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Spelling errors and phonological awareness skills in children with typical and atypical phonological development

Erros ortográficos e habilidades de consciência fonológica em crianças com desenvolvimento fonológico típico e atípico

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Keywords

Phonological Awareness
Spelling
Phonological Disorder
Learning
Evaluation

ABSTRACT

Purpose: To verify and correlate the spelling errors present in the written productions to the performance in phonological awareness skills of children in different school years, with typical and atypical phonological development. **Methods:** The sample consisted of 50 children divided into two groups: with typical phonological development (TPD) and with atypical phonological development (APD); students from the early years (1st to 5th grades) of schooling and ages between 6:0 and 10:0 years old. The children were submitted to speech-language and audiological evaluations. Data were tabulated and statistical analyzes were performed using the Spearman Correlation Coefficient. **Results:** In relation to the number of spelling errors in writing, these were similar in the TPD and APD groups, except for the contextual-arbitrary errors that were greater for the APD. Still, it was observed that the number of written spelling errors decreased with the increase in schooling. Concerning the average performance in phonological awareness, the TPD performed better than the APD in syllabic and phonemic awareness. The children of 4th and 5th grades presented better performance in phonological awareness than those in grades 1st to 3rd. **Conclusion:** The correlation was inversely proportional between the phonological awareness performance and the number of spelling errors (those that alter the syllabic structure) for both groups, demonstrating that the more errors of this type, the lower the performance in syllabic, phonemic and total phonological awareness.

Descritores

Consciência Fonológica
Ortografia
Desvio Fonológico
Aprendizagem
Avaliação

RESUMO

Objetivo: Verificar e correlacionar os erros ortográficos presentes nas produções escritas ao desempenho em habilidades de consciência fonológica de crianças em diferentes anos escolares, com desenvolvimento fonológico típico e atípico. **Método:** A amostra foi composta por 50 crianças divididas em dois grupos: com desenvolvimento fonológico típico (GDFT) e com desenvolvimento fonológico atípico (GDFA); estudantes dos anos iniciais (1ª a 5ª séries) de escolarização e idades entre 6:0 e 10:0 anos. As crianças foram submetidas às avaliações fonoaudiológicas e audiológica. Os dados foram tabulados e as análises estatísticas foram realizadas por meio do Coeficiente de Correlação de Spearman. **Resultados:** Em relação ao número de erros ortográficos na escrita, estes foram semelhantes no GDFT e no GDFA, com exceção para os erros contextuais-arbitrários que foram em maior número para o GDFA. Ainda se observou que o número de erros ortográficos de escrita diminuiu com o aumento da escolarização. No que se refere ao desempenho médio em consciência fonológica, o GDFT teve um desempenho melhor que o GDFA em consciência silábica e fonêmica. As crianças de 4ª e 5ª séries apresentaram melhor desempenho em consciência fonológica que as de 1ª a 3ª séries. **Conclusão:** A correlação foi inversamente proporcional entre o desempenho em consciência fonológica e o número de erros ortográficos (aqueles que alteram a estrutura silábica) para ambos os grupos, demonstrando que quanto mais erros deste tipo, menor o desempenho em consciência fonológica silábica, fonêmica e total.

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INTRODUCTION

Children learn to read and write generally during the preschool years and the beginning of schooling[1]. The acquisition of writing is a complex process[2,3], since it requires the child's ability to pay attention to speech, to segment it into words, to identify the phoneme-grapheme correspondence and the possibility of syllabic language elaboration[3]. In this process, the so-called spelling errors can occur, that could be seen as constructive, according to Piagetian ideas, may occur as a provisional part of the construction of knowledge[4].

The ability to think, reflect and consciously manipulate the sounds of speech is called phonological awareness[1,5]. Phonological awareness skills range from simple perception of word extension and its similarities, to more complex skills such as segmentation and manipulation of syllables and phonemes[1]. Some studies[1,6,7] mention the importance of this in the process of literacy/acquisition of written language. One study[7] found that the better the performance in phonological awareness tasks, the less spelling errors are observed in the written text. This denotes how much phonological awareness is important in the spelling of words.

