Montreal Communication Evaluation Battery – Portuguese version: age and education effects

Bateria Montreal de Avaliação da Comunicação – versão portuguesa: efeito da idade e escolaridade

Mônica de Souza Kerr[1]
Karina Carlesso Pagliarin[2]
Ana Mineiro[3]
Perrine Ferré[4]
Yves Joanette[4]
Rochele Paz Fonseca[5]

ABSTRACT

Purpose: To verify age and education effects on communication performance of healthy adults in the Montreal Communication Evaluation Battery, Portuguese version (MAC-PT). **Methods:** The sample comprised 90 healthy adults from Portugal, European Portuguese speakers, divided into nine groups according to educational level (4–9, 10–13, and >13 years of formal schooling) and age (19–40, 41–64, and 65–80 years). The influence of age and education was assessed by comparing mean scores between groups, using a two-way analysis of variance followed by Bonferroni post hoc tests ($p \leq 0.05$). **Results:** The results showed that participants' performance was influenced by age in pragmatic-inferential, discursive, and prosodic tasks. Education had the greatest influence on the performance in all processes evaluated by the MAC-PT. **Conclusion:** Age and education seem to influence the communicative performance and should be considered in the assessment of neurological patients.

RESUMO

Objetivos: Verificar o efeito das variáveis idade e escolaridade no desempenho de adultos saudáveis na Bateria Montreal de Avaliação da Comunicação, versão portuguesa (MAC-PT). **Métodos:** A amostra foi composta por 90 indivíduos portugueses, falantes do Portugês Europeu, distribuídos em 9 grupos de acordo com a escolaridade (4 a 9; 10 a 13; e mais de 13 anos de ensino formal) e com a idade (19 a 40; 41 a 64; e 65 a 80 anos). Para análise de comparação entre grupos, utilizou-se o teste *two-way* ANOVA, com *post-hoc* Bonferroni (p≤0,05). **Resultados:** Verificou-se que o desempenho dos indivíduos foi influenciado pela variável idade nas tarefas pragmático-inferencial, discursiva e prosódica. Já a escolaridade influenciou o desempenho em todos os processamentos avaliados pela MAC-PT. **Conclusão:** As variáveis idade e escolaridade influenciaram o desempenho comunicativo e devem ser consideradas no processo de avaliação de pacientes neurológicos.

Correspondence address:
Mônica Kerr
Rua Barata Ribeiro, 190, conjunto 11, Bela Vista, São Paulo (SP), Brasil, CEP: 01308-000.
E-mail: monica_kerr@hotmail.com

INTRODUCTION

Nearly a century ago, studies described the important role of the left hemisphere in cognition, emphasizing language, in the data analytical processing, and in verbal memory. However, only from the 1970s on, with the advance in researches on cognitive, psycholinguistic, and neuroanatomical functional models, more systemic researches have been initiated about the functional linguistic components related to the right hemisphere (RH) — nonliteral semantic, discursive, and pragmatic components. In this same period, with the evolution of behavioral and neuroimaging studies, it became possible to verify that a lesion in the right hemisphere (LRH) may cause communication disorders[1-4].

Patients with LRH may also present difficulties in other competences, such as temporal–spatial orientation, attention, perception (anosognosia, hemineglect, and prosopagnosia)[5], memory (visual amnesia and working memory)[6], and emotional processing (comprehension and expression of prosodic stimuli with emotional intonation, emotional processing of faces)[7]. The damage to one or more of the identified components generates distinct profiles of alterations in the expression and verbal comprehension, impairing the quality of life of the individual and their family[8]. This way, the process of language evaluation becomes extremely important after neurological lesions, being fundamental in cases of stroke and traumatic brain injury[8,9].

The main relevance of the evaluation and the diagnosis by the speech language therapist after the stroke is to draw the profile of the cognitive and communicative functions preserved and in deficit, in comparison with the premorbid state of the subject. The evaluation is essential for the prognosis and design of appropriate treatments for the patients[8-10]. Besides that, the incidence of communicative deficit in individuals with LRH depends on personal characteristics such as age, school education, post-lesion time, and nature of the lesion[11], such factors must be considered during the whole evaluation process.

