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# Speech-language pathology program for reading comprehension and orthography: effects on the spelling of dyslexic individuals

## *Programa fonoaudiológico em compreensão leitora e ortografia: efeitos na ortografia em disléxicos*

### Keywords

Dyslexia  
Language  
Language Therapy  
Handwriting  
Speech, Language and Hearing Sciences

### ABSTRACT

**Purpose:** Prepare a Speech-language Pathology Program for Reading Comprehension and Orthography and verify its effects on the reading comprehension and spelling of students with Developmental Dyslexia. **Methods:** The study sample was composed of eleven individuals (eight males), diagnosed with Developmental Dyslexia, aged 09-11 years. All participants underwent a Speech-language Pathology Program in Reading Comprehension and Orthography comprising 16 individual weekly sessions. In each session, tasks of reading comprehension of texts and orthography were developed. At the beginning and end of the Program, the participants were submitted to a specific assessment (pre- and post-test). **Results:** The individuals presented difficulty in reading comprehension, but the Cloze technique proved to be a useful remediation tool, and significant improvement in their performance was observed in the post-test evaluation. The dyslexic individuals showed poor performance for their educational level in the spelling assessment. At the end of the program, their performance evolved, but it remained below the expected, showing the same error pattern at the pre- and post-tests, with errors in both natural and arbitrary spelling. **Conclusion:** The proposed Speech-language Pathology Program for Reading Comprehension and Orthography produced positive effects on the reading comprehension, spelling, and motivation to reading and writing of the participants. This study presents an unprecedented contribution by proposing joint stimulation of reading and writing by means of a program easy to apply and analyze in individuals with Developmental Dyslexia.

### Descritores

Dislexia  
Linguagem  
Terapia da Linguagem  
Escrita Manual  
Fonoaudiologia

### RESUMO

**Objetivo:** Elaborar um Programa Fonoaudiológico em Compreensão Leitora e Ortografia e verificar seus efeitos na compreensão leitora e ortografia de escolares com Dislexia do Desenvolvimento. **Método:** Participaram desta pesquisa onze indivíduos com diagnóstico de Dislexia do Desenvolvimento, com idades entre 9 e 11 anos, sendo oito meninos. Todos foram submetidos ao Programa Fonoaudiológico em Compreensão Leitora e Ortografia, composto por 16 sessões semanais individuais. Em cada sessão, foram desenvolvidas tarefas de compreensão leitora de textos e de ortografia. Antes do início e ao término do Programa, os participantes realizaram uma avaliação específica (pré e pós-teste). **Resultados:** Os indivíduos apresentaram dificuldade na compreensão de textos, porém a técnica de Cloze foi um instrumento útil para a remediação da compreensão leitora, havendo melhora significativa no desempenho destes no pós-teste. Os disléxicos demonstraram um desempenho inferior à escolaridade em ortografia. Após o Programa, o desempenho deles evoluiu, porém permaneceu abaixo do esperado, ocorrendo o mesmo perfil de erros no pré e no pós-teste, com erros de ortografia natural e ortografia arbitrária. **Conclusão:** O Programa Fonoaudiológico em Compreensão Leitora e Ortografia produz efeitos positivos na compreensão leitora, na ortografia e na motivação para a leitura e escrita dos participantes. Este estudo apresenta uma contribuição inédita, ao propor a estimulação conjunta da leitura e da escrita, por meio de um programa de fácil aplicabilidade e análise, em indivíduos com Dislexia do Desenvolvimento.

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## INTRODUCTION

Orthography of a written language influences both its reading and writing. Orthographic knowledge is connected to components that are critically necessary for fluent reading and comprehension. Learning to spell plays a crucial role in the development of automatic word recognition, supporting reading fluency and providing cues to other systems, such as phonology, morphology, syntax, and semantics<sup>(1)</sup>. Orthographic knowledge also influences the correct writing of words, especially those that involve the irregularities of a language, whose orthographic representation must be well specified<sup>(2)</sup>.

In this context, the orthographic characteristics of a language assume special importance, and in alphabetical orthographies, the relationship between graphemes and phonemes can be classified according to the orthographic depth factor. Brazilian Portuguese is considered a transparent, or almost transparent, language because it presents univocal correspondences between graphemes and phonemes, but there are also some irregularities<sup>(2)</sup>.