Writing initially provides the development of basic understanding between phonemes and graphemes and, as a consequence, later on in spelling. In learning, the child is stimulated to think about the phoneme-grapheme correspondences, the relation between written language and spoken language, and about orthographic patterns, establishing a higher phonemic awareness[8]. There are several studies in the literature[1,4,6,8-10] involving the phonological awareness skills and children in the literacy period.

One of these studies[9] showed that children with literacy difficulties presented worse performance in phonological awareness tasks when compared to children without reading and writing difficulties. This same study reported that changes in phonological awareness may influence the literacy process.

Thus, complexity in acquiring writing is a constant concern among educators and researchers. In this sense, some studies[1,3,7,11-13] were performed with the purpose of verifying the orthographic performance in tasks of reading, writing and/or phonological awareness. Others[2,14] investigated the relationship between writing performance and family psychosocial factors, while others[12,14] re-analyzed the types of errors committed by children during the writing acquisition process. However, there are few researches on the relationship between spelling and phonological aspects of language, and one author[13] suggests that these works be performed.

Moreover, preschool oral language has a significant influence on the development of phonological awareness, since at the beginning of literacy, oral language and phonological awareness skills are interrelated[15]. Consequently, children who perform poorly in oral language may have more difficulty learning the written code.

Phonology is one of the constituents of oral language, and children with alterations in this aspect present what is called phonological disorder. In this disorder is characteristic in the speech of the child the presence of omissions and substitutions of phonemes in ages in which they should no longer occur. These children may present, in addition to phonological disorder, changes in phonological awareness[16] and, consequently, may be considered as a risk for reading and writing learning.

Based on the above, this research aimed to verify and correlate the spelling errors present in written productions to the performance in phonological awareness skills of children in different school years, with typical and atypical phonological development.

METHODS

This research was configured within a quantitative and qualitative research paradigm, with data collection and descriptive-exploratory analysis, based on the study of the spelling errors present in written productions of children with typical and atypical phonological development.

Participants

The sample consisted of 50 children divided into two groups: one of 25 children with typical phonological development (TPD); and another group of 25 children with atypical phonological development (APD). The children of the APD had phonological disorder or historical of phonological disorder, all of which had speech-language screening, performed in a public school clinic, and the speech-language diagnostic hypothesis of phonological disorder. Some APD individuals were still awaiting treatment, while others had already been treated, hence the history of phonological disorder.

Participants were students from the early years (1st, 2nd, 3rd, 4th and 5th grades) of public or private schools in the municipality of Santa Maria - RS, monolingual speakers of Brazilian Portuguese.

The sample was of convenience, from the contacts of the researcher with the parents and/or guardians of the children whom the researcher had contact with and children from the file and from the queue of patients of the Speech Sector of the school clinic of an institution of higher education. All should meet the criteria of inclusion and exclusion of the research.

The children were selected according to the following criteria for inclusion: age between 6:0 and 10:0 years old; be authorized by the parents or guardians to participate in the research; agree to participate in the research; attend the first school years; present the hypothesis of alphabetic writing[17], in order to observe the spelling errors produced; and present age-appropriate understanding language.

As exclusion factors, the following were considered: evident neurological, auditory, visual and emotional changes (observed during previous interview); changes in the stomatognathic system or any other organic impairment that could influence speech production. Children with suspected auditory, visual, neurological and psychological alterations were referred for further examination.

The age selection criterion was due to the fact that many children enter school before 6:0 years old and should be literate by 8:0 years old. It should be noted that in early 2013 the federal government launched the National Covenant on Literacy in

the Right Age, which was implemented in municipal and state schools, and ensures that all children are literate until the eight years old, at the end of the 3rd year of elementary school.

Procedures

This study was first registered in the Project Office (PO) and approved by the Research Ethics Committee (REC) of a higher education institution under the number 28729114.9.0000.5346. After approval, the data collection was started by signing the Informed Consent Form (ICF) by the guardians of the children, according to Resolution 466/12; and by the assent of the child obtained through the Term of Assent.