In this sense, the *Protocole Montréal d'Évaluation de la Communication — Protocole MEC*[12] — provided basis for the development of the Montreal Communication Evaluation Battery, Portuguese version (MAC-PT Battery, submitted for publication in Audiology Communication Research), which was adapted from its Brazilian version (Montreal Communication Evaluation Battery — MAC Battery)[13]. Such adaption occurred in six stages: comparative analysis of the MAC batteries and *Protocole MEC*; adaptation and development of new stimuli by specialists; analysis by non-expert evaluators; analysis by expert evaluators; pilot study 1 and pilot study 2; agreement among evaluators, with evidence of content validity; and final adjustments and development of the MAC-PT Battery. It is important to highlight that all stages were intermediated and analyzed by both the authors of the Portuguese adaptation and the authors of the MAC Battery and the *Protocole MEC*. The instrument kept the same amount of items of the French and Brazilian versions. Chart 1 has the alterations performed in the adaptation based on the Brazilian version.

The MAC-PT Battery is an expanded battery, relatively easy to be applied, with an average duration of 90 minutes divided into two sessions of 45 minutes each, which evaluate the four processings of communicative competences (discursive, pragmatic-inferential, lexical-semantic, and prosodic)[13].

To date, there are no reports in Portuguese of a single instrument that evaluates the four competences mentioned earlier. Thus, it has created the necessity of developing and/or adapting an instrument of evaluation of the communicative competences performed by the RH, adapted to the linguistic and sociocultural reality of Portugal. So that the psychometric rigor obtained in the study with the Brazilian version[13] is kept, being necessary empirical studies with the Portuguese version. This way, this study tried to verify the effect of variables such as age and school education on the performance of healthy adults in the MAC-PT Battery, in addition to contributing with performance normative data for the Portuguese population.

METHODS

Participants

Ninety neurologically healthy individuals took part in this study, aged between 18 and 80 years — mean (M) 50.48 years and standard deviation (SD) 19.82 years — and having between 4 and 19 years of formal education (M=11.27 years; SD=4.31 years), which were selected by the non-random convenience method, in college, school, business, hospital, day centers environments, among others, in the region of Great Lisbon, Portugal. As inclusion criteria, the individuals who took part in the study were those who had European Portuguese as the mother language; no sensory disorders (uncorrected hearing and/or visual); no sign of cognitive decline measured by the Clock Test[14] associated with the Mini-Mental State Examination (MMSE), adapted version for the Portuguese population[15]; and no signs of depression measured through the 15-item Geriatric Depression Scale[16], which was used in all individuals to obtain the same measure for youngsters, adults, and the elderly[9]. Also, in order to take part in the sample, the adults could not have a history of alcoholism and/or current or previous abuse of illicit drugs or benzodiazepines and antipsychotics (data collected by the sociocultural and health aspects questionnaire)[17].

The initial sample consisted of 101 individuals. Of those subjects, 11 were excluded from the studies because: 3 subjects did not want to proceed with the evaluation claiming exhaustion, 4 subjects scored above cutoff points in the Geriatric Depression Scale, 2 subjects scored below the cutoff point of the MMSE, and 2 subjects had history of neurological diseases. This way, the final sample consisted of 90 individuals.

After the use of the MAC-PT Battery, the participants were distributed into nine subgroups according to age (18–40, 41–65, and 65–80 years) and school education (4–9, 9–13, and more than 13 years of formal study). Regarding the distribution by gender, the sample consisted of 26.7% male individuals and 76.3% female individuals (Table 1).

