

Marcia Aparecida Grivol¹
Simone Rocha de Vasconcellos Hage²

Descritores

Desenvolvimento da linguagem
Memória
Cognição
Envelhecimento
Avaliação
Efeito idade

Keywords

Language development
Memory
Cognition
Aging
Evaluation
Age effect

Correspondence address:

Marcia Aparecida Grivol
Departamento de Fonoaudiologia, Faculdade de Odontologia de Bauru, Universidade de São Paulo
Al. Octávio Pinheiro Brisola, 9/75, Bauru (SP), CEP: 17012-901
E-mail: mgrivol@yahoo.com.br

Received: 3/11/2010

Accepted: 11/29/2010

Phonological working memory: a comparative study between different age groups

Memória de trabalho fonológica: estudo comparativo entre diferentes faixas etárias

ABSTRACT

Purpose: Considering phonological working memory abilities extend until a certain age and can decline with aging, this study had the aim to verify the performance of individuals without language deficits at different ages in tasks that assess the phonological working memory (non-words and digits). **Methods:** The study involved 90 normal individuals: 30 children (with ages between 6 and 8 years), 30 adults (ages between 19 and 35 years), and 30 elderly (60 years old or older). The selected subjects were submitted to a phonological working memory assessment that included a task of non-words repetition, consisting of the repetition of 40 invented two- to five-syllable words, and a task of repetition of digits, which should be repeated in direct and reverse order. The results were statistically analyzed. **Results:** There were differences between the groups of children, adults and elderly (elderly < children < adults) in the total score of the non-words repetition task. In the digits repetition task, the difference occurred in all groups in the direct order, in the reverse order, and in the total score (children < elderly < adults). **Conclusion:** The elderly have worse performance in phonological working memory tasks, suggesting that this ability declines with the aging process. The adults present better performance, evidencing that they have better abilities to store verbal material.

RESUMO

Objetivo: Considerando-se que as habilidades de memória de trabalho fonológica se estendem até certa idade e que podem regredir com o envelhecimento, este estudo teve por objetivo verificar o desempenho de indivíduos de diferentes faixas etárias sem alterações de linguagem em provas que avaliam a memória de trabalho fonológica (não-palavras e dígitos). **Métodos:** O estudo envolveu 90 sujeitos normais, sendo 30 crianças (entre 6 e 8 anos), 30 adultos (entre 19 e 35 anos) e 30 idosos (idade igual ou superior a 60 anos). Os sujeitos que atenderam aos critérios de inclusão foram submetidos à avaliação de memória de trabalho por meio da prova de não-palavras, que consiste na repetição de 40 palavras inventadas (de duas a cinco sílabas) e prova de dígitos (repetidos em ordem direta e ordem inversa). Os resultados foram analisados estatisticamente. **Resultados:** Na pontuação total da prova de não-palavras, houve diferença entre os grupos de crianças, adultos e idosos (idosos < crianças < adultos). Na prova de dígitos, a diferença ocorreu em todos os grupos em ordem direta, ordem inversa e na pontuação total (crianças < idosos < adultos). **Conclusão:** Idosos apresentam pior desempenho em provas de memória de trabalho fonológica, sugerindo que esta habilidade sofre declínio com o processo de envelhecimento. Já os adultos apresentam melhor desempenho, evidenciando que eles têm melhor capacidade de armazenagem de material verbal.

Work accomplished in Department of Speech-Language Pathology and Audiology, Bauru Dental School, University of São Paulo – USP – Bauru (SP), Brazil.

(1) Graduate Program (Masters degree) in Speech-Language Pathology and Audiology, Department of Speech-Language Pathology and Audiology, Bauru Dental School, Universidade de São Paulo – USP – Bauru (SP), Brazil.

(2) Department of Speech-Language Pathology and Audiology, Bauru Dental School, Universidade de São Paulo – USP – Bauru (SP), Brazil.

INTRODUCTION

Memory is the ability to elaborate, store, retrieve and use information⁽¹⁾. It is also the capacity of learning, preserving, storing and recalling information about ourselves and the world around us, which can be analyzed from different aspects⁽²⁾. The development of this skill in childhood occurs in parallel with general cognitive development, and, like the attention, it intervenes in all cognitive activities (related to language development or recognition of persons and objects). When evaluating, for example, the language of an individual, short-term memory must act.