The children selected according to the inclusion criteria were submitted to several speech-language evaluations: comprehensive and expressive language; oral sensory-motor system; auditory discrimination; phonological; phonological awareness; production of written narrative; and audiological. In addition to these, a detailed anamnesis was performed with those guardians of the children. These evaluations were performed by the post-doctoral researcher Junior CNPq, with the help of a volunteer student and a scientific initiation fellow. Participating children were evaluated individually in sessions of approximately 50 minutes, and the time could be extended to one hour and thirty minutes, depending on the availability of the child and his/her guardian.

Comprehensive and expressive language was evaluated observationally and through the narrative of logical sequences, in which the syntactic, semantic and pragmatic aspects of orality of individuals could be observed. During conversations with the child and the narratives formulated by them, the adequacy of the answers, execution of orders and the logical organization of the thought were observed.

The evaluation of the oral sensory-motor system was performed using the Computerized Orofacial Myofunctional Evaluation (OMES)[18], in order to exclude the existence of any organic factors that could impede the production of speech sounds. The aspects related to the phono-articulatory organs (PAO) and the vegetative functions: sensitivity, morphology, tone, posture, mobility and proprioception of PAO, as well as aspects of occlusion, suction, chewing, breathing and swallowing were evaluated.

For the evaluation of auditory discrimination, the Phonological Discrimination Test[19] was used, which aims to verify if the child has the ability to distinguish sounds, through phonemic analysis of minimum pairs. The test contains 23 minimum pairs, which is the maximum score.

The phonological evaluation was performed by the INFONO *software*[20], with spontaneous appointment of 84 figures. This instrument allows the production of each BP consonant in different positions on the syllable and word, in order to obtain a representation of the infantile phonological system. Transcription of the child's production is performed at the moment of evaluation for later visualization of the results (contrastive analysis, phonetic and phonological inventory). The contrastive analysis is based on the comparison between the phonological system of the child and the standard system of the linguistic community in which he/she is inserted.

Participant children were submitted to phonological awareness evaluation using the CONFIAS (Phonological Awareness - Sequential Assessment Instrument)[21]. This test aims to comprehensively and sequentially analyze the phonological awareness abilities considering the relationship with the writing hypothesis[17], and it can be used in education with non-literate children and in the literacy process, as well as in the treatment of learning and speaking skills. CONFIAS is composed of evidence of synthesis, segmentation, identification, production, exclusion and syllabic and phonemic transposition. The results from the application of the CONFIAS provide subsidies for speech-language intervention and understanding of the most lagged abilities. The test contains a variety of tasks that seek to guarantee access to different levels of phonological awareness (syllabic and phonemic). This should be applied starting with tasks involving syllable awareness and, later, those referring to the level of the phoneme, respecting its order. Correct answers are worth one point and incorrect answers are worth zero. In the syllable, the maximum of score is 40 points and in the phonemes, the maximum is 30, totaling 70 points. The CONFIAS presents scores and standard deviation for each level of writing, suggested by Ferreiro & Teberosky[17], with minimum and maximum number of expected hits.

It was used as instrument of collection of oral and written narratives the story "Magali em Hora da Bóia", taken from the comic strip of the character produced by Maurício de Souza and that composes the database of researches[22,23]. Spontaneous writing data were collected, recorded in audio and transcribed phonetically. After the data collection, the spelling errors present in the writings of each subject were categorized, according to the classification adopted by other authors[24] in: (a) error that does not alter phoneme - errors related to the difficulties arising from the organization of the orthographic system itself, the so-called contextual and arbitrary errors; (b) error that changes phoneme and also changes syllabic structure - observes the manifestations of infantile phonological knowledge, evidencing aspects of its construction; and (c) phonetically motivated error and supergeneralization error - interprets errors based on the relationship between speech and initial writing, phonetically motivated errors. Thus, the children's writing was analyzed and the spelling errors tabulated within each category.