Chart 1. Initial and final stimuli of the Montreal Communication Evaluation Battery, Portuguese version, in comparison to the Brazilian version

Name of the task	MAC-BR Stimuli	First procedure	Second procedure /results
Interpretation of metaphors	*O professor é um sonífero*	*O professor é um soporífero*	*O professor é uma seca*
	O ônibus é uma tartaruga	*O autocarro é uma tartaruga*	*O autocarro é um caracol*
	Meu pai é um pavão	*O meu pai é um pavão*	*Este rapaz é um troca-tintas (substitution)*
	Este cachorro é um grude	–	*Este cão é uma melga*
	A casa deste homem é um lixo	*A casa deste homem é um lixo*	*A casa deste homem é uma lixeira*
	Esta criança é uma pipoca	*Esta criança é uma pipoca*	*Esta criança é um veludo (substitution)*
	A menina morreu de rir	*A menina morreu de rir*	*A Maria gosta muito de dar à língua (substitution)*
	Este homem joga dinheiro no lixo	*Este homem atira dinheiro ao lixo*	*Idem*
	A mãe pisa em ovos com seus filhos	*Idem*	*A mãe anda em pezinhos de lã com os filhos*
	O meu patrão rodou a baiana	*O meu patrão rodou a baiana*	*O dono do café passou-se*
Narrative speech	*Marcos é um agricultor gaúcho na sua fazenda…*	*O Marcos é um agricultor alentejano na sua quinta…*	*O António é um agricultor alentejano* *Idem*
Interpretation of acts of speech	*Você tem algum programa para o fim de semana?*	*Tens algum programa para o fim de semana?*	*Tens alguma coisa para fazer no fim-de-semana?*
	Esta sacola está muito pesada	*Este saco está muito pesado*	*Idem*
	Foram 268 euros	*Foram 268 euros*	*Foram 90 euros*
	Esta impressora tem um bom desempenho	*Idem*	*Esta impressora é de óptima qualidade*
	Você está parecendo gente grande	*Estás a parecer um homenzinho*	*Idem*
	O apartamento é bem claro	*O apartamento é bem claro*	*O apartamento é muito luminoso*
	Vou cozinhar massa hoje a noite	*Hoje a noite vou fazer massa*	*Hoje a noite vou fazer bacalhau no forno*
	Não tinha quase ninguém no supermercado	*Não havia quase ninguém no supermercado*	*O supermercado está tão vazio*
	Eu adoro a cor que a gente escolheu para o carro	*Eu adoro a cor que escolhemos para o carro*	*Idem*
	Não tem papel aqui	*Não há papel aqui*	*Laurinda, não há papel*
	Cristian, que demora	*Cristiano, que demora*	*Estás a lavar os dentes há 20 minutos*
Semantic judgment	*Bomba – Fuzil*	*Bomba – Espingarda*	*Granada – Espingarda*
	Pia – Tanque	*Lavatório – Tanque*	*Lavatório – Sanita*

Caption: MAC-BR = Montreal Communication Evaluation Battery; Idem = the stimuli of the procedure was the same as the previous one; (substitution) = the stimuli were replaced

Table 1. Demographic characteristics of the sample by age and education range

	Groups								
	18–40 years			41–64 years			65–80 years		
School education (years)	4–9	10–13	≥14	4–9	10–13	≥14	4–9	10–13	≥14
n	10	10	10	10	10	10	10	10	10
Gender (M/F)	8/2	3/7	5/5	3/7	1/9	0/10	0/10	8/2	8/2
Mean age	36.1	18.3	25.4	50.5	54.2	52.1	72.7	74.1	70.8
Standard deviation	3.93	0.48	4.14	4.81	3.61	6.01	5.46	3.57	4.21
Mean years of study	7.20	12.1	16.5	6.4	12.1	15.9	4.5	11.4	15.3
Standard deviation	1.32	0.57	0.71	1.96	0.57	1.1	1.58	1.17	1.64

Caption: M = male; F = female

Instruments and procedures

The participation of the individuals was voluntary, and therefore, not remunerated. All of them signed the informed consent. The individuals were assessed individually, in a silent, well lit, and ventilated environment. The evaluation was performed in one single session, lasting about 1 h and 30 min.

