seven years and 11 months were given three versions (I-A, I-B and II) of the *Lindamood Auditory Conceptualization Test* and then divided by age and speech sound disorder severity assessed by Percentage Consonants Correct-Revised (PCC-R) scores. **Results:** The skills testing results indicate that younger children with 85% PCC-R or less experience greater difficulty than the other children with auditory perception and exhibit more disorganized phonological systems, as shown in their execution of simple metaphonological skills throughout testing, which involve discriminating between isolated phonemic units. The complex task results do not provide sufficient information to determine which cognitive-linguistic knowledge features among children with speech sound disorder are most heavily affected. **Conclusion:** The skills testing results indicate that children with more severe speech sound disorder, who thus present higher degrees of phonological system disorganization, experience greater difficulty in the area of auditory perception. The results further indicate that regardless of the degree of disorder severity, children with phonological disorders struggle with more complex metaphonological skills, and those with greater degrees of disorder severity also struggle to master simpler metaphonological tasks.

Keywords: Auditory perception; Speech, language and hearing sciences; Articulation disorders; Child; Evaluation

RESUMO

Objetivo: O presente trabalho teve como objetivo investigar o desempenho de crianças com Transtorno Fonológico nas habilidades metafonológicas avaliadas pelo teste Lindamood Auditory Conceptualization Test (LAC-adaptado para o Português-Brasileiro), de acordo com a idade e a gravidade do transtorno. **Métodos:** Foram avaliadas 50 crianças com Transtorno Fonológico, idade entre 5 anos e 7 anos e 11 meses, submetidas à aplicação das três categorias (I-A; I-B; II) do *Lindamood Auditory Conceptualization Test* e, posteriormente, agrupadas por idade e pela gravidade, de acordo com a aplicação do Índice de gravidade de Porcentagem de Consoantes Corretas-Revisado. **Resultados:** As habilidades avaliadas indicaram que as crianças, cujo valor do Índice de gravidade de Porcentagem de Consoantes Corretas-Revisado foi inferior a 85%, destacando-se a gravidade associada à idade (crianças de menor faixa etária), apresentaram maior dificuldade na percepção auditiva e sistema fonológico mais desorganizado, evidenciado nas habilidades metafonológicas mais simples do teste, que envolvem a discriminação de unidades fonêmicas isoladas. As tarefas complexas não acrescentam informações para determinar quais aspectos do conhecimento cognitivo-linguístico da criança com transtorno fonológico está mais alterado. **Conclusão:** As habilidades avaliadas indicaram que as crianças que apresentaram maior gravidade do transtorno fonológico, e, portanto um sistema fonológico mais desorganizado, apresentaram maior dificuldade na percepção auditiva. Os resultados indicam ainda que crianças com transtorno fonológico, independentemente da gravidade, têm dificuldade em habilidades metafonológicas mais complexas, sendo que as mais graves também apresentam dificuldades naquelas mais simples.

Descritores: Percepção auditiva; Fonoaudiologia; Transtornos da articulação; Criança; Avaliação

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INTRODUCTION

Speech Sound Disorders (SSD) cause speech and language alterations that render affected children unable to create or establish rules for the use of sounds in different situations and contexts. SSD are some of the most common speech and language disorders that affect children[1,2], especially those between the ages of four and six[3,4]. The resulting speech sound difficulties can interfere with school or professional performance and with social communication.

Manifestations of SSD are heterogeneous with respect to severity, causal factors, and underlying difficulties. The Percentage of Consonants Correct-Revised (PCC-R)[5] scale is one most widely used rubrics for measuring SSD severity, according to specialized literature. Only sound substitutions or omissions are considered as errors when calculating the PCC-R score.

A noteworthy feature of schoolchildren with SSD is that they typically exhibit writing difficulties that are related to their speech errors[6-9]. According to most reading models, phonology plays a crucial role in the process of learning to read because written language is an arbitrary representation of oral language[10].

Mental operations based on the use of phonological information while processing oral or written language, known as phonological processing, are determinant skills involved in reading and writing tasks[10-12]. Facets of phonological processing include phonological working memory, phonological access to the mental lexicon, and phonological awareness.