The memory is defined according to its function, its duration and its content. Thus, three levels can be distinguished: sensory memory, lasting less than one second, short-term memory, which corresponds to a time of some seconds to a minute having the same meaning of working memory (ability to temporarily save the information to perform several cognitive abilities); and long-term memory, which covers a time ranging from hours to years and is divided into implicit memory and explicit memory. In short, implicit memory is memory for skills and procedures and explicit memory is memory for facts and events⁽³⁾.

The short-term memory allows the access to events that occurred very recently. The long-term memory refers to events that occurred several minutes, hours, days, months or years⁽⁴⁾.

Working memory (WM) is a system of processing and storing information in short-term that keeps thinking, learning and communication⁽⁵⁾. WM involves the temporary storage and manipulation of information necessary to perform complex cognitive activities such as reading comprehension, access to the vocabulary and reasoning⁽⁶⁻¹⁰⁾.

It is known that WM is limited in the ability to store the information immediately. Thus, it is limited by time, but can be maintained if it is activated by repetition or by transfer to long-term memory. It is also known that the storage capacity in working memory is five to nine elements⁽¹¹⁾.

The WM model studied in more cognitive approach says that the short-term memory does not function as a single entity but as a tripartite system. There is a central executive attentional controller (central executive) and two subsystems specialized in processing and handling of limited amounts of information in areas that are highly specific: the phonological loop (or circuit) and the visuospatial sketch (visual sketchpad). The central executive acts as a regulator of information flow, processing and storing this information. The phonological stores and manipulates speech-based material and has two subcomponents: the phonological storer, which receives information both by direct way (auditory presentation) and by indirect way (visual presentation), and the process of reverberation or subvocal rehearsal, which occurs serially in real time, and acts to restrain the natural decay of the phonological storer. The visual sketchpad executes processing and maintenance of visual and spatial material⁽¹²⁾. In a review of the proposed model, a new component was included, the episodic buffer, a storer responsible for the integration of information, both verbal and visual components and the long-term memory, in a single episodic representation, however, of multi-dimensional codes⁽¹³⁾.

Concerning the language, verbal working memory (phonological) has a key role. Studies have found correlations between phonological memory skills and speech and language skills, saying that the memory expands with age, due to speed increase in subvocal "recall", i.e., the increase in memory skills appeared to be linked to an increase in speech and language skills⁽¹⁴⁾. However, faced with biological changes, physiological and psychological, memory, and various other skills, suffers a decline⁽¹⁵⁾.

Aging, natural stage of life, is influenced by genetic factors, the lifestyle and the environment, and is still marked by physiological changes over time that leads to certain limitations and loss of skills. According to World Health Organization (WHO) it is considered elder any person aged 60 years or more⁽¹⁶⁾.

Studies that seek the relationship between aging and its manifestations in memory have pointed out that in tests that assess this ability, young people perform better than older people. This is because their performance on tasks that require large amount of simultaneous processing in working memory becomes deficient as a result of normal aging⁽¹⁵⁾.

The concern in studying human cognitive aging has intensified over the past 50 years⁽¹⁷⁾, since each year the life expectancy of elderly increases and it is necessary to improve people's life quality. In Brazil, the situation of the elderly has attracted the attention of different areas of society after 1976, when the first seminars were held on the problems of the elderly in our midst⁽¹⁸⁾.

Although there are several speech and language changes related to the aging process, such as hearing, memory and language, articulation and neurovegetative, there are few reported studies of such changes. The understanding, specifically, about the performance of working memory in different age groups, allows the identification of possible damage on this ability, thus enabling early intervention and ensuring better living conditions in individuals with such difficulties⁽¹⁵⁾.

In general, the skills of verbal or phonological WM are evaluated by two index: the memory span (span word/digit span) and repetition of non-words, here with the meaning of words that do not exist, since non-words repetition tests requires more of WM skills due to the fact that the input or receipt is unknown and therefore not subject to lexical influences, preventing the possibility of masking the real system conditions⁽¹⁹⁻²¹⁾. To repeat non-words it is necessary to have connection between the perceptive analysis system and the phonological planning, and the perceptive analysis provides what will be imitated, i.e., the sequence of phonemes that cannot be generated in the lexicon⁽²²⁾.