After the administration of all instruments needed to fulfill the inclusion criteria, the Portuguese version of the MAC Battery was applied, which has the objective of evaluating four components of the communicative processing: discursive, pragmatic-inferential, lexical-semantic, and prosodic[18], through the following tasks:

- conversational speech,
- interpretation of metaphors,
- verbal fluency,
- linguistic prosody, (e) emotional prosody, (f) narrative speech, (g) interpretation of speech acts, and (h) semantic judgment.

The data were registered and recorded using a digital audio recording equipment for later transcription. Two examiners, speech language therapists, specialized and trained, applied the tasks in the MAC-PT Battery supported by its scoring manual, being 27% (30) of the evaluation judged by a blind specialist evaluator, concordance coefficient higher than 75%.

Analysis of the data

The data were analyzed using the SPSS statistical software, version 17.0, for Windows. For the performance comparison among the nine groups, we used the two-way analysis of variance test, with Bonferroni post hoc ($p \leq 0.05$).

RESULTS

Table 2 has the means and standard deviations obtained by the participants in each MAC-PT Battery according to age and school education.

In general, it is observed that the participants with low school education have underperformed in the MAC-PT Battery when compared to those with high education. The same happens with the elderly, among which a decrease in performance is observed in relation to young adults. Table 3 shows the effect of the variables of age and school education on the tasks of the MAC-PT Battery.

An effect of school education was observed on 12 of the 16 scores regarding the analyzed tasks (orthographic verbal fluency, free verbal fluency, semantic judgment, production of emotional prosody, comprehension of linguistic prosody, repetition prosody, interpretation of metaphors, interpretation of speech acts, narrative speech — partial and full recount and questions).

The biological age factor seems to have less influence on the performance of the sample, being present in only six scores (emotional prosody — comprehension and repetition, linguistic prosody — comprehension and repetition, interpretation of metaphors, and conversational speech). It was observed in only one age versus school education interaction — in the semantic

verbal fluency task —, indicating that there was a higher effect of education in the group of younger adults with a peak in the intermediate range of education, while for the elderly the peak was given after 14 years of study. Table 4 presents the post hoc analysis that compares the scores of the three age groups and the three school education groups.

The performance of the participants with low education was found to be worse than those with intermediate to high education in most tasks. The individuals with intermediate education differ from those with high education in only one task of lexical recall with spelling criterion.

Age influences in an important way the scoring of individuals in tasks of the MAC-PT Battery (Table 4). This influence occurs mainly when comparing the age group of young adults (18–40 years) with the group of elderly adults (65–80 years), that is, extreme groups.

DISCUSSION

This study aimed at investigating the role of individual factors of age and sociocultural school education from the comparison of base groups for the generation of normative data of the MAC-PT Battery for the Portuguese population. As well as in other studies, the results showed that the communicative tasks were discriminating to the variables of school education and age, considering the effect of education is more frequent than the effect of age[10,12,19]. These similarities between studies carried out in different languages allow important translinguistic studies.

As for education, the subjects with more than one year of study had better performance, in most tasks of the MAC-PT Battery, than those with lower education. Thus, the lower the education level, the worse the performance in communicative tasks. These findings are consistent with the hypothesis that education increases the level of acquired knowledge of the individuals, promotes greater maturation of brain structures, and, hence, improves language skills[20].

Regarding the effect of age, the difference between the age groups was less evident, showing that this factor influences the performance of participants to a lesser extent, at least until the age range limit of 80 years. This happens because the human brain is able to adapt to aging keeping the functionality of its processing throughout the years, even when there are adaptive changes[21]. However, age seems to influence the scoring of individuals evaluated by the MAC-PT Battery, to the extent that the groups with elder adults had lower scores in relation to the other groups in the task forming the pragmatic-inferential, discursive, and, especially, the prosodic processing. The age factor in the performance of cognitive behavioral tasks has been drawing the interest from the scientific community, considering that some authors observed a decline in the performance of elder adult subjects[22,23], whereas other researchers argued that the execution of many functions is kept stable or improves, as language itself[24].