The data of each group were tabulated, regarding: development (typical or atypical); father's schooling; mother's schooling; age in months; school (public or private); school year; score in syllabic awareness; score in phonemic awareness; total scores on phonological awareness skills; total words written by the child in his written narrative; and the total number of spelling errors (detailing the types of spelling errors, and the number of times they were produced in each category - error that does not change phoneme, error that changes phoneme and that changes the syllabic structure, and motivated errors phonetically).

Data analysis

Statistical analyzes were performed using the SPSS (*Statistical Package for the Social Sciences*), version 17.0 (2004), using the Spearman Correlation Coefficient, with significance level

of p≤0.05. Spearman correlation indicates the dependence between variables. The intensity of the association is given by the correlation coefficient. In the case of this research, the value of the linear correlation coefficient (r_s) was calculated which is a concise mathematical expression of the relationship between the studied variables. The linear correlation coefficient varies between -1 and 1. The value of $r_s = 1$ represents a perfect and positive correlation, in which the variables change in the same direction. The value of $r_s = -1$ represents a perfect and negative correlation, in which the variables change in opposite directions. The values of r_s small or close to zero indicate weak relations or absence of correlation.

RESULTS

The characterization of the sample (Table 1) presents the variables verified from the anamnesis performed with guardians of children participating in this research. The variables involved the fathers and mothers' schooling separately; the school, whether public or private; the age in months; and the school year of the participating children.

It is observed that the statistically significant data refer to fathers' (p=0.004) and mothers' (p=0.033) schooling. The percentage of TPD fathers with complete higher education (60%) and mothers of this same group with this schooling (48%) were also statistically significant. In APD, the schooling of fathers with complete high school (52%) and mothers with complete elementary school (16%) were also statistically significant. Still, there was statistical significance (p=0.001) for the kind of school children attend, public or private. Based on these results, it was opted to statistically analyze the data from the calculation of the adjusted p for schooling of the mother, the father and school, and the adjusted p for schooling of the mother and school.

The types of spelling errors and their categorization in the groups surveyed are shown in Table 2. The number of spelling errors in writing was similar between the TPD and APD, with the exception of arbitrary contextual errors for which there was greater difference in the amount of errors presented between the groups, and the TPD presented less errors of this type.

As for the types of spelling errors and their categorization, the analysis was performed for the groups (TPD and APD) and the school grades (Table 3). In TPD, as in APD, the number of written spelling errors decreased with schooling, that is, children from 1st to 3rd grades presented more errors than 4th and 5th grades, but there was no statistically significant difference.

When comparing the average performance in phonological awareness between the groups (Table 4), it was observed that TPD performed better than APD in syllabic and phonemic awareness. However, there was only statistical difference in the total score of the phonological awareness test.

In the comparison between the average performance in phonological awareness among the school grades (Table 5) in TPD and APD, it was observed that children in 4th and 5th

Table 1. Characterization of the sample

Variables	TPD		APD		p
	n	%	n	%	
Fathers' schooling					0.004*
Complete Higher School	15	60*	3	12	
Incomplete Higher School	1	4	3	12	
Complete Average School	5	20	13	52*	
Incomplete Average School	2	8	1	4	
Complete Elementary School	0	0	4	16*	
Incomplete Elementary School	2	8	1	4	
Mothers' schooling					0.033*
Complete Higher	12	48*	2	8	
Incomplete Higher	3	12	5	20	
Complete Average	7	28	10	40	
Incomplete Average	0	0	3	12	
Complete Elementary	1	4	3	12	
Incomplete Elementary	2	8	2	8	
School					0.001*
Public	10	40	22	88	
Private	15	60	3	12	
Age (months)	99.9 ± 12.0		101.7 ± 9.4		0.557
Ano Escolar					0.130
1st	1	4	0	0	
2nd	9	36	10	40	
3rd	5	20	11	44	
4th	7	28	4	16	
5th	3	12	0	0	

*p<0.05
Caption: TPD = typical phonological development; APD = atypical phonological development; n = number of participants