Spelling is also associated with learning the written language. There is a differentiation between learning the alphabet notation system and learning the orthographic norm. Before mastering the alphabetic principle, children present some level of orthographic knowledge<sup>(3-4)</sup>. However, only after acquisition of alphabetic writing, individuals begin to systematically appropriate the orthographic norm. Spelling is difficult to master, and can not be appropriated spontaneously by apprentices. Its conventions must be taught explicitly, in a timely manner, and in accordance with adequate strategies<sup>(2)</sup>.

Developmental dyslexia (DD) is a specific learning disorder characterized by difficulties in accuracy and fluency in word reading and impairment in writing and spelling skills. Such difficulties usually result from deficits in the phonological component of language and are unexpected with regard to other cognitive abilities and access to effective school education. Consequences secondary to DD include problems in reading comprehension and reduced writing experience, which may hinder the growth of vocabulary and general knowledge<sup>(5)</sup>.

Several studies have addressed orthographic difficulties, suggesting deficits in orthographic processing in individuals with learning disorders and DD<sup>(2,6-11)</sup>.

Specific scientific literature presents, with broad support, programs focused on the stimulation of phonological awareness in individuals with DD<sup>(12-14)</sup>. Surveys dedicated to working with other cognitive and linguistic aspects in individuals with DD are less numerous.

Some studies have addressed remedial programs aimed at spelling for individuals with DD and others at learning disorders, reporting improvement in reading<sup>(1)</sup>, writing and orthographic knowledge<sup>(15)</sup>. Brazilian authors have described intervention programs aimed at spelling difficulties, but not specifically at the population with DD<sup>(2,16)</sup>.

Studies with different populations, with the purpose of evaluating and stimulating reading comprehension, have used the Cloze technique. This procedure consists in organizing a text of approximately 200 words, leaving the first and last sentences intact, and deleting in the rest of the text the words of a certain grammatical category and/or located in strategic positions (fifth, seventh or tenth word in sequence). An empty space (blank) is

inserted in the place of the deleted word. This blank should be filled by the reader in order to restore the full meaning of the sentence and the text as a whole<sup>(17-19)</sup>.

The Cloze technique is considered an effective instrument both in measuring<sup>(20,21)</sup> and remediating reading comprehension<sup>(22,23)</sup>. It is worth noting, however, that no research using the Cloze technique for intervention in individuals with DD has been found in the national or international scientific literature.

The present study is justified by the occurrence, in individuals with DD, of difficulties both in reading comprehension<sup>(5)</sup> and in spelling<sup>(1,2,6-11)</sup>, as well as by the importance of orthographic knowledge for the development of reading, by means of automatic word recognition, which assists reading fluency and provides information about the phonology, morphology, syntax, and semantics of the words read<sup>(1)</sup>, and also by the role that orthographic knowledge plays in correct word writing<sup>(2)</sup>.

In addition, the present research is justified by the scarcity of studies in the scientific literature addressing spelling stimulation in individuals with DD, both through reading (grapheme-phoneme relationship) and writing (phoneme-grapheme relationship).

Based on what has been previously exposed, the objective of the present study was to develop a Speech-language Pathology Program for Reading Comprehension and Orthography (PRCO) and verify its effects on the reading comprehension and spelling of students with DD.

## METHODS

This study was approved by the Research Ethics Committee of the aforementioned Institution under protocol no. 190/14. The parents and/or legal guardians of the participants were informed about the procedures and signed an Informed Consent Form (ICF) prior to study commencement. The participants were also informed, in a simplified way, about the procedures they would undergo and signed an ICF.

Study participants were 11 schoolchildren (eight males), diagnosed with Developmental Dyslexia (DD), aged 9-11 years. Three of these Elementary School students were in 4<sup>th</sup> grade and eight of them were in 5<sup>th</sup> grade.

Inclusion criteria were as follows: having authorization from parents and/or legal guardians to participate in the survey, confirmed by the signature on the ICF; having an informative questionnaire responded by parents and/or guardians; diagnosis of DD, confirmed by two multidisciplinary teams; presenting alphabetical level of writing and basic level of reading decoding verified by tests of reading and writing and related skills conducted by a researcher; not presenting cognitive deficits and auditory and visual impairments; being enrolled in the 4<sup>th</sup> or 5<sup>th</sup> grade of a public or private Elementary School; being between eight and 12 years of age; not being under Speech-language Pathology (SLP) or psycho-pedagogical monitoring at the time.