From the 16 variables analyzed in the MAC-PT Battery, a school education versus age interaction was evidenced in only one of them (semantic verbal fluency). This indicates that for

most of the evaluated subtests, education and age represent relatively independent factors[10]. This reinforces the hypothesis that such variables represent better performance of the MAC-PT Battery when analyzed independently.

The patterns verified in this study, regarding age end education, were similar to those present in the original instrument Protocole MEC[12], in the Montreal Communication Evaluation Battery (MAC-BR)[13], and in the short version of the Montreal Communication Evaluation Battery (MAC-Brief Battery)[19], showing that the population of Portugal, as well as the one from Canada and Brazil, perform language tasks in a different way according to their age and education level and indicate that the education variable influences more the other communicative processing evaluated by the instruments mentioned than the age variable, at least in a sample of individuals aged up to 80 years.

Table 2. Means and standard deviations in the 16 scores regarding the tasks in the Montreal Communication Evaluation Battery, Portuguese version

School education (years)	Groups								
	18–40 years			41–64 years			65–80 years		
	4–9 (n=10)	10–13 (n=10)	≥14 (n=10)	4–9 (n=10)	10–13 (n=10)	≥14 (n=10)	4–9 (n=10)	10–13 (n=10)	≥14 (n=10)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Verbal fluency with orthographic criterion	19.4 (8.53)	22.5 (8.61)	25.5 (8.37)	19.1 (9.24)	20.7 (8.50)	24.6 (7.90)	17.5 (5.19)	17.9 (6.57)	25.8 (5.35)
Verbal fluency with semantic criterion	23.1 (6.21)	34.5 (10.00)	27.0 (4.22)	26.1 (11.14)	29.9 (5.97)	33.2 (7.47)	23.4 (3.89)	22.6 (7.28)	29.3 (5.50)
Free verbal fluency	42.8 (18.83)	69.2 (21.33)	54.1 (9.61)	40.6 (17.51)	60.6 (15.19)	59.4 (18.37)	40.3 (9.68)	42.2 (24.70)	59.1 (16.67)
Semantic judgment / MS 12	10.1 (1.79)	10.3 (1.25)	11.5 (1.08)	9.9 (1.10)	9.9 (1.10)	11.5 (0.71)	10.2 (1.55)	10.6 (1.07)	11.2 (0.92)
Emotional prosody – comprehension/ MS12	10.9 (1.60)	10.9 (1.29)	11.3 (0.82)	10.4 (0.84)	11.3 (1.06)	10.7 (0.95)	8.9 (1.60)	9.8 (2.3)	10.4 (0.70)
Emotional prosody – repetition/MS 12	11.9 (0.32)	11.3 (1.06)	11.8 (0.42)	11.7 (0.95)	11.9 (0.32)	11.7 (0.48)	10.6 (2.17)	10.9 (1.60)	10.9 (0.99)
Emotional prosody – production	15.1 (1.85)	15.6 (2.41)	18.0 (0.00)	13.5 (4.35)	16.1 (1.29)	16.0 (2.11)	16.3 (1.95)	15.5 (1.90)	16.2 (3.33)
Comprehension of linguistic prosody / MS 12	10.1 (1.73)	11.4 (0.70)	11.6 (0.52)	9.1 (2.51)	11.0 (1.05)	11 (1.05)	8.3 (0.95)	10.1 (1.29)	11.4 (0.52)
Repetition of linguistic prosody/ MS 12	11.8 (0.42)	11.7 (0.95)	12.0 (0.00)	11.2 (0.79)	12.0 (0.00)	11.8 (1.03)	10 (2.05)	11.7 (0.67)	11.5 (0.97)
Interpretation of metaphors /MS 40	33.3 (3.06)	34.7 (2.91)	35.6 (2.46)	28.7 (5.01)	34.9 (2.96)	36.8 (1.40)	29 (3.06)	31.7 (4.99)	34.3 (2.67)
Explanation of Interpretation of acts of speech /MS 40	18.3 (2.45)	18.8 (1.23)	18.7 (0.95)	17.9 (2.51)	18.6 (0.97)	18.3 (1.16)	17.1 (2.28)	18.2 (1.14)	19.4 (3.41)
Conversational speech /MS 40	32.7 (0.95)	33.9 (0.32)	33.9 (0.32)	33.9 (0.32)	34.0 (0.00)	33.5 (0.71)	32.5 (2.01)	31.8 (2.90)	33.1 (1.29)
Narrative speech: partial recount, informations present /MS 29	19.8 (4.39)	21.5 (3.31)	21.5 (2.59)	16.9 (4.23)	20.3 (3.95)	21 (3.06)	16.2 (5.12)	18 (4.47)	22.2 (3.26)
Narrative speech: partial recount, essential information /MS 18	14 (2.79)	15.5 (2.59)	15.7 (1.49)	12.1 (3.38)	15.9 (2.18)	16 (1.41)	12.8 (3.61)	14.4 (2.95)	16.7 (1.25)
Narrative speech: full recount /MS 13	7.7 (3.3)	10.1 (1.45)	10.1 (2.6)	6.8 (2.86)	10.1 (1.91)	11.1 (1.97)	6.6 (2.67)	9.7 (2.5)	10.7 (2.31)
Narrative speech: comprehension questions /MS 12	11.6 (0.7)	11.9 (0.32)	11.9 (0.32)	10.9 (1.37)	11.5 (0.85)	11.9 (0.32)	11.1 (1.2)	11.5 (0.85)	11.7 (0.48)