Table 2. Categorization of spelling errors by types in the groups

Spelling errors	TPD		APD		p	adjusted p**	adjusted p***
	n	%	n	%			
Arbitrary Contextual							
Number Arbitrary Contextual Errors	13	52	21	84	0.034*	0.069	0.046*
M (min-max)	1 (0-5)		1 (0-7)		0.114	0.347	0.222
Phonological – Changes Phoneme							
Number Errors that Changes Phoneme	20	80	22	88	0.702	0.307	0.239
M (min-max)	1 (0-5)		3(0-17)		0.025*	0.369	0.049*
Phonological – Changes Syllabic Structure							
Number Errors that Changes Syllabic Structure	19	76	21	84	0.724	0.755	0.743
M (min-max)	2(0-11)		5(0-24)		0.028*	0.311	0.120
Phonetically Motivated							
Number Phonetically Motivated Errors	18	72	18	72	1.000	0.676	0.841
M (min-max)	2(0-13)		3(0-16)		0.266	0.536	0.540

*p<0.05; **adjusted p for schooling of the mother, the father and school; ***adjusted p for schooling of the mother and school
Caption: TPD = typical phonological development; APD = atypical phonological development; M (min-max) = median (minimum-maximum); n = number of participants

Table 3. Categorization of spelling errors by types for the groups and the school grades

	Errors	1st to 3rd grades		4th to 5th grades		p	adjusted p**	adjusted p***
		n	%	n	%			
TPD		15		10				
	Arbitrary Contextual							
	Number Arbitrary Contextual Errors	10	66.7	3	30	0.111	0.070	0.046*
	M (min-max)	1(0-5)		0(0-2)		0.261	0.266	0.303
	Phonological – Changes Phoneme							
	Number Errors that Changes Phoneme	13	86.7	7	70	0.358	0.689	0.489
	M (min-max)	2(0-11)		1(0-4)		0.461	0.989	0.088
	Phonological – Changes Syllabic Structure							
	Number Errors that Changes Syllabic Structure	12	80	7	70	0.653	0.582	0.454
	M (min-max)	2(0-13)		1.5(0-5)		0.428	0.225	0.031*
	Phonetically Motivated							
	Number Phonetically Motivated Errors	12	80	6	60	0.378	0.528	0.374
	M (min-max)	1(0-5)		1(0-3)		0.080	0.299	0.226
APD		21		4				
	Arbitrary Contextual							
	Number Arbitrary Contextual Errors	18	85.7	3	75	0.527	0.390	0.587
	M (min-max)	1(0-7)		1(0-3)		0.262	0.428	0.330
	Phonological – Changes Phoneme							
	Number Errors that Changes Phoneme	18	85.7	4	100	1.000	0.391	0.164
	M (min-max)	5(0-24)		0.5(0-5)		0.047*	0.551	0.554
	Phonological – Changes Syllabic Structure							
	Number Errors that Changes Syllabic Structure	19	90.5	2	50	0.106	0.220	0.303
	M (min-max)	3(0-16)		1.5(0-4)		0.369	0.084	0.254
	Phonetically Motivated							
	Number Phonetically Motivated Errors	16	76.2	2	50	0.548	0.188	0.307
	M (min-max)	4(0-17)		2(1-3)		0.592	0.051	0.290

*p<0.05; **adjusted p for schooling of the mother, the father and school; ***adjusted p for schooling of the mother and school
Caption: TPD = typical phonological development; APD = atypical phonological development; M (min-max) = median (minimum-maximum); n = number of participants

grades presented better performance than those in grades 1 to 3, but there was no statistically significant difference.

