

Performance of Brazilian dyslexic students in reading: a comparative study by gender

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Riassunto: *Il contributo ha lo scopo di analizzare la performance di studenti Brasiliani in riferimento alle prove di lettura e di comprensione, per apprezzare eventuali differenze tra il genere maschile e quello femminile. Le prove utilizzate per la valutazione sono state le seguenti: parole e non-parole di lettura, test di comprensione. Dall'analisi delle correlazioni, è stato possibile esaminare eventuali differenze fra i due gruppi, con la medesima diagnosi di partenza, ma divisi per genere. Si osservano delle differenze legate alle manifestazioni individuali e quindi strettamente connesse all'eterogeneità del profilo, più che l'influenza di differenze di genere.*

Abstract: *This study aims to characterize and to correlate the performance of Brazilian dyslexic students in tests of words and nonwords reading, sentence and texts comprehension, as well as to compare the performance between female and male genders. The students were assessed by the following tests of PROLEC: words and nonwords reading, sentence comprehension and texts comprehension. Evidence of association is noticed in all the evaluated tests which indicates that the better the students with dyslexia perform in high frequency word reading, the better they perform in low frequency word reading, nonwords reading, sentences and texts comprehension and vice-versa. The direction and strength of correlation is strongly and moderately positive. It can be concluded that to discuss the difference between students with dyslexia by gender may not be relevant in the educational context of this genetic-neurological condition, because this did not provide sufficiently precise information for a possible generalization of the results which result an impact in understanding the diagnostic profile of these students.*

Keywords: *Learning, Reading, Evaluation, Dyslexia.*

Introduction

The Brazilian Portuguese is a language that conforms to the alphabetic writing system, which requires the child to make the combination of an auditory phonemic component with a graphic visual component. To un-

derstand this alphabetic principle it's required three factors: to it's possible to segment the spoken language in different units, to understand that these same units can be repeated in different spoken words and to acquire the knowledge of the rules of correspondence between graphemes and phonemes. The first two factors are part of phonological processing, and this places it as one of the key processes in the development of reading and writing (Veuillet *et al.*, 2007; Germano & Capellini, 2011; 2015).

The Portuguese writing system is characterized by orthographic transparency, i.e., regularity, each corresponding to a phoneme and only one grapheme and vice versa, and by orthographic opacity, that is, the irregularity, with which graphemes correspond more than one phoneme and phonemes corresponding to different grapheme (Germano & Capellini, 2011; 2015).

To explain the model of word recognition in reading, we adopted the model of Double Route (Ellis & Young, 1988). In this model, the child can perform reading using two routes, being described as phonological and lexical. Reading the phonological route depends on the use of knowledge of the conversion rules between grapheme and phoneme for the construction of the pronunciation of the word. It is created a phonological code, which is identified by the auditory system of recognition of words, accessing the meaning of the word. Reading by the lexical route depends on the recognition of a word previously acquired and stored in the visual recognition system of words and on recovering of the meaning and the pronunciation of the word through direct addressing to the lexicon, and this pronunciation obtained as a whole (Capellini, Oliveira, & Cuetos, 2012; Germano, Pinheiro, & Cunha, 2010; Kim, Petscher, Foorman, & Zhou, 2010; Nation & Cocksey, 2009; Pinheiro, 2006; Pinheiro, Lúcio, & Silva, 2008; Vellutino & Fletcher, 2013).

Developmental dyslexia has been reported in different languages, but few studies have been done in Brazilian dyslexic children regarding reading tests. Dyslexia is a neurodevelopmental disorder and can be defined as a severe difficulty learning to recognize written words, which are not explained in terms of intellectual or sensory impairments (Pennington & Olson, 2013; Vellutino & Fletcher, 2013), and can be characterized by failures in the process of decoding and word recognition, which entails failure in reading comprehension (Gori & Facoetti, 2015; Lyon, Shaywitz, & Shaywitz, 2003).