A study that validated the phonological working memory test demonstrated the influence of age, educational level and extension of non-words in children's performance, since the older and with more education had better performance. Another observation was that the performance of children of all age groups decreases as the number of syllables of words increases. This occurs because of non- words are retained for a time in working memory. Thus, the higher the number of syllables of the non-words, more difficult was the subvocal process of the

working memory to rescue the verbal information declining and keep verbal material in memory⁽²³⁾.

Considering the digits repetition test, it was shown that subjects recall more digits in forward order than in reverse order. The reverse has a higher degree of complexity and is thus related to the central executive, while in direct order would be associated to phonological loop. It is known that, in direct order, children were able to save an average of five digits and in reverse order three digits. The adults were able to remember five digits in forward order and four digits in reverse order⁽²⁴⁾.

In digits repetition and non-words tests was found superior performance among younger individuals than in older people. In phonological working memory, the elderly were able to retain between three and four syllables in non-words repetition tests, while adults have retained an average of five syllables. In addition, the elderly have retained four or five digits and the adults, six digits⁽¹⁵⁾.

Studies on the assessment of phonological working memory show the relevance of this skill investigation in this children, adults and senior's population. Thus, under the hypothesis that the phonological skills of the working memory extends at a certain age and later can regress with age, this study aimed to verify the performance of individuals of different ages without language impairment in phonological working memory tests (non-words and digits).

METHODS

Participants in this study were 90 individuals: 30 children attending preschool and elementary school (16 females and 14 males), with ages between 6 years and 8 years and 11 months; 30 young adults (18 female and 12 male), with ages between 19 and 35 years; and 30 elderly (17 female and 13 male), with 60 years old or older. These subjects were not matched by gender.

The 30 children were randomly selected among the 200 who were evaluated to provide parameters of phonological working memory at the undergraduate research works, conducted between 2006 and 2007. For this previous study, the 200 children were selected from preschools and elementary schools in the São Paulo state countryside, considering the following inclusion factors: no history of deficits in oral language and/or hearing; provide consistent performance with the chronological age in phonology task and school performance task (for children in the literacy process).

The 30 young adults between 19 and 35 years were selected from among undergraduate students at a public university, considering the following inclusion factors: no history of deficits in oral language and/or hearing; no memory complaint.

The 30 elderly aged 60 years or more were selected for convenience in the community, without regard to their levels of education and with the following inclusion factors: no history of deficits in oral language; no memory complaint; no progressive degenerative diseases.

We obtained authorization from the director of the Bauru Dental School – Universidade de São Paulo (USP) to conduct the study at the institution. The study was also approved by the Research Ethics Committee of the institution under number

94/2008. All subjects (or their parents/caregivers) were informed about the purposes and procedure of the study and signed the Free and Informed Consent.

To respond the inclusion factors of the children group a short questionnaire was applied to those responsible (Questionnaire 1) and teachers (Questionnaire 2) with questions about possible language, hearing and school performance complaints. Children with a history of language difficulties, hearing or inconsistent performance with age and schooling were excluded from the sample. Those who did not have such a history were submitted to the phonology task (imitation) of the Children Language Test – ABFW⁽²⁵⁾ to verify if the phonological system was compatible with chronological age and children aged 7 and 8 years were submitted to the School Performance Test – TDE⁽²⁶⁾, developed for children aged between 7 and 12 years, in order to check compatibility with schooling.

To respond the inclusion factors of the adults and elderly groups, it was applied a short questionnaire with questions about possible communication complaints (Questionnaire 3). Individuals who had a history of difficulties with language, hearing (except the elderly), learning and memory were excluded from the sample.

