

Phonological working memory and phonological awareness in students at the end of cycle I of elementary school

Memória operacional fonológica e consciência fonológica em escolares ao final do ciclo I do ensino fundamental

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ABSTRACT

Purpose: To investigate the performance of students at the end of Cycle I of Elementary School in phonological working memory and phonological awareness, as well as the possible relationship between these skills in this level of schooling. **Methods:** The research group was composed by 29 subjects of both genders, with mean age of 10 years, students from the 5th grade of Elementary School with no oral or written language disorders. The phonological working memory was assessed using the Pseudoword Repetition Test, and the Phonological Awareness: Instrument of Sequential Assessment – CONFIAS was used to assess phonological awareness. **Results:** The students showed appropriate performance in phonological working memory regardless of the similarity of the pseudoword. Concerning phonological awareness, it was observed better performance in the syllabic level and lower score than expected for the phonemic level. Although several studies claim correlation between phonological working memory and phonological awareness, no correlation was found in this sample. **Conclusion:** The lack of correlation between these skills raises reflections regarding possible extrinsic factors that may influence performance in phonological awareness.

Keywords: Evaluation; Language; Memory; Learning; Education

INTRODUCTION

Phonological awareness (PA) enables individuals to reflect on the spoken language and its structure. It is related to progressive skills such as identify, manipulate and split the phonemes^(1,2). Those skills are on the basis of a diversity of phonological representations: syllabic and phonemic tasks⁽³⁾. Researchers^(4,5) claim that PA has an important role in letter-sound correspondence and leads to domain alphabetic principle resulting in reading and writing development.

Some studies pointed out that even though PA development begins early^(5,6) the improvement of reading and writing promotes PA increasing due to the exposition of written letters in

texts and the link between grapheme and phonemes⁽⁷⁾.

Phonological working memory (PWM) is a system which retains and manipulates information that can be remained either by repetition or transfer to long term memory⁽⁸⁾. There are two systems which organize the information: one related to visual-spatial sketchpad and another one concerning phonological information. Moreover, the central executive acts as a supervisor system and controls the flow of information⁽⁹⁾.

The phonological system process sounds and phonological information supported by two components: phonological loop which deals with sound or phonological information in a short period and articulatory rehearsal component that can revive spoken information from decay⁽¹⁰⁾ allowing better processing and organization of language.

Phonological system is absolutely necessary during language acquisition since it is related to stronger representations of new words⁽²⁾. Due to memory, new words are read and kept leading to reading comprehension of a text^(11,12). Loop phonological performance is steady during childhood development, however there is an increase of it as a result of formal education⁽¹³⁾.

A Brazilian research verified the relationship between PWM, PA and writing level in students from first grade of elementary school. The authors conclude that PWM and PA are related and depend on the age and maturity of the individual. Moreover, they claimed that PWM and PA foster writing

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acquisition and can be influenced by educational stimuli⁽⁶⁾.

Nevertheless, studies which investigate the relationship between the skills previously mentioned are mainly concerned about initial grades of elementary schools in which the role of PA and PWM is undeniable. Thus, with the advancement of schooling it is expected an improvement of PA and PWM. Although it is necessary to investigate if there is influence of formal education on PA and PWM performance in order to better understand this relationship once are scarce studies which purposed that⁽¹⁴⁾. This way this study aimed to investigate the performance in PA and PWM of children in the final of cycle I of the elementary school as well as the relationship.

METHODS

Study approved by Ethics Commission for Analysis of Research Projects of School of Medicine, Universidade de São Paulo, under number 220/11. All parents signed Free Informed Consent Form.

The research group counted on 29 students, both genres, aged between 10-11 years old (mean 10) from 5th grade of public elementary school of São Paulo. To participate in the study all students suited the following inclusion criteria: permission of parents to take part in the study; lack of cognitive, hearing or visual impairment; lack of either oral or written language disorders as well as previous speech-language pathology (SLP) treatment.

Parents/caretakers performed a questionnaire concerning general health, oral and written language development (Appendix 1). Teachers performed a questionnaire related to behavior and learning process of their students who were participating in the study in order to confirm the inclusion criteria (Appendix 2).

Procedures for selecting subjects

It was performed a SLP screening consisting of phonological assessment from a standardized test⁽¹⁵⁾ and a storytelling by the subjects based on action picture⁽¹⁶⁾ in which was verified oral language cohesion and coherence⁽¹⁷⁾. Regarding written language it was used the School Performance Test (TDE)⁽¹⁸⁾ which assess writing, reading and arithmetic skills. Its application lasts about 20-30 minutes and provides a general result concerning students' performance. Therefore all students had performed a hearing assessment in a special program of the school.