Caption: SD = standard deviation; MS = maximum score of the task

Table 3. Effect of the variables of age and school education on the tasks of the Montreal Communication Evaluation Battery, Portuguese version

	Age		School education		Interaction age x school education	
	F	p-value	F	p-value	F	p-value
Verbal fluency with orthographic criterion	0.538	0.586	5.983	0.004	0.303	0.875
Verbal fluency with semantic criterion	3.199	0.046	5.309	0.007	3.048	0.022
Free verbal fluency	1.797	0.172	8.563	<0.001	2.380	0.058
Semantic judgment	0.324	0.724	10.523	<0.001	0.437	0.781
Emotional prosody – comprehension	8.592	<0.001	2.586	0.082	1.061	0.381
Emotional prosody – repetition	7.014	0.002	0.064	0.938	0.575	0.682
Emotional prosody – production	1.503	0.229	4.016	0.022	2.054	0.094
Linguistic prosody – comprehension	5.486	0.006	22.996	0.000	1.277	0.286
Linguistic prosody repetition	5.233	0.007	6.592	0.002	2.390	0.058
Interpretation of metaphors	5.609	0.005	18.89	<0.001	2.272	0.069
Interpretation of acts of speech	0.761	0.470	3.285	0.042	1.499	0.210
Conversational speech	8.355	0.001	0.936	0.396	2.302	0.066
Narrative speech: partial recount, informations present	2.394	0.098	7.722	0.001	1.166	0.332
Narrative speech: partial recount, essential informations	0.269	0.765	12.408	0.000	1.247	0.298
Narrative speech: full recount	0.168	0.846	18.269	<0.001	0.456	0.768
Narrative speech: comprehension questions	2.094	0.130	4.898	0.010	0.485	0.747