From the moment that attended the inclusion criteria, the subjects of all groups were submitted to phonological work memory tasks⁽²⁷⁾ in a silent place. The non-word test was created based on the phonological structure of the Portuguese language spoken in Brazil, consisting of 40 invented words with sequences of two to five syllables. All invented words were paroxytone, because most words in Portuguese are also paroxytone, and were elaborated containing different orders of the following phonemes: six occlusive (/p/, /t/, /k/, /b/, /d/, /g/), three nasal (/m/, /n/, /ŋ/), six fricative (/f/, /v/, /ʃ/, /z/, /s/, /z/), and three liquids (/l/, /ʎ/, /R/), as well as five closed vowels (/a/, /e/, /i/, /o/, /u/). The syllabic patterns used were: CV, VC, CVC, CCV.

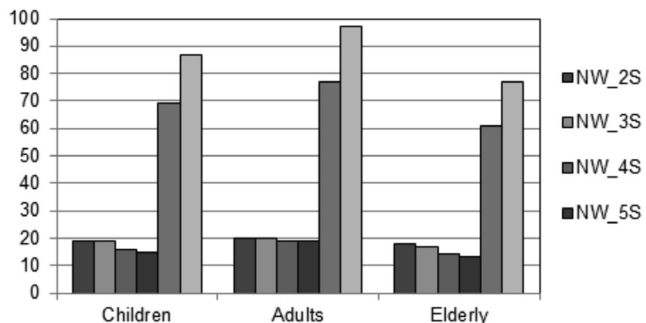
The list of non-words was applied without visual clues. The examiner spoke each word on the list and the subjects immediately repeated it. The subject received two points when the non-words were repeated correctly in the first time, one point when they were repeated correctly in the second time, and zero point when the child was unable to repeat the non-words correctly after two attempts.

The digits task was composed of various sequences of numbers from one to nine to be repeated in direct and reverse order. The direct sequence ranged from two to eight digits and reverse, two to seven. The way to score was identical to that used in the non-word test.

Results were presented considering descriptive measures with mean, minimum and maximum values with their standard deviations and percentages of correct answers. It was used the Tukey's Multiple Comparisons test and One-Way Analysis of Variance to compare the number of syllables in the non-word test and Tukey's test and Analysis of Variance to compare the performance between the ages. Finally, to compare the performance between the non-words test and the digits task based on the percentage of correct answers we used the Paired t Test. We adopted a significance level of 0.05.

RESULTS

The average performances of children, adults and elderly groups in the non-words test (two to five syllables and total score) were obtained, calculating the mean score and the percentage of correct answers (Figure 1).



Note: NW_2S = non-words with two syllables; NW_3S = non-words with three syllables; NW_4S = non-words with four syllables; NW_5S = non-words with five syllables; NW_Total = non-words total score; NP_% = non-words percentile of correct answers

Figure 1. Mean performance of the groups of children, adults and elderly about the non-words from two to five syllables, total score and percentile of correct answers

Comparing the performance of groups in the non-words test, it can be observed that there were differences between the children, adults and elderly groups (elderly < children < adults) (Table 1).

Table 1. Comparison between children, adults and elderly in non-words repetition test

	Children	Adults	Elderly
Mean	69.43	77.27	61.63
Children (p-value)		0.00*	0.00*
Adults (p-value)			0.00*

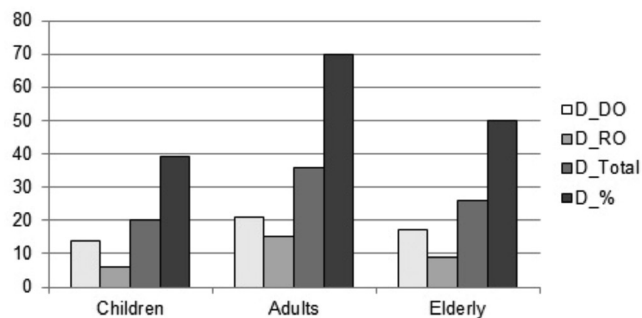
* Significant values (p<0.05) – Tukey Test

The results also show the performance measures of children, adults and elderly groups in the digits task (direct order, reverse order and total score), with the mean score and the percentage of correct answers (Figure 2)

When the groups were compared for the variable digits (direct order, reverse order, and both), there were differences between all groups in the direct order, the reverse order and the total score. Adults performed better than children and the elderly, and children performed worse than the elderly (Table 2).