Phonological awareness has been especially stressed as one of the main components associated with the acquisition and development of reading skills[8]. Phonological awareness concerns a child's knowledge of and access to the oral structure of language and focuses on how the latter both reflects on and manipulates sounds of speech. Difficulties utilizing previously stored phonological information may explain why some children with SSD exhibit reading difficulties[13]. In the present study, the term "metaphonological skills" is used in place of "phonological awareness" because the test method that is used to assess metaphonological skills involves first learning the structure of language[10].

Several studies have found that metaphonological skills alterations have a direct relationship with difficulties in the development of oral language and writing skills[8,12,14-17]. Assessments of such skills, which measure one's ability to reflect on and manipulate sounds[12,14], reveal that difficulties with understanding small units of language, which are needed for formulation, translate into difficulties with oral and written word production[8,18]. In the specific case of SSD, evidence indicates that affected children may exhibit difficulties in the development of metaphonological skills and in the acquisition of reading skills[6,13].

Although the relationship between auditory discrimination and reading skills is a subject of much discussion in the literature, the nature of this relationship also varies depending on the language in which studies are conducted. Various standardized tests that assess metaphonological skills are available in English[11,19] and in the Brazilian Portuguese language[10,20,21,22]. Many of these tests require children to produce verbal responses to tasks. Examples include the *Comprehensive Test of Phonological Processing* (CTOPP)[11], which assesses phonemic manipulation, segmentation and omission; CONFIAS – Sequential Assessment Instrument[20], which assesses synthesis, identification, production, exclusion and segmentation levels; Tests of Metalinguistic and Reading Skills - PROHMELE[10], which assesses skills related to non-word repetition and the identification and manipulation (addition, subtraction and combination) of syllables and phonemes; and Cielo's Assessment of Phonological Awareness[21], which assesses syllable- (rhyme, synthesis, segmentation and reversion) and phoneme- (reversion, exclusion, detection, synthesis and segmentation) related skills, among others. Non-verbal tasks, i.e., those that do not require verbal responses, can be assessed by means of the *Lindamood Auditory Conceptualization* Test (LAC)[19], which has been adapted to the Brazilian Portuguese language[22].

Tests that assess metaphonological skills but that do not require verbal responses, such as the LAC test[19,22], appear to provide superior information on phonological representations because they prevent language production errors from affecting respondent performance. Most individuals with oral language and/or literacy disorders appear capable of making coarse judgments on differences and similarities between spoken words and syllables but are unable to make precise judgments on the form and location of speech sound differences[9,23]. These speculations may be verified by running a test that does not require verbal responses.

The LAC test[19] was developed as a response to the issues described above. The primary function of this test is to measure auditory perception and speech sound comprehension levels, which are tested separately without requiring children to provide oral responses. The creators of the LAC test observe that auditory perception also includes sound identification and cognition, as it involves the organization of data that are perceived through hearing. They further emphasize that the auditory ability to perceive syllable structure segments may depend on the role that this structure plays in the phonology of language.

A longitudinal study conducted in North America compared the results of a reading test applied to 86 children with SSD and 37 children without SSD using the LAC[19], among other tests. The authors concluded that the persistence of SSD is associated with impaired metaphonological skills[24].

In 2002, the LAC test was adapted to the Brazilian Portuguese language[22] and applied to 144 children with no language/speech impairment of both genders between the ages of six and nine who were attending public or private school in the state of São Paulo, Brazil. The results indicated that performance in the three tested categories improved with age, i.e., the older the children were, the greater the number of correct responses.

Although a number of studies have described higher tendencies for children with SSD to exhibit impaired metaphonological skills, there is limited existing evidence to support this fact. In addition, assessment instruments such as the LAC test[20], which do not require the oral repetition of stimuli and which contribute to the detection of impaired skills, have been found to be relevant.

Hence, the objective of the present study is to assess the metaphonological skills performance of children with SSD using the adapted LAC test[22]. The study presents a novel approach in that it accounts for SSD severity, age, and performance when discriminating between isolated phonemic units and syllables. As these skills are specifically related to reading development, the adapted LAC test provides data on the capacities of children with SSD[22].

METHODS

The present study was approved by the research ethics committee of the School of Medicine at the Universidade de São Paulo (USP) (225/05, 0958/08). The parents of the participants also signed informed consent forms.