Participated in the research students who did not present

disorders in hearing, oral and written language achieving standardized parameters expected to either their age or schooling level. All students had alphabetic writing level. Concerning the phonological test, children who did not reach the highest level were not included in the study since in this age group it is not expected phonological disorders. All students who presented any kind of disorders were referred to SLP services.

Experimental tasks

It was performed PWM assessment using Pseudoword Repetition Test (PRT)⁽¹³⁾ which consists of 40 pseudowords of low, middle and high similarity following Brazilian Portuguese structure. The task was applied individually according to instructions provided by the test. In order to assess PA⁽¹⁹⁾ it was used a standardized sequential assessment tool (CONFIAS)⁽¹⁹⁾ composed by syllabic (40 stimuli) and phonemic (30 stimuli) level. The test was applied following the statements established in its instructions.

Data were analyzed in the software Minitab 16 and SPSS 18. It was used non parametric tests. Thus, both descriptive analysis and relation between the tasks applied was verified through Wilcoxon test and Spearman correlation coefficient with significance level of 5%.

RESULTS

Descriptive analysis showed that concerning PWM the mean of correct answers were 38 out of 40. Coefficient of variation indicated that low similarity items had less variability whereas greater variability was found in middle similarity items (Table 1).

Concerning PA the mean score was 59.4 out 70. In syllabic tasks the mean was 36.9 out of 40 whereas in phonemic it was 22.5 out of 30. Coefficient of variation indicated that phonemic score presented greater variability (Table 2).

To analyze the relationship between PWM and PA in this sample the score of both tests was standardized to allow comparison. Thus, it was used Wilcoxon test which showed that the most part of students had greater performance in PWM when compared to PA ($Z=-4.385$, $p<0.001$). In order to better investigate those differences it was compared performance in PWM between syllabic and phonemic skills. In the first case there was no difference ($Z=14.479$, $p=0.0139$) whereas in the second the subjects performed better in PWM ($Z=-4.707$, $p<0.001$). The comparison between PA with each kind of similarity shows that subjects had a greater perfor-

Table 1. Score of subjects in RPT (n=29)

Items	Mean	SD	Minimum	Maximus	Lower quartile	Median	Upper quartile	VC
High similarity	9.4	0.6	8.0	10.0	9.0	10.0	10.0	6.7
Middle similarity	18.6	1.4	15.0	20.0	18.0	19.0	20.0	7.7
Low similarity	9.9	0.3	9.0	10.0	10.0	10.0	10.0	3.1
Total	38.0	0.3	33.0	40.0	36.5	38.0	39.0	4.8

Note: SD = standard deviation; VC = variation coefficient

Table 2. Score of subjects in phonological awareness test (n=29)

Phonological awareness	Mean	SD	Minimum	Maximus	Lower quartile	Median	Upper quartile	VC
Syllabic	36.9	2.6	32.0	40.0	35.0	38.0	39.0	7.1
Phonemic	22.5	4.1	14.0	29.0	20.5	23.0	25.5	18.4
Total	59.4	6.0	46.0	68.0	54.0	61.0	64.5	10.1

Note: SD = standard deviation; VC = variation coefficient

mance in PWM regardless the level of similarity among the words (Table 3).

Table 3. Comparison between performance in phonological working memory and phonological awareness (n=29)

Teste	Z	Valor de p
CONFIAS RPT	-4.385	<0.001*
CONFIAS syllabic RPT	-1.479	0.139
CONFIAS phonemic RPT	-4.704	<0.000*
CONFIAS RPT high similarity	-4.113	<0.000*
CONFIAS RPT middle similarity	-3.493	<0.000*
CONFIAS RPT low similarity	-4.707	<0.000*

* Significant values ($p \leq 0.05$) – Wilcoxon Test

Note: RPT = repetition pseudoword test; CONFIAS = phonological awareness test

To verify if that measures correlates it was used Spearman correlation coefficient and the results indicated no correlation in this sample (Table 4).

Table 4. Correlation between working memory and phonological awareness

Variables	r_s	p-value
CONFIAS x RPT	0.269	0.079
CONFIAS x RPT high similarity	0.253	0.092
CONFIAS x RPT middle similarity	0.181	0.174
CONFIAS x RPT low similarity	0.258	0.088
CONFIAS syllabic x RPT	0.146	0.225
CONFIAS phonemic x RPR	0.190	0.162

* Significant values ($p \leq 0.05$) – Spearman correlation coefficient

Note: RPT = repetition pseudoword test; CONFIAS = phonological awareness test

DISCUSSION

Some studies have shown that PA and PWM are strongly related to reading and writing acquisition^(7,20,21) since PA represents the skill of reflection on speech structure and PWM acts as a system which retains and manipulates temporary

information. This way, this study aimed to investigate the performance in PA and PWM of children in the final of cycle I of the elementary school as well as the relationship.