It was obtained the performance of 90 individuals regarding the number of syllables of the non-words (two to five syllables) (Figure 3).

The results show differences in the number of syllables in different groups. It was found that, for children, the length of non-words varied as it follows: two syllables = three syllables < four syllables < five syllables. For the adults group the following characteristics were found: two syllables = three syllables = four syllables, two syllables and three syllables < five syllables.



Note: D_DO = digits direct order; D_RO = digits reverse order; D_Total = digits total score; D_% = digits percentile of correct answers

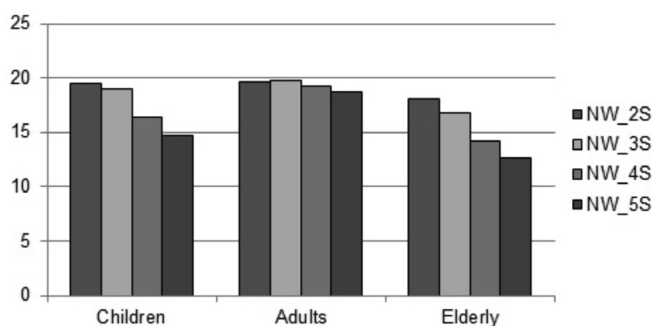
Figure 2. Mean performance of the groups of children, adults and elderly about the variable digits in direct order, reverse, total score and percentile of correct answers

Table 2. Comparison between children, adults and elderly about digits in direct order, reverse order and total score

Digits repetition task	Children	Adults	Elderly
D_DO			
Mean	13.87	20.93	17.07
Children (p-value)		0.00*	0.00*
Adults (p-value)			0.00*
D_RO			
Mean	6.20	15.30	8.80
Children (p-value)		0.00*	0.00*
Adults (p-value)			0.00*
D_Total			
Mean	20.07	36.23	25.87
Children (p-value)		0.00*	0.00*
Adults (p-value)			0.008*

* Significant values (p<0.05) – Tukey Test

Note: D_DO = digits direct order; D_RO = digits reverse order; D_Total = digits total score



Note: NW_2S = non-words with two syllables; NW_3S = non-words with three syllables; NW_4S = non-words with four syllables; NW_5S = non-words with five syllables

Figure 3. Mean performance of the groups of children, adults and elderly about non-words from 2 to 5 syllables

Finally, the elderly showed the following variation considering the length of non-words: two syllables and syllables three < four syllables and five syllables (Table 3).

Table 3. Comparison between children, adults and elderly about non-words from two to five syllables

Group	2_S	3_S	4_S	5_S
Children				
Mean	19.50	18.93	16.33	14.67
2_S		0.79	0.00*	0.00*
3_S			0.00*	0.00*
4_S				0.04*
Adults				
Mean	19.60	19.70	19.20	18.76
2_S		0.98	0.37	0.00*
3_S			0.18	0.00*
4_S				0.29
Elderly				
Mean	18.03	16.73	14.23	12.63
2_S		0.15	0.00*	0.00*
3_S			0.00*	0.00*
4_S				0.05

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

Note: 2_S = two syllables; 3_S = three syllables; 4_S = four syllables; 5_S = five syllables

DISCUSSION

With the hypothesis that working memory skills increase until a certain age and then may regress with aging, this study aimed to verify the performance of individuals at different ages (children, adults and elderly) without language impairments, in tests that assess phonological working memory – non-words test and digits task.

The choice for tests involving the repetition of digits and non-words was based on studies that indicate that phonological working memory skills are typically evaluated using two indices: “digit span” (repetition of sequences of numbers) and repetition of words invented. They also claim that tests of non-words repetition demands with greater confidence working memory skills due to the fact that the verbal material is unknown and therefore not subject to lexical influences, thus preventing the possibility of masking the real system conditions, since there is no lexical support^(19,20,28,29).

This study showed that young adults performed better regarding children and the elderly. The elderly had worse performance in non-words repetition task comparing to both adults and children, thus confirming the hypothesis that phonological memory stretches with age, but declines in old age.

The memory stretches with age, due to speed increase of subvocal recall, which means that the increase in memory skills appeared to be linked to the increase in speech and language skills⁽¹⁴⁾. However, memory decline suffers from biological, physiological and psychological issues related to aging.