All individuals were assessed before and after participation (pre- and post-tests) in the Speech-language Pathology Program for Reading Comprehension and Orthography (PRCO). The tests applied at these two moments were the same (Chart 1). The PRCO was especially prepared for the present research based on the studies and material described in Chart 2.

**Chart 1.** Pre-test and post-test instruments

Pre- and post-test instruments	Application
<b>Test of Reading Comprehension of Expository Texts</b> (Saraiva RA, Moojen S, Munarski R. Avaliação da compreensão leitora de textos expositivos: para fonoaudiólogos e psicopedagogos. 2. ed. Casa do Psicólogo; 2009.)	A 4 <sup>th</sup> grade text (“As lhamas”, containing 140 words) adapted to application of the structural Cloze technique without support with deletion at every five words was used in this assessment. Participants were instructed to read the whole text, silently, trying to understand the message, even in the presence of blanks. Next, they were asked to fill in each of the blanks with the words that they thought fit to maintain the content. At the end of the reading and filling process, the participants were asked to respond, orally, to seven comprehension questions on the text used, without support.
<b>Assessment of Reading Comprehension Levels</b> (Cárnio MS, Soares AJC, Alves DC. Protocolo adaptado de Castillo, HV para utilização no Programa Escola e no Laboratório de Investigação Fonoaudiológica em Leitura e Escrita do Curso de Fonoaudiologia da FMUSP; 2012.)	The protocol, which aims to classify the levels of decoding and reading comprehension, was completed by the examiner. It consists of two parts: The first one addresses decoding and contains seven questions. Participants can score up to 14 points, and their classification is determined at the initial, intermediate, or automatic decoding levels. The second part deals with comprehension levels and contains 10 questions. Participants can score up to 20 points, having their performance classified as follows: “does not understand”, “initial comprehension”, “literal comprehension”, “independent comprehension”, and “critical comprehension”. In this study, only the second part of the protocol was filled in, based on the individuals’ performance in the Test of Reading Comprehension of Expository Texts.
<b>“Pró-Ortografia” Dictation of Words, Spelling Assessment Protocol for 2nd to 5th-Grade Elementary School Children</b> (Batista AO, Cervera-Mérida JF, Ygual-Fernández A, Capellini SA. Pró-Ortografia: Protocolo de avaliação da ortografia para escolares do segundo ao quinto ano do ensino fundamental. Manual Introdutório. Barueri: Pró-Fono; 2014.)	This assessment enables verification of the knowledge level of students about the notation rules, within a controlled situation and with the support of the orthographic lexical memory/grapheme lexicon. The test is composed of 86 words: three monosyllabic, thirty-three disyllabic, thirty-five trisyllabic, and fifteen polysyllabic words. The words were presented orally to the schoolchildren, who wrote them on a specific protocol. Subsequently, the examiner computed the correct responses and classified the spelling mistakes of each word according to the proposed classification of errors: Univocal Phoneme-Grapheme Correspondence; Omission and Addition of Segments; Alteration of the Order of the Segments; Separation or Improper Junction of Words; Phoneme-Grapheme Correspondence Dependent on the Phonetic Context/Position; Phoneme-Grapheme Correspondence Regardless of Rules; Inadequate Absence or Presence of Word Stress; Other Findings. Spelling mistakes made by the study participants were analyzed and classified according to the semiology of errors.

**Chart 2.** Studies and material used in the preparation of the Speech-language Pathology Program for Reading Comprehension and Orthography (PRCO)