Children with dyslexia have impairment in phonological representations that makes difficult to them to acquire the phonological skills such as phonological awareness, alphabetic mapping and phonological decoding along with skills like spelling knowledge. The weak phonological decoding

skills may be the cause of other problems that contribute to difficulties in the acquisition of reading, especially difficulties in store and retrieve words in spoken language (Fletcher *et al.*, 1999; Snowling, 2004; Vellutino & Fletcher, 2013; Vellutino *et al.*, 1994, 1996).

In dyslexic students, the phonological decoding component is changed due to a flaw in the model of dual processing of reading, which relies on the use of knowledge of the conversion rules of grapheme-phoneme to reading the word of construction. Such failure in this skill, essential for reading and writing learning, has been the subject of discussion among researchers, both education and health (Batista Cunha, & Herman, 2011; Cunha & Capellini, 2009, 2010; Desroches, Joannis, & Robertson, 2006; Pinheiro & Capellini, 2010).

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Reading difficulties in children with dyslexia manifests as basic and overall shortcomings in word identification, phonological decoding (letter-sounds) and spelling. Deficits in these skills at the level of words can be accompanied by deficits in the understanding of language and related skills such as knowledge of vocabulary and syntactic competence. Dyslexia is often defined as a developmental disorder characterized by significant difficulties in learning to decode the written words (Leach, Scarborough, & Rescorla, 2003; Vellutino & Fletcher, 2013). In other words, it is defined as a basic and widespread disorder that affects a child's ability to learn to decode the writing (Vellutino & Fletcher, 2013).

The disorders in lexical skills as word identification and spelling along with disorders in related skills such as phonological awareness, observed in dyslexic students at the beginning of the development of their reading ability, and can be still evident until adulthood (Hatcher, Snowling & Griffiths 2002; Vellutino & Fletcher, 2013).

Thus, the application of validated protocols of reading tests in students with Developmental Dyslexia allows establishing criteria of classification and favors the understanding of mechanisms used by these subjects.

Given the above, this study aims to characterize and to correlate the performance of Brazilian dyslexic students in tests of words and nonwords reading, sentence and texts comprehension, as well as to compare the performance between female and male genders.

Material and Method

This study was approved by the Ethical Committee in Research of the School of Philosophy and Sciences of São Paulo State University “Júlio de Mesquita Filho” – FFC/UNESP – Marília/São Paulo/Brazil, under the protocol n. 182-2011.

Participants

Forty eight students with an interdisciplinary diagnosis of dyslexia, age range 8 to 12 years old, attending 3rd grade to 5th grade of elementary school, from public and private, in the interior of São Paulo. The diagnosis of dyslexia was made by an interdisciplinary team of the Laboratory for the Investigation of Learning Disabilities, Faculty of Philosophy and Sciences– LIDA/FFC/UNESP – Marília- SP/ Brazil attending the diagnosis criteria (Germano & Capellini, 2011, 2014). The students were divided into two (2) groups, according to gender, as presented below:

- Group I (GI): 14 students with an interdisciplinary diagnosis of dyslexia female gender.
- Group II (GII): 34 students with an interdisciplinary diagnosis of dyslexia male gender.

Procedures

- Signing of the term of free and informed consent by the students’ parents or caretakers.
- Signing of the term of assent by the evaluated students.

Instruments

Reading processes evaluation test – PROLEC (Capellini, Oliveira, & Cuetos, 2012). The students were evaluated individually, during approximately 30 minutes. The tests are described below:

- *Words and nonwords Reading*: the aim is to analyze the use of phonological and lexical route in reading. The words and nonwords belong to

six categories: 10 high frequency short words, 10 high frequency long words, 10 low frequency short words, 10 low frequency long words, 10 short nonwords and 10 long nonwords.