Participants

As the present study follows a retrospective design, we selected clinical records of boys and girls with SSD as diagnosed at the Laboratory of Phonological Investigation that is part of the Course of Speech Language and Audiology Pathology held within the Department of Physical Therapy, Speech, Language and Audiology Therapy and Occupational Therapy of the School of Medicine at the Universidade de São Paulo/Clinics Hospital (FMUSP/HC). The inclusion criteria were as follows: diagnosis of SSD; aged five years to seven years and 11 months at the time of SSD diagnosis assessment; no history of previous speech therapy intervention; understands and responds to adapted LAC test tasks[22].

From these inclusion criteria, 64 clinical records of children diagnosed with SSD between 2002 and 2011 were selected and analyzed. Fourteen children were excluded from the study because they failed to complete adapted LAC test[22] training. Thus, 50 clinical records were analyzed.

SSD diagnosis and PCC-R severity index calculation

SSD diagnoses were determined based on the results of phonology tests[25] that assess how participants recognize figures and imitate words included in the ABFW – Children Language Test[26]. Tests were recorded using a video camera and digital recorder for subsequent phonetic transcription by two speech therapist examiners. One of the examiners was a child therapist, and the other was a graduate (master or doctoral) student enrolled in the speech therapy course wherein the study was conducted.

PCC-R[5] scores were independently calculated for each figure-naming (34 figures with 90 consonants) and word-imitation (39 words with 107 consonants) task included in the phonology test. The average PCC-R value for both phonology tests was used for analysis.

LAC test application and analysis

After its adaptation, the LAC test was systematically applied by graduate (master and doctoral) students of the speech therapy course. The speech therapists hold considerable experience with this particular test, and responses were systematically recorded with a video camera for further analysis.

Upon its adaptation to the Brazilian Portuguese language (the version used in the present study)[22], some of the original content used in the English original version was modified to better complement the phonetic/phonological structure of the Brazilian Portuguese language. However, the test structure and application technique were left unchanged. Tasks were selected using small, colored dice (blue, yellow, green, red, white and black), whereby colors denoted the various components of the test.

Step one tests respondent comprehension of the same/different concept, knowledge of the numbers one to four, left to right orientation, and the first/last concept. If children fail to respond appropriately on the first attempt (Test 1), the therapist explains the concept again, and children are retested (Test 2), as Appendix 1 (adapted LAC test[22] standard record form) shows. The LAC test is only applied when a child exhibits a sufficient understanding of the above mentioned concepts in at least one of the two attempts; otherwise, the test is not applied.

Step two involves the actual application of the adapted LAC test[22], of which there are two categories. Category I assesses auditory perception skills through the auditory selection of speech sounds (for instance, distinction between /p/ and /ch/). This category is divided in two subcategories, I-A and I-B. Subcategory I-A includes 10 sequences that involve situations of sameness/difference (for instance, the therapist requests that the child produces the sequence [s, s] using colored blocks wherein the correct response is to produce two blocks of the same color; in the case of the sequence [g, b, v], the correct response is to produce three blocks of different colors). Subcategory I-B includes six sameness/difference sequences (for instance, the therapist asks the child to produce the sequence [b, b, z], the correct response being two blocks of the same color at the beginning of the sequence and one block of a different color at the end of the sequence).

Category II assesses comprehension skills associated with one's ability to perceive and compare the number and order of sounds in a spoken pattern (for instance, distinguishing between 'pat', 'apt' and 'tap'). Hence, category II measures most consonant/vowel contrasts present in simple syllables by assessing phoneme manipulation within syllables. Each item of this category (12 stimuli in total) assesses the manipulation of one phonemic change (addition, substitution, omission, shift and repetition). If a child makes five consecutive mistakes in category II, the test is interrupted. Further information on the test application procedure is provided in the description of the test's adaptation[22].

After the data were tabulated, an analysis of participant performance in the various adapted LAC test categories[22] was performed using two different techniques. First, correct responses were calculated separately for each category and subcategory (I-A and I-B) and category II. The adapted LAC test[22] total score (termed Total-LAC in this article) was then calculated by adding together all of the correct responses for categories I (including subcategories I-A and I-B) and II.

Data analysis

For the purpose of analysis, the respondents were categorized according to two different criteria to assess their performance in the adapted LAC test tasks according to age and SSD severity (assessed based on the average PCC-R score).

For the age categorization, participants were divided into three groups: five years, which included 12 children aged five years to five years and 11 months; six years, which included 21 children aged six years to six years and 11 months; and seven years, which included 17 children aged seven years to seven years and 11 months.