Caption: F = F-statistics

Table 4. Comparison of the scores between age range and school education groups

	Age (years)			School education (years)		
	18–40 *versus* 41–64	18–40 *versus* 65–80	41–64 *versus* 65–80	4–9 *versus* 10–13	4–9 *versus* 14+	10–13 *versus* 14+
Verbal fluency with orthographic criterion	ns	ns	ns	ns	4–9<14+ (p≤0.01)	10–13<14+ (p≤0.05)
Verbal fluency with semantic criterion	ns	ns	ns	4–9<10–13 (p≤0.05)	4–9<14+ (p≤0.05)	ns
Free verbal fluency	ns	ns	ns	4–9<10–13 (p≤0.01)	4–9<14+ (p≤0.01)	ns
Semantic judgment	ns	ns	ns	ns	ns	ns
Emotional prosody – comprehension	ns	18–40>65–80 (p≤0.001)	41–64>65–80 (p≤0.05)	ns	ns	ns
Emotional prosody – repetition	ns	18–40>65–80 (p≤0.05)	41–64>65–80 (p≤0.05)	ns	ns	ns
Emotional prosody – production	ns	ns	ns	ns	4–9<14+ (p≤0.05)	ns
Linguistic prosody – comprehension	ns	18–40>65–80 (p≤0.05)	ns	4–9<10–13 (p≤0.001)	4–9<14+ (p≤0.001)	ns
Linguistic prosody – repetition	ns	18–40>65–80 (p≤0.05)	ns	4–9<10–13 (p≤0.01)	4–9<14+ (p≤0.01)	ns
Interpretation of metaphors – explanation	ns	18–40>65–80 (p≤0.05)	ns	4–9<10–13 (p≤0.001)	4–9<14+ (p≤0.001)	ns
Interpretation of acts of speech – explanation	ns	ns	ns	ns	ns	ns
Conversational speech	ns	18–40>65–80 (p≤0.05)	41–64>65–80 (p≤0.001)	ns	ns	ns
Narrative speech: partial recount, informations present	ns	ns	ns	ns	4–9<14+ (p≤0.001)	ns
Narrative speech: partial recount, essential information	ns	ns	ns	4–9<10–13 (p≤0.01)	4–9<14+ (p≤0.001)	ns
Narrative speech: full recount	ns	ns	ns	4–9<10–13 (p≤0.001)	4–9<14+ (p≤0.001)	ns
Narrative speech: comprehension of questions	ns	ns	ns	ns	4–9<14+ (p≤0.01)	ns

Caption: ns = not significant

The size of the sample and the absence of analysis of the gender variable may have limited our results. Some standardization studies of neuropsychological instruments consider that the gender variable influences the performance[25], while other researches show no significant differences[13]. This way, the influence of gender on the performing of cognitive and language tasks is not a consensus in literature. Besides that, the use of the Geriatric Depression Scale in youngsters and adults may limit the results, once that it is indicated for the elderly population. However, it is important to note that there is no valid tracking instrument for these populations.

The MAC-PT Battery came to fill a gap in the evaluation of patient speakers of European Portuguese. This fact makes MAC-PT an instrument capable of providing clear directions in the evaluation process, being easy to apply and analyze.

CONCLUSION

This study allows us to verify the influence of school education in the performance of most tasks in the MAC-PT Battery, considering that the difference in the performance between age range groups was less evident when compared to the effect of education. This way, school education and age must be considered in the evaluation of neurological patients, avoiding false-positive or false-negative results.