Study / Material	Item used	Reference
<b>Reading comprehension intervention based on the Cloze Technique</b>	Levels of blank filling using the Cloze technique	Capellini SA, Germano GD. Intervenção com compreensão de leitura a partir do uso da Técnica de Cloze. In: Pró- Fono (Organizadora). Planos Terapêuticos Fonoaudiológicos (PTFs). Barueri: Pro-Fono; 2012. pp: 149-158.
<b>Intervention Program for Spelling Difficulties</b>	Sequences of stimulation of orthographic difficulties	Sampaio MN, Ygual-Fernández A, Cervera-Mérida JF, Capellini SA. Programa de intervenção com as dificuldades ortográficas: proposta de um modelo clínico e educacional. São José dos Campos: Pulso Editorial; 2013.
<b>“Pró-Ortografia” Dictation of Words, Spelling Assessment Protocol for 2nd to 5th Grade Elementary School Children</b>	Classification of spelling errors	Batista AO, Cervera-Mérida JF, Ygual-Fernández A, Capellini SA. Pró-Ortografia: Protocolo de avaliação da ortografia para escolares do segundo ao quinto ano do ensino fundamental. Manual Introdutório. Barueri: Pró-Fono; 2014.
<b>Phonology and spelling subsidies for the understanding of dysgraphia</b>	Orthographic classification of Brazilian Portuguese	Capellini SA, Batista AO. Subsídios da fonologia e ortografia para a compreensão da disortografia. <i>apud</i> Batista AO. Desempenho ortográfico de escolares do 2º ao 5º ano: proposta de elaboração de um protocolo de avaliação da ortografia [dissertação]. Marília: Universidade Estadual de Paulista “Júlio de Mesquita Filho” – Faculdade de Filosofia e Ciências; 2011. p. 182-186.
<b>Reading of Literary Texts vs. Scientific Texts by Incipient Readers</b>	Complexity levels of reading comprehension	Castillo, HV. A Leitura de Textos Literários vs Textos Científicos Por Leitores Incipientes. In: Witter GP. Leitura: Textos e Pesquisas. Campinas: Alínea. 1999. Cap. 4. pp. 55-64.
<b>“Estrelinha” Book Collection</b>	Texts used for reading comprehension activities using the Cloze technique at levels 1 and 2	Junqueira, S. Coleção Estrelinha. São Paulo: Editora Ática; 2007.
<b>“Mico Maneco” Book Collection</b>	Texts used for reading comprehension activities using the Cloze technique at levels 1 and 2	Machado, AM. Coleção Mico Maneco. São Paulo: Salamandra, 2012.
<b>Aesop’s Fables</b>	Texts used for reading comprehension activities using the Cloze technique at levels 3 and 4	Ash R, Hington B (compilação). Fábulas de Esopo. São Paulo: Companhia das Letras; 1994.

Two charts similar to Charts 1 and 2 have been submitted as part of another article to CoDAS Journal (ID 2017-0058) because this other research was conducted in the same laboratory. The authors are aware of this and agree with the publication of both articles

The PRCO is a closed program comprising 16 individual, weekly sessions (60 min each). The sessions were divided into four levels of complexity, with four sessions at each level. The criterion of advancement from one level to the other was  $\geq 50\%$  of correct responses in filling the text using the Cloze technique in the fourth session of each level.

Participants who achieved or exceeded this percentage of success in the fourth session of each level participated in 16 sessions, concluding the four proposed levels. Participants who failed any of the levels were reassessed (with four new texts and spelling activities, respecting the same level of complexity). Thus, all the participants undertook the 16 proposed sessions, but not all of them completed the four levels of complexity. For this reason, the PRCO was designed with 16 sessions for Level I, 12 sessions for Level II, eight sessions for Level III, and four sessions for Level IV.

The levels presented increasing difficulty, and the sessions were composed of a text using the structural Cloze technique, with deletion of every fifth word; comprehension tasks based on the different levels of reading comprehension complexity; spelling tasks following the classification adopted for the orthography of Brazilian Portuguese.

Texts in Levels I and II were excerpted from materials addressing the initial stage of literacy, in order to facilitate decoding and memorization, because of the high word repetition rate and simple spelling construction.

Texts in Levels III and IV were selected from more complex materials, which require greater reading comprehension and orthographic knowledge.

The different levels and their activities are described ahead:

### Level I

- Reading comprehension using the Cloze technique: The texts were adapted to the Cloze technique with a total of 20 blanks in each text. Below each blank, two terms of different semantic classes were written in parentheses.
- Reading comprehension through tasks related to the text: Each session had four literal comprehension level tasks (associated with the explicit content of the text) with support (containing the correct response within the proposed activity).
- Spelling activities: Each session included three tasks to stimulate the orthographic category “phoneme-grapheme correspondence from the regular phonographic principle”.

### Level II

- Reading comprehension using the Cloze technique: The texts were adapted to the Cloze technique with a total of 25 blanks in each text. Below each blank, two terms of approximate semantic classes were written in parentheses.
- Reading comprehension through tasks related to the text: Each session had four reading comprehension tasks: two literal comprehension level tasks, with and without support (the reader does not receive the aid of guiding responses),

and two independent comprehension level tasks (associated with the implicit content of the text) with support.

- Spelling activities: Each session included three tasks to stimulate the orthographic category “phoneme-grapheme correspondences from the rule-dependent phonographic principle”.