For the SSD severity categorization, children were divided into two groups based on PCC-R scores. One group included 21 children with PCC-R scores of less than 85% (higher SSD severity), and the other included 29 children with PCC-R scores that were equal to or higher than 85% (lower SSD severity). The 85% value was selected as the cutoff point in accordance with studies that have shown that most children with SSD achieve PCC-R scores higher than 85%, while a minority achieve scores of less than 85%[3,4].

Statistical analysis

A comparison between categories I-A, I-B and II and Total-LAC scores accounting for age interference was performed using the Kruskal-Wallis statistical model. A comparison between category I-A, I-B and II and Total-LAC scores relative to the PCC-R score was performed by means of the Mann-Whitney statistical model. Spearman's correlation test was conducted to investigate relationships among the assessed variables.

RESULTS

Descriptive analysis

The average values corresponding to the number of correct responses for the adapted LAC test[22] subcategories I-A and I-B, category II and Total-LAC results according to age and SSD severity are shown in Table 1. The *boxplot* graphics depict respondent performance in subcategories I-A and I-B, category II and the Total-LAC according to age and SSD severity (Figure 1).

The results show that the older participants exhibit stronger performance in the adapted LAC test[22] tasks. Moreover, all of the participants provided the highest number of correct responses to category I-A tasks.

Analysis of variables according to age

A review of adapted LAC test results across the three age groups shows a slight tendency towards significance in subcategory I-B (p=0.081) and Total-LAC (p=0.083) scores, wherein average scores corresponding to older children were higher than those of the youngest respondents. Subcategory I-A (p=0.181) and category II (p=0.145) results did not differ as a function of age (Table 2).

Analysis of variables according to PCC-R

A review of scores for respondents exhibiting PCC-R levels of less than 85% or of equal to or higher than 85% shows variations relative to subcategory I-A (p=0.033). No difference was found relative to subcategory I-B (p=0.178), category II (p=0.531) or Total-LAC (p=0.171) (Table 3).

Correlations between variables

The correlation test detected positive, albeit weak, correlations between PCC-R scores and age (p=0.042), subcategory I-A (p=0.035), subcategory I-B (p=0.041) and Total-LAC (p=0,045); age showed a correlation with subcategory I-A (p=0.050) and Total-LAC (p=0.037). A positive correlation with a tendency towards significance was found between age and subcategory I-B (p=0.068) and category II (p=0.081) (Table 4).