- *Sentence comprehension*: the aim is to assess if the student is able to extract the meaning of simple clauses and does not require, therefore, the memory intervention neither the mental patterns. The test consists of 12 sentences (some accompanied by pictures) which express a simple order that the students must perform.
- *Texts comprehension*: the aim is to investigate if the student is able to extract the meaning and integrate it to his knowledge. This test require the memory intervention and the mental pattern and it is composed by four texts, two narrative and two expositive. Each text has four questions, being two literal and two inferential, totalizing 16 questions.

The students' performance was assessed by scores in each test, according to the application and manual correction procedure.

Data Analysis

In order to make the statistical analysis, the program used was the SPSS (Statistical Package for Social Sciences), version 21.0. The analysis was based on the number of correct answers in each test presented by GI and GII groups. A significance level of 5% (0.05) was adopted for the statistical tests.

The descriptive analysis of the data was made, obtaining the values of the mean, the median, the 25th and 75th percentiles, the minimum and maximum values, and the standard deviation. The Mann-Whitney's test was used to compare both groups, aiming to verify the possible differences in the performance of students from GI and GII. The Spearman correlation was used to measure and interpret the strength of the data. We adopted the Zou, Tuncali e Silverman, (2003) criteria in order to interpret the strength of the data.

Results and Discussion

Table 1 presents the Spearman rank correlation in order to verify the direction and strength of correlation among the reading tests of high and low frequency words, nonwords, sentences and text comprehension of PROLEC in the students with dyslexia. They are not separated by groups in this analysis.

Evidence of association is notices in all the evaluated tests which indicates that the better the students with dyslexia perform in high frequency word reading, the better they perform in low frequency word reading, nonwords reading, sentences and texts comprehension and vice-versa.

The direction and strength of correlation is strongly positive for the test HFWR and NWR (0,831) and moderately positive for the following tests: HFWR and LFWR (0,749), HFWR and SC (0,772), HFWR and TC (0,658), LFWR and NWR (0,721), LFWR and SC (0,680), LFWR and TC (0,632), NWR and SC (0,734), NWR and TC (0,697) and SC and TC (0,753).

Table 1. Spearman rank correlation among the reading tests of high and low frequency words, nonwords, sentences and text comprehension of PROLEC in the students with dyslexia.

Variable	Statistic	HFWR	LFWR	NWR	SC	TC
HFWR	Correlation coefficient (r)	-	0,749	0,831	0,772	0,658
	P value	-	0,000*	0,000*	0,000*	0,000*
	n	-	48	48	48	48
LFWR	Correlation coefficient (r)	0,749	-	0,721	0,680	0,632
	P value	0,000*	-	0,000*	0,000*	0,000*
	n	48	-	48	48	48
NWR	Correlation coefficient (r)	0,831	0,721	-	0,734	0,697
	P value	0,000*	0,000*	-	0,000*	0,000*
	n	48	48	-	48	48
SC	Correlation coefficient (r)	0,772	0,680	0,734	-	0,753
	P value	0,000*	0,000*	0,000*	-	0,000*
	n	48	48	48	-	48
TC	Correlation coefficient (r)	0,658	0,632	0,697	0,753	-
	P value	0,000*	0,000*	0,000*	0,000*	-
	n	48	48	48	48	-

* *Spearman* rank correlation coefficient, significance level of 5% ($\alpha = 0.050$).

Key: HFWR: high frequent word reading, LFWR: low frequent word reading, NWR: nonword reading, SC: sentence comprehension, TC: text comprehension.

