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Prosodic parameters of reading in 2nd to 5th grade students

Parâmetros prosódicos de leitura em escolares do segundo ao quinto ano do ensino fundamental

Keywords

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Fluency
Prosody
Reading Speed
Melodic Variation

Descritores

Escolares
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ABSTRACT

Purpose: Characterize and compare melodic variation and reading speed and verify their evolution throughout the development of schooling. **Methods:** The reading of 78 Elementary School (2nd to 5th grade) students was analyzed using the Praat program with regards to the parameters of melodic variation (F0) and reading speed (Duration). Statistical measures (mean and standard deviation) were taken and the Student's t-test was applied at significance level of 5%. **Results:** Melodic variation and reading speed increased as schooling progressed, especially during 5th grade. **Conclusion:** Melodic variation increases as schooling progresses, mainly during 5th grade. First minute of reading analysis is sufficient to assess reading speed, not being necessary to analyze the full text.

RESUMO

Objetivo: Caracterizar a variação melódica e a velocidade de leitura, comparando-as e verificando se há evolução de acordo com o avanço da escolaridade. **Método:** Foi analisada a leitura de 78 escolares do 2^o ao 5^o ano do Ensino Fundamental I, por meio do Praat, por meio da análise dos parâmetros de variação melódica (F0) e velocidade de leitura (Duração) e foram realizadas medidas estatísticas (média e desvio padrão) e o teste de student (com nível de significância de 5%). **Resultados:** Foi possível observar que a variação melódica e a velocidade de leitura tendem a aumentar com o desenvolvimento da escolaridade, especialmente para o quinto ano. **Conclusão:** A variação melódica aumenta de acordo com o avanço da escolaridade, assim como a velocidade de leitura, sendo maiores os resultados para o quinto ano. Verificou-se que a análise de leitura do primeiro minuto seria necessária para a análise da velocidade de leitura de textos, não sendo necessária a análise do texto completo.

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INTRODUCTION

Research on reading fluency and its relationship with school development has been growing over the years, and the oral reading fluency is an important tool to monitor this evolution⁽¹⁾. The way prosody is used in reading directly reflects the fluency of readers, and demonstrates their ability to convey and understand information.

Although the concept of prosody is often limited to intonation or accentuation, it is still a subject of discussion among several scholars. Regarding its formal aspects, prosody is composed of parameters phonetically described as intensity, melodic variation, and temporal organization of speech. Intensity refers to the amount of energy present in the vibratory movement, and it is represented by dB (decibel); melodic variation is a recurring measure that characterizes the melodic curve, and is associated with fundamental frequency (F0), which is described as the mean frequency of vocal fold vibration and is represented by Hz (hertz)⁽²⁾; the temporal organization of speech includes pause, elocution time, and total articulation time, and through these measures it is possible to obtain others, such as the rates of speech and reading^(2,3).

In a study involving children with dyslexia and a control group, prosodic aspects were compared in the reading of such children, including the aspects of melodic variation. From the values obtained by the rates of elocution and articulation, slower reading speed and slowness in the production of each articulatory gesture were observed in children with dyslexia compared with those of children in the control group. This slowness reflects in the characteristics of melodic variation⁽⁴⁾.

A study conducted with 32 5th grade students, after stimulation based on prosodic patterns, concluded that temporal aspects significantly affect reading fluency⁽⁵⁾.

A longitudinal intra-subject study, which aims to characterize the growth in prosody between 2nd and 3rd grade students, demonstrated that control of reading speed is directly associated with prosody, although expressiveness is as necessary as speed⁽⁶⁾.

Therefore, considering melodic variation and reading speed as prosodic parameters determining for reading fluency, the present study aims to characterize and compare the reading of Elementary School (2nd to 5th grade) students in relation to the aforementioned aspects and to verify their evolution throughout the schooling years.

METHODS

This study was approved by the Research Ethics Committee of the aforementioned Institution under protocol no. CAAE: 38861914.4.0000.5096. All participants and their parents/guardians signed an Informed Consent Form (ICF) prior to study commencement.

Study participants were 79 Elementary School (2nd to 5th grade) students enrolled in the private education network of Belo

Horizonte, Minas Gerais state, Brazil. One student was excluded due to acoustic interference in the collected audio, thus 78 schoolchildren participated in the study: 20 from 2nd grade, 12 from 3rd grade, 23 from 4th grade, and 23 from 5th grade.

The students presented no speech, hearing, and written language disorders. To confirm these data, two questionnaires addressing issues associated with these aspects were applied, one to the children's legal guardians⁽⁷⁾ and another to their teachers⁽⁸⁾.

The text "*A coisa*" (The Thing)⁽⁹⁾, which is a simple text with possibilities of prosodic modulations and easy decoding, was used for data collection. The text was initially read silently and then aloud, according to the children's initiative.

For analysis of melodic variation, the beginning and the end of each audio recording were demarcated using the acoustic analysis program Praat 5.4.19 in order to determine the exact duration of each reading. After that, mathematical treatment was applied to the audio recordings with the objective of eliminating macroprosodic effects by means of the wave smoothing algorithm of fundamental frequency (F0)⁽¹⁰⁾.

The F0 curve was used as the basis for prosodic analysis. The maximum and minimum points of F0 of the reading of the full text were selected, and the minimum point was subtracted from the maximum point, resulting in the melodic variation. The same procedure was adopted for analysis of the title and expressive phrase (short phrase with an exclamation mark).