### Level III

- Reading comprehension using the Cloze technique: The texts were adapted to the Cloze technique with a total of 30 blanks in each text. The deleted words were randomly arranged in a rectangular box at the end of the text, so that individuals could select from all of them the appropriate word to fill each blank.
- Reading comprehension through tasks related to the text: Each session contained four reading comprehension tasks: one at the literal comprehension level without support, one at the independent comprehension level with support, and two at the independent comprehension level without support.
- Spelling activities: Each session had three tasks to stimulate the orthographic category “phoneme-grapheme correspondence from the semiographic principle”.

### Level IV

- Reading comprehension using the Cloze technique: The texts were adapted to the Cloze technique with a total of 35 blanks in each text. The words deleted from the texts were not offered to the individuals, and the participants had to fill in the blanks with the words they considered correct.
- Reading comprehension through tasks related to the text: Each session had four reading comprehension tasks, and the first two sessions included two independent comprehension level tasks without support and two critical understanding level tasks, one with support and one without support. The last two sessions contained two independent comprehension level tasks and two critical comprehension level tasks, all without support. The critical understanding level tasks are associated with the manipulation of the text and its correlation with the readers’ global knowledge.
- Spelling activities: Each session included four tasks to stimulate the orthographic category “phoneme-grapheme correspondences from irregularities in the orthographic system”.

## RESULTS

Regarding the effects of the PRCO on reading comprehension using the Cloze technique, the mean percentage of correct responses observed in text filling using this procedure in the post-test was higher than that in the pre-test (Table 1).

Statistically significant difference was found between the means of correct responses in the pre- and post-tests ( $p=0.001$ ), with



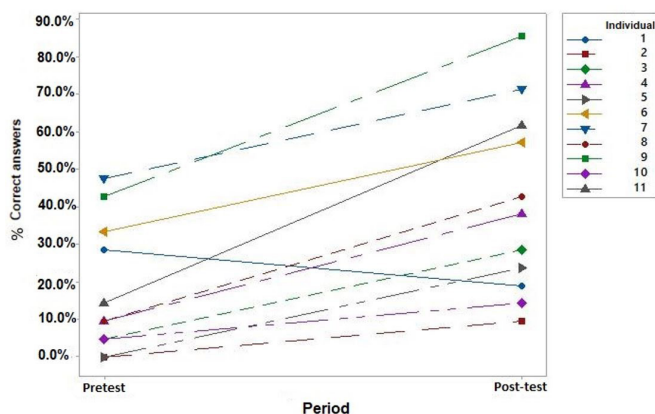
the post-test mean higher than that in the pre-test. The estimated mean difference is 23.4% (95% CI: [12.6%; 34.1%]).

In the individual profiles, depicted in Figure 1, it is possible to observe that most individuals show higher percentage of correct responses in the post-test.

Effects of the PRCO on the performance of individuals regarding spelling were positive, because the mean of correct responses in the “Pró-Ortografia” Dictation of Words Protocol in the post-test was higher than that in the pre-test (Table 2).

Statistically significant difference was found between the means of the number of correct responses at the two moments ( $p=0.004$ ). The estimated mean difference was 5.8 correct responses (95% CI: [2.3; 9.3]). Figure 2 shows that most individuals presented a larger number of correct responses in the post-test.

Table 3 presents a descriptive summary of the number of mistakes in each error category in the “Pró-Ortografia” Dictation



**Figure 1.** Individual profiles for the percentage of correct responses in the Cloze technique, Pre-test and post-test

**Table 1.** Percentage and difference of individuals’ correct responses in the Cloze technique, Pre-test and post-test

Period	N	Mean	Standard deviation	Minimum	Median	Maximum
Pre-test	11	17.7	17.3	0.0	9.5	47.6
Post-test	11	41.1	25.0	9.5	38.1	85.7
Difference	11	23.4	16.0	-9.5	23.8	47.6

**Table 2.** Number and difference of individuals’ correct responses in the “Pró-Ortografia” Dictation of Words Protocol, Pre-test and post-test

Period	N	Mean	Standard deviation	Minimum	Median	Maximum
Pre-test	11	16.9	15.4	1	11	51
Post-test	11	22.7	16.2	4	18	58
Difference	11	5.8	5.2	-5	8	11