Concerning the correlation between performance in phonological awareness and number of spelling errors (Table 6), the statistically significant data referred to the number of errors that alter the syllabic structure for both groups, TPD and APD, with a correlation inversely proportional to the performance in phonological awareness. This means that the variables correlated in opposite directions, demonstrating that the more errors of this type, the worse the performance in syllabic, phonemic and total phonological awareness. In addition, the correlation was also statistically significant and inversely proportional between

Table 4. Performance in phonological awareness by groups

	TPD	APD	p	adjusted p**	adjusted p***
	Average ± SD	Average ± SD			
SPA	37.8 ± 3.2	35.6 ± 4.8	0.063	0.449	0.277
PPA	23.5 ± 6.2	20.1 ± 6.5	0.066	0.788	0.471
TPA	61.3 ± 8.6	55.7 ± 10.6	0.046*	0.859	0.346

*p<0.05; **adjusted p for schooling of the mother, the father and school; ***adjusted p for schooling of the mother and school
Caption: TPD = typical phonological development; APD = atypical phonological development; SPA = syllabic phonological awareness; PPA = phonemic phonological awareness; TPA = total phonological awareness; SD = standard deviation

Table 5. Performance phonological awareness by group and grades

		1st to 3rd grades	4th to 5th grades	p	adjusted p**	adjusted p***
		Average ± SD	Average ± SD			
TPD						
	SPA	37.4 ± 3.8	38.3 ± 2.3	0.507	0.195	0.194
	PPA	22.1 ± 7.3	25.7 ± 3.3	0.109	0.010*	0.007*
	TPA	59.5 ± 10.1	64.0 ± 5.1	0.155	0.034*	0.017*
APD						
	SPA	35.0 ± 5.0	38.8 ± 1.5	0.150	0.411	0.475
	PPA	19.4 ± 6.8	24.0 ± 2.8	0.201	0.285	0.371
	TPA	54.3 ± 10.9	62.8 ± 3.9	0.148	0.320	0.385

*p<0.05; **adjusted p for schooling of the mother, the father and school; ***adjusted p for schooling of the mother and school
Caption: TPD = typical phonological development; APD = atypical phonological development; SPA = syllabic phonological awareness; PPA = phonemic phonological awareness; TPA = total phonological awareness; SD = standard deviation

Table 6. Correlation between performance in phonological awareness and number of spelling errors

		TPD			APD		
		SPA	PPA	TPA	SPA	PPA	TPA
Number of Arbitrary Contextual Errors	r_s	0.136	0.063	0.083	0.080	-0.118	-0.091
	p	0.516	0.766	0.695	0.704	0.575	0.664
Number of Errors that Changes Phoneme	r_s	0.039	-0.235	-0.196	-0.279	-0.201	-0.261
	p	0.852	0.258	0.346	0.177	0.335	0.208
Number of Errors that Changes Syllabic Structure	r_s	-0.413	-0.399	-0.411	-0.446	-0.407	-0.467
	p	0.040*	0.048*	0.041*	0.025*	0.043*	0.019*
Number of Phonetically Motivated Errors	r_s	0.041	0.118	0.081	-0.216	-0.474	-0.439
	p	0.957	0.576	0.700	0.299	0.014*	0.028*

*p<0.05
Caption: TPD = typical phonological development; APD = atypical phonological development; SPA syllabic phonological awareness; PPA phonemic phonological awareness; TPA total phonological awareness; r_s = Spearman Linear Correlation

the number of phonetically motivated errors in the APD and the phonemic awareness and total. This demonstrates that the more errors of this type, the worse the performance in skills involving the phoneme and in the total score of phonological awareness.

DISCUSSION

This study characterized and correlated spelling errors in written productions with performance in children's phonological awareness skills of TPD and APD. Regarding the characterization of the sample, significant data for the TPD regarding the schooling of the fathers and mothers and regarding the complete higher education was observed when compared to the APD. The literature has pointed out that parents' schooling[2,14] can influence children's school learning. One study[2] observes that there is a lower level of schooling of parents in a group of children with reading difficulties. This is because children with learning difficulties may have fewer family stimuli and less experience with reading, noting that family members reported that they often did not read children's stories at home.