For analysis of reading speed, the number of words read (WPM) and the number of correct words read (CWPM) per minute in the full text and the 1st minute of reading were determined. Statistical analysis was performed using descriptive statistics (mean and standard deviation) and the Student's t-test was applied to the two samples at significance level of 5% for comparison of the results.

RESULTS

Assessment of melodic variation shows an increasing trend of this prosodic parameter throughout the schooling years, especially during 5th grade (Table 1). The same pattern can be observed with respect to reading speed (Table 1).

For analysis of melodic variation, readings of the title, expressive phrase, and full text were compared between students from 2nd to 5th grades, as shown in Table 2.

The aforementioned variables were assessed in order to compare the performance of the classes studied. Statistically significant difference was observed regarding melodic variation only in the comparison with the 5th grade. In contrast, the reading rates (CWPM and WPM) showed statistically significant differences for practically all comparisons.

In the comparison between the number of words read in the 1st minute of reading and WPM, values of 0.8, 0.6, 0.4, and 0.6 were found for the 2nd, 3rd, 4th, and 5th grades, respectively.

Table 1. Mean and standard deviation of the results found regarding melodic variation (full text, title, and expressive phrase) and reading speed (CWPM, WPM, and 1st minute of reading) for each grade assessed (2nd, 3rd, 4th, and 5th), as well as the comparison between them

	MELODIC VARIATION			READING SPEED		
	FULL TEXT	TITLE	EXPRESSIVE PHRASE	CWPM	WPM	1 st MINUTE
	Mean in Hz (SD)	Mean in Hz (SD)	Mean in Hz (SD)	Mean number of words read (SD)	Mean number of words read (SD)	Mean number of words read (SD)
2 nd	230.7 (35.03)	98.6 (48.50)	102.9 (36.73)	56.2 (23.4)	59.2 (24.22)	41.3 (22.92)
3 rd	233.5 (34.53)	112 (32.65)	106.3 (57.22)	100.2 (18.66)	104.6 (17.50)	100.8 (18.71)
4 th	233.6 (48.67)	122.2 (47.66)	109.5 (56.03)	105.4 (24.19)	109.8 (25.07)	106.3 (24.57)
5 th	270.5 (54.12)	122.7 (38.01)	147.7 (42.98)	119.4 (20.41)	124.9 (18.97)	127.4 (19.44)
2 nd ×3 rd	0.7	0.3	0.8	0.0001*	0.0001*	0.0006*
2 nd ×4 th	0.7	0.1	0.6	0.0002*	0.0004*	0.0005*
2 nd ×5 th	0.05	0.08	0.0007*	0.0001*	0.0001*	0.0002*
3 rd ×4 th	0.9	0.4	0.8	0.4	0.4	0.6
3 rd ×5 th	0.02*	0.4	0.04*	0.009*	0.004*	0.0004*
4 th ×5 th	0.01*	0.9	0.01*	0.04*	0.02*	0.001*

*Values with statistically significant differences

Caption: CWPM: Correct words read per minute; WPM: Words read per minute; 1st MINUTE: Number of words read during the first minute of recording; SD: standard deviation

Table 2. Comparison between the variables found for melodic variation (full text, title, and expressive phrase)

	2	3	4	5
Full text × Title	0.0002*	0.09	0.4	0.0001*
Full text × Expressive phrase	0.0001*	0.0003*	0.0007*	0.0001*
Title × Expressive phrase	0.8	0.6	0.4	0.04*

*Values with statistically significant differences

Caption: Expressive phrase: a short phrase with an exclamation mark

DISCUSSION

The variables Full Text, Title, and Expressive Phrase were considered in the assessment of melodic variation. Analysis of these variables showed evolution of Full Text and Expressive Phrase in the comparison between the reading of 5th grade students with that of students of the other grades. As for Title, no significant changes were observed in the comparison between grades (Table 1). Only the variable Full Text presented statistically significant difference between the grades studied (Table 2). In the comparison of each variable between the grades investigated, difference was observed regarding the reading of the full text only during 5th grade (Table 2).

In view of this, it is possible to conclude that the full text seems to be the best variable of melodic variation to assess prosody in oral reading, and that differences are relevant only during 5th grade. Studies have shown that in the comparison of reading aloud between dyslexic children and a control group, considering the prosodic parameters of F0 (maximum, minimum, tessitura, and reading speed), typical readers produce melodic variations and reading speed more appropriately than children with dyslexia^(11,12).

For the analysis of reading speed, the variables WPM, CWPM, and 1st minute of Reading were considered. For the analysis of WPM and CWPM, a comparison of such parameters was conducted between all the grades studied, and statistically

significant difference was observed in practically all the grades confronted, except in the comparison between the 3rd and 4th grades (Table 1).

This demonstrates that the performance of oral reading and comprehension improves as schooling progresses^(13,14).

No statistically significant differences were observed in the comparison between the rates of WPM and 1st minute of reading (Table 2). Therefore, it can be concluded that it is possible to analyze reading rate by counting only the number of words read during the first minute, obtaining a result similar to that of the analysis of WPM.

CONCLUSION

Based on the data of this study, we conclude that, melodic variation (F0) increases as schooling progresses, mainly during 5th grade. With respect to reading speed (Duration), the number of words read as well as the number of correct words read per minute tend to expand throughout the schooling years.

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Author contributions

LCC was the main researcher; ESP and LMA were responsible for data collection and discussion of the results; NRRP was in charge of data analysis and discussion of the results.