Another observed fact was that, in general, there was a decline in the performance of individuals as the number of non-words syllables increases. These results confirm data from studies that demonstrated the effect of the extent of non-words

reflected on the individuals performance, i.e., the greater the number of syllables and non-words, the worst was the performance⁽²³⁾. In spite of that study⁽²³⁾ involve only children, this aspect seems to be used for other age groups.

CONCLUSION

The study confirms the hypothesis that phonological skills of working memory are influenced by age, showing that the older the subject, the better the performance, however, in old age memory decline and shows it is superior only on digits repetition tests with children. We conclude, therefore, that memory, as well as other cognitive skills evolves over the years, but declines in old age and also that the greater the number of syllables, the greater the difficulty in storing the material in verbal memory, regardless of age.

REFERENCES

- Narbona J, Chevrie-Miller C, organizadores. A linguagem da criança: aspectos normais e patológicos. 2a ed. Porto Alegre: Artmed; 2005. Avaliação neuropsicológica; 146-70.
- Lobo FS, Acrani IO, Ávila CR. Tipo de estímulo e memória de trabalho fonológica. Rev CEFAC. 2008;10(4):461-70.
- Izquierdo I. Memória. Porto Alegre: Artmed. 2002. 96p.
- Gathercole SE. The development of memory. J Child Psychol Psychiat. 1998;39(1):3-27.
- Montgomery JW. Working memory and comprehension in children with specific language impairment: what we know so far. J Commun Disord. 2003;36(3):221-31.
- Vieira MG, Mota HB, Keske-Soares M. Memória de trabalho e consciência fonológica no desvio fonológico. In: XIII Congresso Brasileiro de Fonoaudiologia; 2005 Set 28-30; Santos. Anais.
- Gindri G, Keske-Soares M, Mota HB. Memória de trabalho, consciência fonológica e hipótese de escrita. Pró-Fono. 2007;19(3):313-22.
- Leather CV, Henry LA. Working memory span and phonological awareness tasks as predictors of early reading ability. J Exp Child Psychol. 1994;58(1):88-111.
- Gathercole SE, Alloway TP, Willis C, Adams AM. Working memory in children with reading disabilities. J Exp Child Psychol. 2006;93(3):265-81.
- Giangiacomo MC, Navas AL. A influência da memória operacional nas habilidades de compreensão de leitura em escolares de 4ª série. Rev Soc Bras Fonoaudiol. 2008;13(1):69-74.
- Miller GA. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychol. Rev. 1956;63(2):81-97.
- Baddeley AD, Hitch GJ. Working memory. In: Bower GA, editor. Recent advances in learning and motivation. Nova York: Academic Press; 1974. p.47-90.
- Baddeley A. The episodic buffer: a new component of working memory? Trends Cogn Sci. 2000;4(11):417-23.
- Hulme C, Thomson CM, Lawrence A. Speech rate and development of short-term memory span. J Exp Child Psychol. 1984;38(2):241-53.
- Siqueira LS. Estudo da memória de trabalho em adultos e idosos normais [dissertação]. Santa Maria (RS): Universidade Federal de Santa Maria, Centro de Ciências da Saúde; 2006.
- Brasil. Senado Federal. Estatuto do Idoso. Brasília: Senado Federal; 2003.
- Yassuda MS, Batistoni SS, Fortes AG, Neri AL. Treino de memória no idoso saudável: benefícios e mecanismos. Psicol Repl Crít. 2006;19(3):470-81.
- Carmo LC, Silveira JA, Marone SA, D'Ottaviano FG, Zagati LL, Lins EM. Estudo audiológico de uma população idosa brasileira. Rev Bras Otorrinolaringol. 2008;74(3):342-9.