In this study it was observed that the number of spelling errors in writing was similar in the TPD and APD, except for the contextual-arbitrary errors for which there was a greater difference, with more errors being committed by the APD. It was also observed that the phonological errors that alter the phoneme were more frequent than the errors that alter the syllabic structure, followed by the contextual-arbitrary and the phonetically motivated ones. Some studies[3,13,25,26] have analyzed errors in writing. One of them[13] described the orthographic performance of children without complaints of language and/or learning difficulties reported by parents and/or teachers and concluded that among the errors found in writing were phonological substitutions followed by omissions and substitutions orthographic. Phonological substitutions occurred

mainly among the graphemes that refer to the sonorant's class. Thus, the study[13] corroborates this research when verifying that the phonological errors are the most frequent among the children of the sample.

In TPD and APD it was observed that the number of spelling errors in writing decreased with schooling. That is, children in grades 1 to 3 presented more errors than those in grades 4 and 5. This shows that the spelling errors are gradually overcome as the schooling and formal teaching of spelling advances. The fact that writing errors become less common as the child progresses in literacy is reported in the literature[3,7,12,25,26] and justified by increased reading exposure[7]. A study[25] verified that the students of the 2nd and 3rd years had similar levels of knowledge of spelling; and this was higher than that of first year students. This same author pointed out that, as schooling progresses, the average number of writing errors decreases, students in the more advanced years begin to write words using the phoneme-grapheme conversion mechanism, failing to write unreadable words.

Several researches point out that difficulties in the development of oral and written language are related to changes in phonological awareness skills[5,8]. In this research, when comparing the average performance in phonological awareness skills between TPD and APD, it was observed that TPD performed better than APD in syllabic and phonemic awareness. Children with phonological disorder present difficulties in phonological awareness skills in simpler tasks[6].

Regarding the average performance in phonological awareness between the TPD and APD school grades, it was noticed that children in 4th and 5th grades presented better performance than those in grades 1 to 3. One study[1] states that the literacy process has improved performance in phonological awareness skills. This may be related to the fact that phonemic awareness develops with literacy, while the development of reading and writing depends on the awareness of the phoneme.

Another study[9] mentioned that literacy and phonological awareness levels are directly proportional measures, that is, the higher the levels of phonological awareness, the more advanced is the child's literacy phase. As noted above, it was observed in this study that older children (more advanced grades) presented better performance in phonological awareness than the younger ones (initial grades), this was observed for both TPD and APD. Differently, another study[26] pointed out that children with phonological disorder did not improve performance in phonological awareness as a function of age.

The findings discussed above are relevant to show the importance of phonological awareness skills in the process of reading and writing, both for children with and without phonological difficulties, since both TPD and APD groups behaved similarly to errors in writing. The TPD performed better than the APD in phonological awareness tasks. These findings indicate the importance of inserting activities of phonological awareness in the process of children's literacy in order both to prevent or reduce learning difficulties of the written code and to rehabilitate learning difficulties[27,28].

One important limitation of this study was the small sample size that prevented the investigation of differential patterns between the groups (TPD and APD) per school year. Thus, the need for continuity of research with a greater number of children, with both typical and atypical phonological development, is necessary in order to establish the orthographic development profile of these students. In this way, it will be possible to identify the similarities and differences between the common errors to the appropriation of the writing system in children with typical and atypical phonological development.

Another limitation was the impossibility to consider in APD the severity of phonological disorder in the study sample. However, it is suggested for future research the need to consider severity to determine the influence of this and the phonological awareness skills of these children during the literacy process.

CONCLUSION

The results revealed that the number of spelling errors in writing was similar in the TPD and APD, except for the contextual-arbitrary errors that were more in APD. Also, TPD performed better than APD in syllabic and phonemic awareness; and children in 4th and 5th grades presented better performance than those in grades 1 to 3.

As for the correlation between the performance in phonological awareness and the number of spelling errors, those that alter the syllabic structure for both groups (TPD and APD) correlated in opposite directions, demonstrating that the more errors of this type, the lower the performance in syllabic, phonemic and total phonological awareness.

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Author contributions

GD was responsible for project design, data collection, data tabulation, study design, project execution and manuscript preparation; MIC was responsible for preparing writing of the manuscript; MKS was responsible for designing and delineating the study, guiding and reviewing the manuscript.