The performance above the average showed by the subjects in PWM indicates what a diversity of authors had claimed^(6,22) regarding the possible contribution provided by the schooling process in skills from phonological processing. Learning to read in an alphabetic system of writing such as Portuguese assumes that the skill of analyzing speech structure as well as proper PWM which allows retain information and access phonological representations of the language^(14,23). Therefore it is possible to affirm that the well performance in RPT occurred due to proper skills of oral language as well as an appropriate system of keeping information retained⁽²²⁾ once all the subjects performed well in the SLP screening.

Different studies claimed that some factors can affect PWM performance such as phonological similarity and word extension. Concerning similarity, a research⁽²²⁾ affirmed that similar words are more difficult to remember than words that sound different, revealing that oral information is represented by a specific phonological system instead of another system such as visual or semantic. However, data from this study show that regardless word similarity, students recalled them with no effort once PWM is more related to syntactic and phonological aspects of language⁽²²⁾. Such fact was verified in this study sine all subjects did not present disorders either concerning phonological and syntactic aspects of oral language.

Regarding word extension, some researches^(22,24) mentioned greater performance in word with less articulation time even though it could not be investigated in this study since in the task performed there was no monosyllable.

Concerning PA, data from the present study are in agreement with others researchers⁽⁶⁾ when analyzed according to the instructions of the test which score the performance of the subjects based on their level of writing, in this case, alphabetic level⁽²⁵⁾. Nevertheless the test used was standardized to children from a high socioeconomic level with mean age of 7 years old. Under this perspective, it was expected a greater performance of the subjects from this study once they are older and have a greater level of schooling and it did not occur.

Analyzing the performance of the subjects in PA it was noticed a greater performance in syllabic tasks than in phonemic. A diversity of studies^(14,26-28) claimed that schooling provides better knowledge regarding phonemes once they demand higher skills of PA and their full development only achieve greater levels after years of formal education. This fact was not verified in this study and can be related due to the emphasis given in syllables in the school where the rese-

arch was performed. Moreover, the phonemic aspects of the language are not discussed in Portuguese classes.

Another factor that might have contributed to the low score in PA is the poor quality of education in public schools of the country depicted in different indexes. The low conditions of infrastructure, the poor professional training of the school staff, the low commitment of students and even the underprivileged socioeconomic level⁽²⁹⁾ of their families seem to influence the performance of the students from this study.

Even though many researchers^(5,6,23) showed the correlation between PWM and PA, it was not verified in the present study. This way, it is important to consider that such result might have occurred due to the multiple factors (educational and social) that can have led to a low performance in PA and not necessarily the lack of correlation between PWM and PA, since both compose the phonological processing and act simultaneously in order to process linguistic information⁽⁶⁾.

Moreover, the variability of those skills was low and this can affect the analysis of correlation.

It is suggested new studies with larger sample, and if possible, comparing students from private and public schools. Therefore, using another test of PA which provides standardized data to different levels of schooling can achieve more fruitful results.

CONCLUSION

Students from this study showed proper performance in PA and PWM. Although, considering their level of schooling and writing, they had a low performance in PA when compared with other researches either national or international.

The lack of correlation between PA and PWM verified in this study provides new issues of discussion in relation to extrinsic factors that can influence the performance in PA.

RESUMO

Objetivo: Investigar o desempenho de crianças ao final do Ciclo I do Ensino Fundamental em memória operacional fonológica e consciência fonológica, bem como a possível relação entre essas habilidades nesta faixa de escolaridade. **Métodos:** O grupo de pesquisa foi composto por 29 sujeitos de ambos os gêneros, com média de idade de 10 anos, todos regularmente matriculados no 5º ano do Ensino Fundamental com ausência de alterações de linguagem oral e/ou escrita. Foi realizada a avaliação da memória operacional fonológica com a utilização do Teste de Repetição de Pseudopalavras e, posteriormente, utilizou-se o Instrumento de Avaliação Sequencial – CONFIAS para avaliar a consciência fonológica. **Resultados:** Os escolares apresentaram desempenho adequado na memória operacional fonológica independente da similaridade da pseudopalavra. Para a consciência fonológica, observou-se desempenho melhor no nível silábico e inferior ao esperado para o nível fonêmico. Apesar de muitos estudos afirmarem a correlação entre a memória operacional fonológica e a consciência fonológica, esta não foi observada nesta amostra. **Conclusão:** A ausência de correlação encontrada entre essas habilidades traz reflexões quanto a possíveis fatores extrínsecos que podem influenciar o desempenho em consciência fonológica.