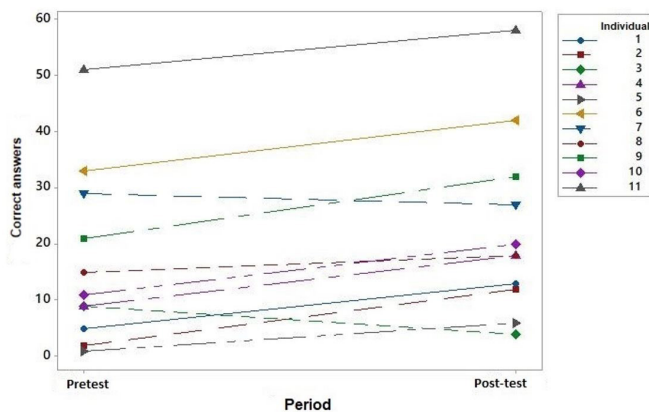
**Table 3.** Number and difference of errors in each error category in the “Pró-Ortografia” Dictation of Words Protocol, Pre-test and post-test

Error category	Period	N	Mean	Standard deviation	Minimum	Median	Maximum
P-GC	Pre-	11	23.8	14.7	4	24	45
	Post-	11	19.5	11.0	0	17	34
	Difference	11	4.4	11.4	-23	4	18
OAS	Pre-	11	31.6	28.3	1	30	78
	Post-	11	26.6	21.6	1	24	65
	Difference	11	4.9	18.4	-32	6	32
AOS	Pre-	11	3.7	4.3	0	2	12
	Post-	11	3.1	3.9	0	1	10
	Difference	11	0.6	2.4	-3	0	6
SIJW	Pre-	11	0.1	0.3	0	0	1
	Post-	11	0.0	0.0	0	0	0
	Difference	11	0.1	0.3	0	0	1
P-GCDC	Pre-	11	17.6	6.4	7	20	26
	Post-	11	15.2	6.4	5	14	27
	Difference	11	2.4	6.2	-6	1	16
P-GCRR	Pre-	11	31.7	14.7	17	28	69
	Post-	11	28.7	11.0	12	29	44
	Difference	11	3.0	16.8	-9	-1	51
IAPS	Pre-	11	15.6	2.6	12	15	20
	Post-	11	15.0	3.1	11	14	21
	Difference	11	0.6	2.5	-3	1	5
OF	Pre-	11	1.3	1.3	0	1	3
	Post-	11	0.7	2.1	0	0	7
	Difference	11	0.6	1.9	-4	1	3

**Captions:** P-GC = Univocal Phoneme-Grapheme Correspondence; OAS = Omission and Addition of Segments; AOS = Alteration of the Order of the Segments; SIJW = Separation or Improper Junction of Words; P-GCDC = Phoneme-Grapheme Correspondence Dependent on the Phonetic Context/Position; P-GCRR = Phoneme-Grapheme Correspondence Regardless of Rules; IAPS = Inadequate Absence or Presence of Word Stress; OF = Other Findings

**Table 4.** Mean percentage of correct responses according to level and session of the Speech-language Pathology Program for Reading Comprehension and Orthography (PRCO)

Level	Session	N	Mean	Standard deviation	Minimum	Median	Maximum
1	1	11	84.5	11.7	60	85	100
	2	11	82.7	12.9	70	85	100
	3	11	96.8	4.0	90	100	100
	4	11	88.6	8.1	75	90	100
	<b>Total</b>	<b>44</b>	<b>88.2</b>	<b>10.9</b>	<b>60</b>	<b>90</b>	<b>100</b>
2	1	11	84.7	10.4	68	84	100
	2	11	78.9	16.9	48	88	96
	3	11	81.8	8.3	68	84	96
	4	11	81.5	12.9	56	80	96
	<b>Total</b>	<b>44</b>	<b>81.7</b>	<b>12.3</b>	<b>48</b>	<b>84</b>	<b>100</b>
3	1	11	33.6	21.0	13	27	67
	2	11	47.6	22.3	13	47	87
	3	11	46.7	24.5	20	50	93
	4	11	44.5	24.8	17	43	80
	5	6	42.2	19.9	23	40	77
	6	6	40.6	16.1	20	37	67
	7	6	26.1	22.5	3	22	60
	8	6	40.0	19.6	23	35	77
<b>Total</b>	<b>68</b>	<b>41.0</b>	<b>21.9</b>	<b>3</b>	<b>40</b>	<b>93</b>	
4	1	5	61.7	10.2	54	54	74
	2	5	52.6	11.0	43	49	66
	3	5	52.0	15.2	34	51	69
	4	5	52.0	23.3	26	46	89
<b>Total</b>	<b>20</b>	<b>54.6</b>	<b>15.1</b>	<b>26</b>	<b>54</b>	<b>89</b>	



**Figure 2.** Individual profiles for the number of correct responses in the “Pró-Ortografia” Dictation of Words Protocol, Pre-test and post-test

of Words Protocol at both moments, as well as the differences between the numbers of errors in the pre- and post-tests. A decrease in the mean number of errors is observed from the pre-test to post-test in all categories, but with similar distribution profile between categories at both times.