ACKNOWLEDGMENTS

REFERENCES

1. Gindri G, Pagliarin KC, Casarin FS, Branco LD, Ferré P, Joanettes Y, et al. Rehabilitation of discourse impairments after acquired brain injury. Dement Neuropsychol. 2014;8(1):58-65.
2. Bhatnagar SC, Mandybur GT, Buckingham HW, Andy OJ. Language representation in the human brain: evidence from cortical mapping. Brain Lang. 2000;74(2):238-59.
3. Tompkins CA. Rehabilitation for cognitive-communication disorders in right hemisphere brain damage. Arch Phys Med Rehabil. 2012;93(1 Suppl):S61-9.
4. Cote H, Payer M, Giroux F, Joanette Y. Towards a description of clinical communication impairment profiles following right-hemisphere damage. Aphasiology. 2007;21(6-8):739-49.
5. Myers PS. Right hemisphere damage: disorders of communication and cognition. San Diego: Singular Pub; 1999.
6. Batchelor S, Thompson EO, Miller LA. Retrograde memory after unilateral stroke. Cortex. 2008;44(2):170-8.
7. Witteman J, Goerlich-Dobre KS, Martens S, Aleman A, Van Heuven VJ, Schiller NO. The nature of hemispheric specialization for prosody perception. Cogn Affect Behav Neurosci. 2014;14(3):1104-14.
8. Tompkins, CA, Klepousniotou E, Scott AG. Nature and assessment of right hemisphere disorders. In: Papathanasiou I, Coppens P, Potagas C, editors. Aphasia and related neurogenic communication disorders. Burlington: Jones & Bartlett Learning; 2012.
9. Lezak MD. Neuropsychological Assessment. New York: Oxford University Press; 2012.
10. Pagliarin KC, Ortiz KZ, Parente MAMP, Nespoulous J-L, Joanette Y, Fonseca RP. Individual and sociocultural influences on language processing as assessed by the MTL-BR Battery. Aphasiology. 2014;28(10):1244-57.
11. Mackenzie C, Brady M. Communication difficulties following right-hemisphere stroke: applying evidence to clinical management. Evid Based Commun Assess Interv. 2008;2(4):235-47.
12. Joanette Y, Ska B, Côté H. Protocole MEC: Protocole Montreál d'Évaluation de la Communication. Montréal: Ortho Édition; 2004.
13. Fonseca RP, Parente, MAMP, Côté H, Ska B, Joanette Y, Ferreira GD. Bateria Montreal de Avaliação da Comunicação: Bateria MAC. Barueri: Pró-Fono; 2008.
14. Atalaia-Silva KC, Lourenço, RA. Tradução, adaptação e validação de construto do Teste do Relógio aplicado entre idosos no Brasil. Rev Saúde Pública. 2008;42(5):930-7.
15. Guerreiro M, Silva AP, Botelho A, Leitão O, Castro-Caldas A, Garcia C. Adaptação à população portuguesa da tradução do Mini Mental State Examination (MMSE). Rev Port Neurol. 1994;1:9-10.
16. Yesavage JA, Brink TI, Rose TL, Lum O, Huang V, Adev M, et al. Development and validation of a geriatric depression screening scale. J Psychiatr Res. 1982-1983;17(1):37-49.
17. Fonseca RP, Zimmermann N, Oliveira CR, Gindri G, Pawlowski J, Scherer LC, et al. Métodos em avaliação neuropsicológica: pressupostos gerais, neurocognitivos, neuropsicolinguísticos e psicométricos no uso e desenvolvimento de instrumentos. In: Fukushima SS, organizador. Métodos em Psicobiologia, Neurociências e Comportamento. São Paulo: ANPEPP; 2012.
18. Kerr MS. Adaptação da Bateria Montreal de Avaliação da Comunicação para o Português Europeu [dissertação]. Lisboa: Universidade Católica Portuguesa; 2012.
19. Casarin FS, Scherer LC, Parente MAMP, Ferré P, Côté H, Ska B, et al. Bateria Montreal de Avaliação da Comunicação, versão abreviada: Bateria MAC Breve. São Paulo: Pró-Fono; 2014.
20. Parente MAMP, Scherer LC, Zimmermann N, Fonseca RP. Evidências do papel da escolaridade na organização cerebral. Rev Neuropsicol Latinoamer. 2009;1(1):72-80.
21. Fonseca RP, Ska B, Scherer LC, Oliveira CR, Parente MAMP, Joanette Y. Mudanças no processamento cognitivo em adultos idosos: déficits ou estratégias adaptativas? Estud Interdiscipl Envelhec. 2009;14(1):13-24.
22. Mammarella N, Fairfield B. Where did I put my keys: a "we" intervention to promote memory in healthy older adults: a controlled pilot study. Gerontology. 2013;59(4):349-54.
23. Mahoney JR, Verghese J, Dumas K, Wang C, Holtzer. The effect of multisensory cues on attention in aging. Brain Res. 2012;1472:63-73.
24. Dennis NA, Kim H, Cabeza R. Age-related differences in brain activity during true and false memory retrieval. J Cognit Neurosci. 2008;20(8):1390-402.
25. Collie A, Shafiq-Antonacci R, Maruff P, Tyler P, Currie J. Norms and the effects of demographic variables on a neuropsychological battery for use in healthy ageing Australian populations. Aust N Z J Psychiatry. 1999;33(4):568-75.