19. Baddeley AD. Working memory. Oxford: Claridon Press; 1986. 282 p.
20. Gonçalves CS. A interferência da memória de trabalho fonológica no desenvolvimento da linguagem. *Fonoaudiologia Brasil*. 2002;2(1):10-8.
21. Laws G. The use of nonword repetition as a test of phonological memory in children with Down syndrome. *J Child Psychol Psychiatry*.1998;39(8):1119-30.
22. Bryan A, Howard D. Frozen phonology thawed: the analysis and remediation of a developmental disorder of real word phonology. *Eur J Disord Commun*. 1992;27(4):343-65.
23. Santos FH, Bueno OF. Validation of the brazilian children's test of pseudoword repetition in portuguese speakers aged 4 to 10 years. *Braz J Med Biol Res*. 2003;36(1):1533-47.
24. Figueiredo VL, Nascimento E. Desempenhos nas duas tarefas do subteste dígitos do WISC-III e do WAIS-III. *Psicol Teor Pesqui*. 2007;23(3):313-8.
25. Wertzner HF. Prova de fonologia. In: Andrade CR, Befi-Lopes DM, Fernandes FD, Wertzner HF. *ABFW: Teste de linguagem infantil nas áreas de fonologia, vocabulário, fluência e pragmática*. 2a ed. Carapicuíba: Pró-Fono; 2004.
26. Stein LM. *TDE – Teste de Desempenho Escolar*. São Paulo: Casa do Psicólogo; 1994.
27. Hage SRV, Grivol MA. Desempenho de crianças normais falantes do português em prova de memória de trabalho fonológica. *CAD Comum Ling*. 2009;1(1):61-9.
28. Aguado G. *Trastorno específico del lenguaje: reraso de lenguaje y disfasia*. Málaga: Ediciones Aljibe; 1999. 217p.
29. Baddeley A. Working memory and language: an overview. *J Commun Disord*. 2003;36(1):189-280.

Questionnaire 1

This is a questionnaire that is part of the research "Profile of children with typical language development in a Phonological Working Memory Test", where your child, with your permission, will participate. It consists of some questions about their speech, language and hearing development. Please read and respond by marking a "X" at the option that best describes your child's development.

Thanks for your collaboration!

Does your child took too long time to start speaking? () Yes () No

Around what age did your child begin to speak the first words, such as "Mom" and "Dad"?

() 1 year () 1 year and a half () 2 years () 2 years and a half () more than 2 years and a half

Around what age did your child begin to speak the first few sentences, or put two words together, such as, "wanna water" to say that he wanted water?

() 1 year () 1 year and a half () 2 years () 2 years and a hal () more than 2 years and a half

Nowadays, does your child changes speech sounds? () Yes () No

Do you and others are able to understand what your child speaks? () Yes () No

Do you think that your child has a good hearing? () Yes () No

Do you have or did you have any complaints about the hearing of his child? If so, what?

() Yes () No What? _____

Are there any complaints from teachers about your child's school performance? If so, what?

() Yes () No What? _____

Compared with other children, does your child presents difficulties in school? () Yes () No

If there is something about your child's development that was not asked and you think important to tell, please describe below.

Parent's signature

Questionnaire 2

This is a questionnaire that is part of the research "Profile of children with typical language development in a Phonological Working Memory Test", where your student, after theirs responsible permission will participate.

It consists of some questions about their development of speech, communication, hearing, vision, and school performance, please read and respond marking a "X" at the option that best describes their development.

Thanks for your collaboration!

1. Does the student have some difficulties at school? () Yes () No

What? _____

2. Does the student have some visual impairment? () Yes () No

What? _____

3. Does the student have some speech or communication impairment? () Yes () No

What? _____

4. Does the student have some hearing impairment? () Yes () No

What? _____

Questionnaire 3

This is a questionnaire that is part of the research: "Phonological Working Memory: a comparative study between different age groups," where you participate by signing the informed consent. It consists of questions about your communication and learning, please read and respond marking a "X" at the option that best describes your profile.

Thanks for your collaboration!

1. Do you think that you communicate well? () Yes () No

If no, why? _____

2. Do the people think that you communicate well? () Yes () No

If no, why? _____

3. Do you understand what the people say? () Yes () No

4. Do the people understand what you say? () Yes () No

5. Do you have any memory complaint? () Yes () No

If yes, what? _____

6. Do the people think you are forgotten? () Yes () No

If yes, what? _____

7. If you have attended the school, did you have some difficulty in school? () Yes () No

If yes, what? _____

8. Do you have any hearing impairment? () Yes () No

If yes, what? _____