Performance of individuals at the different complexity levels of the PRCO demonstrated that all of them underwent four sessions at Levels I and II. At Level III, five participants (45%) underwent four sessions and six individuals (55%) completed eight sessions. Only five schoolchildren (45%) achieved Level IV, and completed four sessions at this level.

Percentage means of correct responses according to level and session are shown in Table 4. The highest means of correct responses were observed in the sessions of Levels I and II, whereas the lowest ones were found in the sessions of Level III.

## DISCUSSION

The purpose of this study was to prepare a Speech-language Pathology Program for Reading Comprehension and Orthography (PRCO) and verify its effects on the reading comprehension and spelling of students with Developmental Dyslexia (DD). Results demonstrated that the PRCO positively influenced the reading and writing of the schoolchildren investigated. Although the difficulties persisted, significant improvement was observed in the performance of individuals in the skills assessed, as discussed ahead.

With respect to reading comprehension, significant improvement was found in the mean performance of participants in the post-test; most of them showed better performance in the post-test compared with that in the pre-test (Figure 1), except for Individual 1, who filled in six blanks correctly in the pre-test (28.57%) against four in the post-test (19.05%). It is worth noting that this participant experienced serious family problems during the course of the research, leading to considerable absence throughout the Program, which hampered his learning.

This finding corroborates those of previous studies that presented the Cloze technique as adequate for the development of reading comprehension<sup>(23-25)</sup>. There are no intervention studies

addressing remediation for reading comprehension using the Cloze technique in individuals with DD in the literature; therefore, the findings of the present survey are unprecedented.

Spelling assessment also showed significantly improved mean performance in the post-test. Most of the participants presented better performance in the post-test, except for Individuals 3 and 7, as it can be observed in Figure 2. Individual 3 had nine correct responses in the pre-test against four in the post-test. However, it is worth mentioning that this student presented a higher degree of difficulty in all the pre- and post-tests compared with their peers, suggesting greater severity of the condition. Individual 7 had 29 correct responses in the pre-test and 27 in the post-test. This participant had an important attention problem throughout the research, which may justify this information.

Most of the schoolchildren analyzed showed improved performance from pre- to post-test, demonstrating the positive effects of a remediation program on the spelling of individuals with DD. This finding is in agreement with those of previous surveys, which reported improvement in the performance of students with orthographic difficulties after an intervention program<sup>(16)</sup> and of individuals with a diagnosis of reading disorder and dyslexia after intervention to stimulate the learning of orthographic rules<sup>(15)</sup>.

Nevertheless, most participants presented performance below the expected for their educational level in both the pre- and post-test. This finding confirms those of previous studies that addressed the existence of persistent impairment in the orthography of individuals with DD<sup>(1,26)</sup> and continuity of difficulties even after intervention<sup>(2,12,27,28)</sup>.

Analysis of the error categories demonstrated the same profile in the pre- and post-test (Table 3), that is, despite the decrease in the number of errors, individuals continued to present the same error pattern after the PRCO. The most commonly found error types in descending order were P-GCRR – Phoneme–Grapheme Correspondence Regardless of Rules; OAS – Omission and Addition of Segments; P-GC – Univocal Phoneme–Grapheme Correspondence; P-GCDC – Phoneme–Grapheme Correspondence Dependent on the Phonetic Context/Position; IAPS – Inadequate Absence or Presence of Word Stress.

Therefore, the main difficulty found by students with DD in this research concerned the irregularities of Brazilian Portuguese (P-GCRR). Previous studies have reported, to a greater or lesser degree, difficulties in spelling irregular words in individuals with dyslexia. These difficulties tend to be persistent, considering that individuals fail to consolidate the orthographic patterns of irregular words because of reading impairment, presenting reduced mental lexicon and lower storage capacity of orthographic patterns<sup>(2,9)</sup>.

The second major difficulty for individuals in the spelling assessment in the present study is associated with a mismatch in the correspondence between sounds and letters (OAS and P-GC). These errors, which are predominantly phonological, are reported in the literature as an important characteristic of DD, because individuals present phonological processing deficits<sup>(5,7,9)</sup>.