The strength of correlation strongly and moderately positive in this study are justified by the fact that the difficulty in the use of decoding ability impairs the fluent reading and, consequently, the comprehension of the

read material. The students who recognized the words automatically and quickly can give more attention to the comprehension than for word decoding (Lukasova, Barbosa & Macedo, 2009; Capellini, Oliveira & Cuetos, 2012; Cunha & Capellini, 2009; Germano & Capellini, 2008; Germano, Pinheiro, & Capellini, 2010; Lukasova, Oliveira, Lukasova, & Macedo, 2010; O'Connor, Swanson, & Geraghty, 2010; Piasta & Wagner, 2010; Sanches, García, & Gonzales, 2007). The decoding process contributes to the development of the orthographic representation allowing the reading by the lexical route (Capellini, Oliveira, & Cuetos, 2012; Cunha & Capellini, 2009, 2010; Kirmizi, 2010). The phonological ability are linked with the sentence processing, since that interfered directly in the grammatical and semantic structure of the word in the sentence and in the text (Fletcher *et al.*; 2009; Nation & Cocksey, 2009; Pinheiro, Germano, & Capellini, 2010).

Table 2 presents the results of Mann-Whitney Test in order to verify the possible differences in the performance of students with dyslexia of female (GI) and male gender (GII) in the tests of reading high frequency words, low frequency words, nonwords, sentences and texts comprehension from PROLEC.

Table 2. Comparison of performances among students of GI and GII in reading tests of high and low frequency words, nonwords, sentences and text comprehension of PROLEC

Variable	Group	n	Mean	Standard deviation	25th percentile	Median	75th percentile	min.	max	P value
HFWR	I	14	16,07	5,757	14,50	18,50	20,00	0	20	0,080
	II	34	13,15	6,787	8,00	16,50	19,00	0	20	
	Total	48	14	6,582	10	17	19	0	20	
LFWR	I	14	15,71	4,983	14,50	17,50	19,00	0	19	0,018*
	II	34	11,12	6,727	3,75	13	16,25	0	20	
	Total	48	12,46	6,565	9,25	15	18	0	20	
NWR	I	14	13,29	5,915	7	16	18	0	19	0,070
	II	34	9,50	6,491	5	9,50	15,50	0	20	
	Total	48	10,60	6,503	6	10	17	0	20	
SC	I	14	10,29	3,221	9	12	12	0	12	0,047*
	II	34	6,91	5,160	0,00	8	12	0	12	
	Total	48	7,90	4,896	3,50	11	12	0	12	
TC	I	14	9	4,438	7,75	9,50	12,25	0	15	0,218
	II	34	6,24	6,095	0,00	7	12	0	16	
	Total	48	7,04	5,757	0,00	8,50	12	0	16	

* *Mann-Whitney Test*, significance level of 5% ($\alpha = 0.050$).

Key: HFWR: high frequent word reading, LFWR: low frequent word reading, NWR: nonword reading, SC: sentence comprehension, TC: text comprehension.

By the average score it is noticed that the test which obtain higher punctuation by the dyslexic students was the high frequency word reading. It is justified by the fact that reading by the lexical route is benefit from the frequency of occurrence of the words in language, once the higher this frequency more established is your lexical representation and easier your recovery from the lexicon (Breznitz, 2006; Capellini, Oliveira, & Cuetos, 2012; Cunha & Capellini, 2009, 2010; Germano, Pinheiro, & Cunha, 2010; Lukasova, Barbosa, & Macedo, 2009; Pinheiro & Capellini, 2010; Snellings *et al.*, 2009). Most students with dyslexia has difficulties in the phonological and orthographic level of recognition words level process (Stanovich *et al.*, 1997; Vellutino & Fletcher, 2013), it is observed that the average performance in the tests decreases as the complexity of the tests increase as noticed in the low frequency words reading, nonwords, sentences and text comprehension.

The dyslexia is characterized by significant difficulties in learning to decode the writing. The difficulties presented in this abilities in the word level could be accompanied by difficulties in the comprehension of language, vocabulary knowledge and syntactical competence (Leach, Scarborough, & Rescorla, 2003; Vellutino & Fletcher, 2013), which affects directly the students' performance in the tests of sentence and texts comprehension.