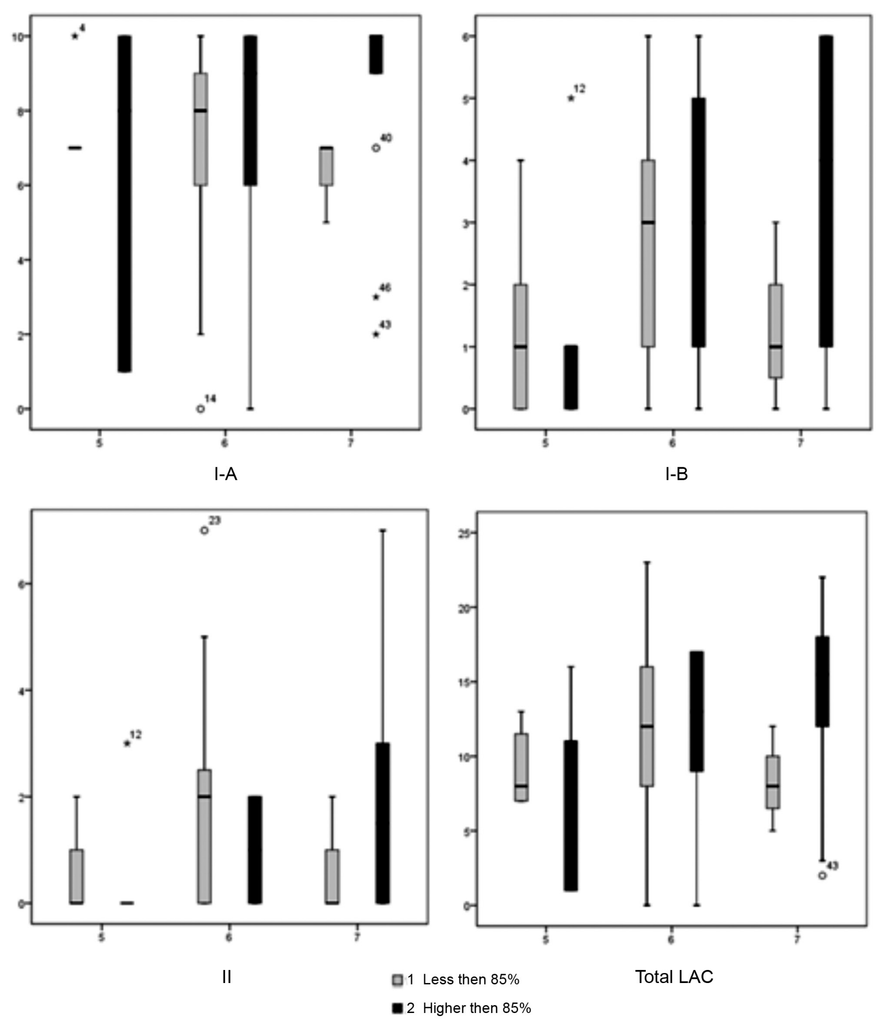
DISCUSSION

The challenges that children with SSD face with respect to metaphonological skills development are continuously addressed in Brazilian[12,14,16,17] and international[8,15] studies. The adapted LAC test was chosen to assess children with SSD in the present study because this test allows one to assess metaphonological skills, attention and memory, which affect child phonological organization. In addition, because the adapted

Table 1. Participant performance in the adapted LAC test per age and PD severity

Age	PCC-R		I-A	I-B	II	Total-LAC
Five years to five years and 11 months	Less than 85%	N	7	7	7	7
		Mean	7.43	1.29	0.57	9.29
		SD	1.13	1.60	0.98	2.63
	Above 85%	N	5	5	5	5
		Mean	6.00	1.40	0.60	8.00
		SD	4.64	2.07	1.34	6.71
Six years to six years and 11 months	Less than 85%	N	11	11	11	11
		Mean	6.91	2.82	1.91	11.64
		SD	3.30	2.09	2.34	6.95
	Above 85%	N	10	10	10	10
		Mean	7.30	2.90	1.00	11.20
		SD	3.77	2.13	1.05	6.32
Seven years to seven years and 11 months	Less than 85%	N	3	3	3	3
		Mean	6.33	1.33	0.67	8.33
		SD	1.15	1.53	1.15	3.51
	Above 85%	N	14	14	14	14
		Mean	8.64	3.43	2.14	14.21
		SD	2.73	2.34	2.25	6.34

Note: PCC-R = Percentage Consonants Correct - Revised; I-A = Category I-A; I-B = Category I-B; II = Category II; Total-LAC = Total Raw Score of the *Lindamood Auditory Conceptualization Test*



Note: I-A = Category I-A; I-B = Category I-B; II = Category II; Total-LAC = Total Raw Score of the *Lindamood Auditory Conceptualization Test*

Figure 1. Boxplot for participant performance in the adapted LAC test per age and PD severity

Table 2. Comparison of participant performance in the adapted LAC test as a function of age

AGE		I-A	I-B	II	Total-LAC
Five years to five years and 11 months	Mean	6.83	1.33	0.58	8.75
	SD	3.010	1.723	1.084	4.535
Six years to six years and 11 months	Mean	7.10	2.86	1.48	11.43
	SD	3.448	2.056	1.861	6.493
Seven years to seven years and 11 months	Mean	8.24	3.06	1.88	13.18
	SD	2.658	2.331	2.147	6.287
Inferential tests	χ^2	3.42	5.03	3.87	4.98
	df	2.00	2.00	2.00	2.00
	p value	0.181	0.081	0.145	0.083

Kruskal-Wallis test (p≤0.05)

Note: SD = standard deviation; PCC-R = Percentage Consonants Correct - Revised; I-A = Category I-A; I-B = Category I-B; II = Category II; Total-LAC = Total Raw Score of the *Lindamood Auditory Conceptualization Test*

Table 3. Comparison of participant performance in the adapted LAC test as a function of PD severity as measured by PCC-R

Severity		I-A	I-B	II	Total-LAC
PCC-R less than 85%	Mean	7.00	2.10	1.29	10.38
	SD	2.470	1.947	1.901	5.417
PCC-R above 85%	Mean	7.72	2.90	1.48	12.10
	SD	3.484	2.273	1.844	6.592
Inferential tests	U	199.50	237.00	275.00	235.00
	p value	0.033*	0.178	0.531	0.171