The third major difficulty individuals presented in the spelling assessment relates to errors in orthographic rules (P-GCDC and IAPS). These errors reflect an unconsolidated knowledge about

the characteristics of the orthography of Brazilian Portuguese, which are influenced by a wide and complex knowledge network, such as contextual and morphosyntactic rules<sup>(8)</sup>.

Therefore, the data found show that the spelling of individuals with DD can be stimulated with remediation programs focused on the theme, being an important aspect for their development in both reading<sup>(1)</sup> and writing<sup>(2)</sup>.

As for the performance of individuals at the different levels of the PRCO, it was possible to verify that all the participants in the study underwent the sessions of Levels I and II with no need for repetition. At these levels, the texts are simpler and redundant, with greater frequency of spelling difficulties and smaller frequency of complex orthographic rules and language irregularities. In addition, the Cloze technique was constructed so as to present support (two alternatives) under each blank. In this way, participants were able to participate in the sessions satisfactorily, and it was possible to note that this fact assisted with their motivation, participation and performance.

Level III was more difficult than all the others for the participants. At this level, the texts are more complex and the orthographic difficulty requires integration of different linguistic analyses, such as semantic and morphosyntactic aspects. Moreover, the Cloze technique at this level was built without support under the blanks, with a box containing all the words deleted at the end of the texts. Thus, filling in the gaps required more attention, memory, and more complex processing of visual information, with many options presented together. The sessions at this level were the most time-consuming and tiring. Six individuals (54.54%) failed to advance to the next level.

Few individuals participated at Level IV; consequently, the analysis of their characteristics was impaired. Nevertheless, it could be noted that, compared with Level III, individuals were freer, with less demand for seeking the correct word and for memory. However, more was required of their linguistic and encyclopedic knowledge to fill the blanks, and it was also a level with greater difficulty than the initial ones.

Thus, the PRCO levels presented increasing complexity. However, the difficulty of Level III was higher than that of Level IV, and most participants were unable to progress to the last level of the program. It is worth emphasizing that those who reached the last level performed better at it than at the previous one.

The main limitation to this study was the small sample size, despite the extensive search, with wide dissemination in institutions, partner schools, and the press, and development of informative materials for the divulgation of DD. Difficulties related to the participants' attendance on a weekly basis, restrictions on physical space available for research, holidays, and absences of individuals should be highlighted. In addition, lack of knowledge about DD from the part of the schools led to numerous screenings in individuals without the disorder. In some cases, the multidisciplinary evaluation discarded the presence of DD. For these reasons, only 11 individuals out of 55 participated in the survey.

The aforementioned difficulties also prevented the researcher from applying the PRCO to a control group, which would have provided more evidence on the benefits of this type of intervention.

This limitation in sample size hindered comprehensive statistical analysis and precluded the application of some alternative designs for exploration of new hypotheses.

It is important to highlight that similar studies have not been found in the literature, with levels of complexity for remediation of the reading comprehension and spelling of individuals with learning difficulties and disorders, and more specifically, Developmental Dyslexia.

## CONCLUSION

The Speech-language Pathology Program for Reading Comprehension and Orthography (PRCO) was a useful instrument for remediation for reading comprehension in the individuals with diagnosis of Developmental Dyslexia (DD) who participated in this study. Improvement in the performance of schoolchildren was observed after application of the PRCO, with larger number of correct responses in filling of blanks in texts adapted to the Cloze technique, better understanding, and increased motivation for reading.

The PRCO provides improved spelling performance to individuals. The number of correct responses was larger in the post-test compared with that in the pre-test, although it was lower than the expected for the participants' educational level. It is worth noting that the same error pattern occurred at both assessment times, with errors in both arbitrary and natural spelling.

Although the PRCO was prepared with four levels of increasing complexity, it was verified that the worst performance of individuals occurred at Level III, and most of them failed to complete this level.

This study presents an unprecedented contribution to remediation for reading comprehension and orthography for individuals with DD by proposing the joint stimulation of reading and writing by means of an instrument easy to apply and analyze, with possible applications in the clinical, educational and research contexts.

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### **Author contributions**

*DMN was responsible for collection, classification, analysis, and interpretation of the data and writing of the manuscript; MSC was the study adviser; and contributed in analysis and interpretation of the data and writing, supervision, and revision of the manuscript.*