Regarding the comparison between genders of the students with dyslexia, it is verified that there is an evidence of difference in the tests LFWR and SC, in other words, the groups differ from each other in low frequency word reading (LFWR) and sentence comprehension (SC). By analyzing the average score in the applied tests, a higher performance of GI students was shown when compared to those of GII. Observing the standard deviation, it may be noticed that GII students presented a high variability in their answers when compared to those of GI, which suggests a higher heterogeneity in their answers (higher occurrence of errors).

To better understand this finding we will observe the scores of table 2 of students from GI and GII. For female students (GI) in the test of LFWR the average value was 15.71 and standard deviation was 4,983. On the same line, we draw attention to the 25th, 50th (median) and 75th. We note that 25% of GI students obtained a score of 14.50 in this test (25th percentile). Using the 50th percentile or median, we note that 50% of students achieved a score 17.50. The final rest of the population (75th percentile), showed a value of 19, and the minimum and maximum values were zero (minimum value) and some students who scored 19 (maximum).

In the same test, the male students (GII) showed lower performance when compared to GI. Observing the GII average values, we find the value of 11.12 and standard deviation with the value of 6.727. Regarding percentiles, we note that 25% of GI students received a score of 3.75. For the 50th percentile or median the score was 13.00 and for the 75th percentile value of 16.25, and the minimum values and maximum were zero (minimum value) and some students who scored 20 (maximum).

Regarding the SC test, female students (GI) had average of 10.29 value and standard deviation to the value of 6,503. Regarding percentiles, to observe the 25th percentile value of 9.00%, 50th percentile or median value of 12.00 and, for the 75th percentile value 12. Noting the median value, we note that this test for GI 50% population achieved the top value of the test (12 points).

The male students (GII) had average of 6.91 value and standard deviation value of 5,160. Regarding percentiles, we observe the 25th percentile value of 0.00, 50th percentile or median value of 8.00 and, for the 75th percentile the value 12. For this group, we observed that 50% of this population (GII) reached the maximum value of the evidence (8 points).

In this study, we noticed that there was a prevalence of male students compared to female. These data corroborate the findings of the international literature. Hawke, Olson, Willcut, Wadsworth and DeFries (2009) reported that the ratio of male and female students in samples of children with reading difficulties vary widely. However, the authors have highlighted a greater number of children with reading problems.

Hawke *et al.* (2009) reported that various biological and environmental hypotheses have been proposed in an attempt to explain this gender difference in prevalence rates including studies related to inheritance of the X chromosome (Symmes & Rapoport, 1972), functional brain differences due to difference in exposure or hormone sensitivity (Geschwind, 1981; Nass, 1993; Fitch & Talal, 1993), immunologic factors, sexual imprinting, perinatal complications, and the differential resistance to neural insult (Liederman, Kantrowitz, & Flannery, 2005).

Also, Hawke *et al.* (2009) also reported that there are studies that indicate that girls may be less sensitive to environmental factors, such as teaching methods and socioeconomic status (Geschwind, 1981), and genetic influences that can influence performance on tasks reading when compared to boys (DeFries & Gillis, 1993; Stevenson, 1992).

However, in our study, as described above, only two tests showed evi-

dence of a difference between students by sex, showing that regardless of the sex of dyslexic students they presented difficulties in tests of reading and reading comprehension.

Still, we emphasize that a limitation of this study lies in the fact that there was no possibility of pairing the sample by gender, since dyslexia is a genetic, neurological condition more prevalent in males, which caused a reduction in the sample size of this study.

Conclusion

In summary, data from our analysis showed difference in the dyslexics students' performance in reading and reading comprehension by gender in only two tests, low frequency word reading and sentence comprehension.

Thus, it can be concluded that to discuss the difference between students with dyslexia by gender may not be relevant in the educational context of this genetic-neurological condition, because this did not provided sufficiently precise information for a possible generalization of the results which result an impact in understanding the diagnostic profile of these students.

Authors' Presentation

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