*Significant values (p≤0.05) – Kruskal-Wallis test

Note: SD = standard deviation; PCC-R = Percentage Consonants Correct - Revised; I-A = Category I-A; I-B = Category I-B; II = Category II; Total-LAC = Total Raw Score of the *Lindamood Auditory Conceptualization Test*

Table 4. Correlations between values corresponding to adapted LAC test performance, age and PCC-R

		Age	PCC-R
Age	rho		0.288
	p value		0.042*
I-A	rho	0.278	0.299
	p value	0.050*	0.035*
I-B	rho	0.260	0.290
	p value	0.068	0.041*
II	rho	0.249	0.197
	p value	0.081	0.170
Total-LAC	rho	0.296	0.285
	p value	0.037*	0.045*

*Significant values (p≤0.05) – Spearman's correlation test

Note: PCC-R = Percentage Consonants Correct - Revised; I-A = Category I-A; I-B = Category I-B; II = Category II; Total-LAC = Total Raw Score of the *Lindamood Auditory Conceptualization Test*

LAC test[22] does not involve the analysis of verbal responses, it thus allows one to assess responses with respect to auditory perception and discrimination, which are not affected by speech production errors.

The analyses performed in the present study did not detect differences between respondents as a function of age, although a correlation was found between age and LAC subcategory I-A test results. This correlation shows that while children with SSD struggle to produce certain sounds and organize phonological systems due to the demands of language and cognition, these children continuously improve their knowledge of the phonological language system[27-30]. It is worth noting that unlike children without SSD, participants performance in the present study did not improve with age.

An analysis of skills assessed by the adapted LAC test[22] as a function of SSD severity showed that phonological test performance among children with PCC-R scores lower than 85% was poorer compared to that with PCC-R scores equal to or higher than 85%. However, a statistically significant difference was found only for the results corresponding to subcategory I-A, indicating that this is the most effective variable for differentiating between children as a function of SSD severity interference. Subcategory I-A examines the simplest skill assessed in the adapted LAC test[22]: the ability to perceive speech sounds while identifying similarities or differences between different stimuli. The remaining categories assessed more complex factors and could not differentiate between participants as a function of SSD severity, as subcategory I-B and category II performance was similar for both groups.

Responses to category II, which assesses speech sound manipulation (the most complex category), were not influenced by either age or SSD severity. However, fewer correct responses were collected for this category than for categories I-A and

I-B. It thus appears that irrespective of age and SSD severity factors, the participants struggled with the two simplest metaphonological skills, which suggests that their phonological systems are less organized[8].

A study using the LAC test adapted to the Brazilian Portuguese language that examined children of six years to nine years and nine months of age who did not have speech or language disorders found that children aged six years to seven years and six months provided an average of 9.7 correct responses to subcategory I-A, 5.0 to subcategory I-B, and 6.7 to category II. Relative to the normal population, only 18 participants in the present study achieved a score higher than 9.7 for subcategory I-A, 12 achieved a score higher than 5.0 for subcategory I-B, and two reached a score higher than 6.7 for category II. The present study thus found that the overall performance of children with SSD was poorer compared to those without speech and language disorders, although older participants performed better than younger ones.

Interestingly, children aged seven years to seven years and 11 months provided more correct subcategory I-B and Total-LAC responses than their younger counterparts; this difference exhibits a tendency towards statistical significance. These findings show that the ability to perceive auditory stimuli presented as similar or different sounds (subcategory I-A) does not vary among children with SSD as a function of age, as all of the children exhibited satisfactory performance in this area. The same rule applies to category II, which also failed to differentiate children as a function of age, as participants from all three groups struggled considerably with the phoneme manipulation task. In addition, the tendency towards statistical significance among subcategory I-B responses (which assesses auditory perceptions of similar and different sounds within one sequence) shows that the participants varied in their performance of moderately difficult tasks, with older children exhibiting better performance.

The correlation analysis showed the influence of SSD severity on metaphonological skills performance as assessed by the adapted LAC test[22]. This finding shows that irrespective of the level of SSD severity, phonetic-phonological system disorganization among children, as shown by SSD diagnostic test results, affects metaphonological performance and, consequently, performance in school learning activities.