Descritores: Avaliação; Linguagem; Memória; Aprendizagem; Escolaridade

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Appendix 1. Questionnaire to parents*

School: _____

Childs' name: _____

Age: _____ Data birth: ____/____/____

1) Did you child delay to speak?

() yes () no

2) Did your child pronounce any word wrongly?

() yes () no

Do you remember any work wrongly pronounced by your child? Give examples _____

3) Did people understand your child when he/she began to speak?

() yes () no

Who used to understand?

Father () yes () no Mother () yes () no

Relatives () yes () no Neighbor () yes () no

Everybody () yes () no

4) Does your child pronounce any word wrongly nowadays?

() yes () no

Do you remember any word wrongly spoken? _____

5) Is your child understood nowadays?

() yes () no

Who does understand he/she nowadays?

Father () yes () no Mother () yes () no Relatives () yes () no

Neighbors () yes () no

Everybody () yes () no

6) Has your child been through a speech-language pathology treatment? () yes () no.

Why? _____

How long? _____

7) Did your child face any difficult to either to learn or writing?

() yes () no

Which difficulty? () read () writing () copy

8) Does your child misspell when writing?

() yes () no

If yes, which letters? _____

9) Does your child see properly?

() yes () no

10) Does your child wear glasses?

() yes () no

11) Does your child hear properly?

() yes () no

12) Does your son take the volume either of TV or radio up?

() yes () no

13) Does your son have earache?

() tes () no.

How often? _____

* Rosal CA. Habilidades de segmentação fonêmica em crianças normais de primeira, segunda e terceira séries do ensino fundamental [Dissertação]. São Paulo: Universidade de São Paulo - Faculdade de Filosofia, Letras e Ciências Humanas; 2002.

Appendix 2. School Program**

Questionnaire to teachers

Student's name

Age.....Teacher..... Time of classes.....

1. Concerning oral language of the student:

Understand simple commands properly () yes () no

() sometimes

Understand complexes comamand properly () yes () no

() sometimes

Organize him/her ideas properly () yes () no () sometimes

2. The student's vocabulary is:

() proper to the age () inappropriate to the age

() above the average to the age

3. Concerning reading:

() do not read () read syllables () read words

() read short texts () read only known words

4. Regarding writing:

() do not write () do not show alphabetic writing

() write syllables () write words

() write phrases () write short texts

5. In relation to writing:

() orthographic errors

() invert letters

() omitting letters

() misspelling

() mixing words

6. Follow a specific literacy book? () no () yes

Which? _____

7. Use of literature book? () always () sometimes () never

If yes, in which way? () read to students () offer to the student read () dramatization

() another. Specify _____

8. Does the student write alphabetically: () words () phrases

() short tests

9. In relation to student's attention:

Is innatentive during tasks executio: () always () never

() sometimes

Attention needs to be calles () always () never () sometimes

Is attentive () always () never () sometimes

10. In relation to following instructions the student execute them better when:

() orally given

() visual given

() does not matter

11. Regarding student performance:

() is confident during tasks

() is unconfident during tasks

() needs either teacher's or friend's support during tasks

12. Concerning student's behaviour he/she is:

() talkative

() messy

() agressive

() quiet/shy

() another. Specify _____

13. List the three most difficulties of students:

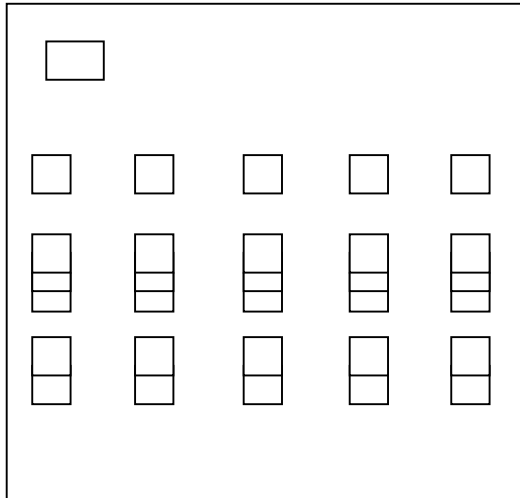
- a) _____
- b) _____
- c) _____

14. Indicate how you perceive the student in the class:

() brilliant () great () ordinary () under enough

15. Tick in the chart below the spot where your student sit:

(Tip: if the frame below does not match you class layout, make another presentation indicating the spot of the student at issue)



** Created by Cárnio MS (2002)