Despite its complexity, as a complementary tool for SSD diagnosis, the adapted LAC test application has shown that SSD severity should be accounted for during metaphonological assessments. It is also worth stressing that because the adapted LAC test uses meaningless sound combinations that represent syllabic structures present in the Brazilian Portuguese language and because responses involve the presentation of sounds using colored dice, the test allows one to assess phonological representation capacities and their organization within a child's system of sounds.

CONCLUSION

The results concerning the skills assessed through the adapted LAC test showed that children with PCC-R levels of less than 85% exhibited greater difficulty with auditory perception (category I) and higher degrees of phonological system disorganization compared to respondents with PCC-R levels equal to or higher than 85%. Respondents exhibiting SSD severity levels of less than 85% struggled with the simplest metaphonological tasks assessed by the adapted LAC test, whereas assessments of more complex tasks did not provide additional information on which aspects of cognitive-linguistic knowledge were affected most among the sample. The results indicate that children with SSD are impaired in executing simple metaphonological skills that involve discriminating between isolated phonemic units. Hence, irrespective of SSD severity, participants struggled to complete more complex metaphonological tasks, and those with more severe SSD also struggled to execute the simplest tasks.

These results on SSD severity effects on simple metaphonological task execution as assessed by means of non-verbal task completion may guide speech therapists on approaches to screening and definite assessment material selection.

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Appendix 1. LAC test records form (Lindamood and Lindamood, 1979, 2nd ed.) – Readaptation (Rosal, 2002)

Name:		Date of birth:	Age:
Educational level:	Public school ( ) Private school ( )		Date of application:
LAC score			
Categories	Correct responses		Converted score
I – A		x 1 =	
I – B		x 3 =	
II		x 6 =	
Test 1	Test 2	Application technique	
		Three blocks of the same color	
		Four blocks of different colors	
		Three blocks, the first two are of the same color	
		Three blocks, the last two are of the same color	
		Three blocks, the first and last are of the same color	
Caption: Yellow = Y; Blue = BU; White = W; Black = BK; Green = G; Red = R; Correct (+); Error (-);			

Model for Category I	1 - [z] [z] – show two identical blocks 2 - [v] [m] – show two different blocks of different colors from the previous ones 3 - [p] [p] [ch] – provide two identical sounds and one different sound in the sequence				
Category I					
I-A			**I-B**		
Target stimulus	**Responses**	**1/0**	**Target stimulus**	**Responses**	**1/0**
1 - Show [s] [s]			1 - Show [b] [b] [z]		
2 - Show [p] [p] [p]			2 - Show [j] [m] [m]		
3 - Show [s] [ch]			3 - Show [n] [l] [n]		
4 - Show [g] [b] [v]			4 - Show [s] [ch] [ch]		
5 - Show [i] [e]			5 - Show [k] [t] [k]		
6 - Show [d] [d] [d]			6 - Show [t] [t] [ch]		
7 - Show [o] [a] [u]			Only after the first error should the examiner repeat the child's response and then present the correct stimulus. If the child self-corrects, the response will be deemed correct.		
8 - Show [f] [s] [t]					
9 - Show [t] [t]					
10 - Show [d] [t]					
Model for Category II	1 - [u] – show one block 2 - [zu] – add one block 3 - [uz] – invert the blocks 4 - [zuz] – add one additional block 5 - [ziz] – change and replace blocks 6 - [zizdã] – add block 7 - [izdã] – remove a block				
Category II					
Basic stimulus	**Responses**	**1/0**	**Responses**	**Basic stimulus**	**1/0**
1 - Show [i]					
2 – If I say [i] Show [ip]			2 - If I say [e] Show [et]		
3 - If I say [ip] Show [pi]			3 - If I say [et] Show [te]		
4 - If I say [pi] Show [pip]			4 - If I say [te] Show [tet]		
5 - If I say [pip] Show [ip]			5 - If I say [tet] Show [et]		
6 - If I say [ip] Show [op]			6 - If I say [et] Show [ot]		
7 - If I say [op] Show [vop]			7 - If I say [ot] Show [fot]		
8 - If I say [vop] Show [vopr]			8 - If I say [fot] Show [fotr]		
9 - If I say [vopr] Show [vapr]			9 - If I say [fotr] Show [futr]		
10 - If I say [vapr] Show [apr]			10 - If I say [futr] Show [utr]		
11- If I say [apr] Show [arp]			11- If I say [utr] Show [urt]		
12- If I say [arp] Show [rarp]			12- If I say [urt] Show [rurt]		