

Phonemic and Semantic Verbal Fluency Tasks: Normative Data for Elderly Brazilians

Fluência Verbal Fonêmica e Semântica: Dados Normativos de Idosos Brasileiros

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Abstract

This study aims to investigate the influence of sociodemographic characteristics on the performance of older people on two tasks of verbal fluency and provide normative data for a Brazilian population of healthy elderly individuals with different educational levels. The initial sample included 521 individuals aged from 60 years, participating in the Program Family Health Strategy. Participants who had scores suggestive of cognitive decline on the Mini-Mental State Examination, depressive symptoms in Geriatric Depression Scale and self-reported neurological or psychiatric disorders were excluded. The final sample consisted of 218 participants in phonemic verbal fluency task (letters F, A and S) and 265 participants for semantic verbal fluency task (animals). The performance in both tests was associated with age and education, but not with sex. Still, the education variable was shown to have a greater impact on scores in phonemic and semantic tests than age in both forms of evocation. The results of this study suggest the importance of providing normative data for elderly Brazilians appropriate to age and education on verbal fluency tasks.

Keywords: Verbal fluency, normative data, elderly.

Resumo

Este estudo buscou investigar a influência de características sociodemográficas no desempenho de idosos em duas tarefas de fluência verbal, além de fornecer dados normativos de referência nessas tarefas, conforme níveis de educação, para a população brasileira de idosos saudáveis. A amostra inicial incluiu 521 idosos com idade a partir de 60 anos, participantes do Programa Estratégia Saúde na Família. Foram excluídos os participantes que tinham pontuações sugestivas de declínio cognitivo no Mini Exame do Estado Mental, de sintomas depressivos na Escala de Depressão Geriátrica e com autorrelato de doenças neurológicas ou de distúrbios psiquiátricos. A amostra final foi composta por 218 participantes que responderam à tarefa de fluência verbal fonêmica (letras F, A e S) e 265 que responderam à tarefa semântica (animais). O desempenho em ambas as tarefas foi associado à idade e aos anos de ensino formal, mas não ao sexo. Ainda, a variável escolaridade mostrou ter um impacto maior no desempenho de fluência verbal do que a idade em ambas as modalidades de evocação. Os resultados desse estudo sugerem a importância de oferecer dados normativos de idosos brasileiros, adequados à idade e à escolaridade, em tarefas de fluência verbal.

Palavras-chave: Fluência verbal, dados normativos, idosos.

The verbal fluency tasks are frequently used to evaluate cognitive changes, characterize the performance profiles in healthy aging and in neurodegenerative diseases (Di Biasio et al., 2012; Martyr et al., 2012). Fast and easy to administer,

these tasks can be managed individually or as being present in some assessment protocols (Dubois, Slachevsky, Litvan, & Pillon, 2000; Fillenbaum et al., 2008). In general, the patient must evoke the greatest possible number of words

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in accordance with a predetermined rule. There are three types of verbal fluency tasks: free (no predetermined criterion to evoke words), phonemic (words must start with a certain letter) and semantic (words must correspond to a particular semantic field). Although the purpose of the activities is the same (evoking words), patients may present different performances according to the modality used and the type of stimulus chosen (Beausoleil, Monetta, Leblanc, & Joannette, 2001), since there are less frequent words that begin with specific letter (letter B *versus* X), as well as more restricted semantic fields (food *versus* color). In addition, sociodemographic characteristics, such as age and education, have been reported as variables that influence performance in both modalities (Bolla, Gray, Resnick, Galante, & Kawas, 1998; Brucki & Rocha, 2004; Carnero, Lendínez, Maestre, & Zunzunegui, 1999; Kempler, Teng, Dick, Taussig, & Davis, 1998; Silva, Yassuda, Guimarães, & Florindo, 2011). Other authors also point to the contribution of gender (Kempler et al., 1998; Silva et al., 2011).

Some studies suggest that the performance in verbal fluency modalities is a result of different cognitive functions that are activated during the task. In phonemic fluency were evaluated primarily production and language fluency skills, while in semantic verbal fluency observed semantic memory skills (Peña-Casanova et al., 2009). However, both forms are associated with executive functions (Schlindwein-Zanini, 2010), since they require self-regulation, working memory, processing speed and organization (Magila & Caramelli, 2001). Functional neuroimaging studies highlight an increased activation of the frontal cortex to the evocation of words with phonemic criteria, while the temporal cortex is related to the recall of words with semantic criteria. Moreover, in both modes there is greater involvement of the left hemisphere (Gourovitch et al., 2000).

During the aging process, many factors can influence the performance of cognitive skills. The verbal abilities (e.g., syntactic production), however, remain preserved with normal aging. Nevertheless, there is a perceived difficulty with advancing age in activities that relate language and memory (Parente, Saboskinsk, Ferreira, & Nespoulous, 1999). Thus verbal fluency tasks are used as identifiers of early cognitive decline (Chaves et al., 2011; Silva et al., 2011). Verbal fluency tests are considered primarily as screening tools able to identify early cases of brain deterioration. The verbal fluency appears altered in multiple pathological processes such as Alzheimer's dementia or frontotemporal dementia, in the left or bilateral frontal lesions, and in psychiatric disorders such as schizophrenia and depression (Rodrigues, Yamashita, & Chiappetta, 2008). Therefore this study aims to investigate the influence of sociodemographic characteristics on the performance of older people on two tasks of verbal fluency (phonemic and semantic) and provide normative data for a Brazilian population

of healthy elderly individuals with different educational levels.

Method

Participants

The initial sample included 521 older adults, aged from 60 years, participants of the Family Health Strategy Program (FHSP; Gomes et al., 2013) in Porto Alegre, RS, Brazil. The FHSP randomly selected elderly residents of East/Northeast and Parthenon/Lomba do Pinheiro MD (evaluated by neurologists, psychiatrists, psychologists and nutritional experts). We excluded participants who had scores suggestive of cognitive decline in Mini Mental State Examination (MMSE) according to the cutoff points for education, scores ≥ 7 at the Geriatric Depression Scale of 15 points (GDS-15), and self-reported diseases neurological or psychiatric disorders. In the sample for the FAS verbal fluency, illiterate participants were not included. The final sample consisted of 218 participants in phonemic verbal fluency task and 265 participants for semantic verbal fluency task. Other sociodemographic informations of the participants are shown in Table 1.

Procedures and Instruments

After signing the informed consent form (research protocol approved – 10/04967), participants were evaluated in a session of approximately 90 minutes duration. The older adults completed the sociodemographic and health questionnaire, MMSE, GDS-15, and two tasks of verbal fluency: phonemic modality and semantic modality.

In phonemic modality used the FAS verbal fluency task (Benton & Hamsher, 1976) which consists in evoking words that begin with the letters “F”, “A” and “S”, for a total of three minutes, one minute for each letter. The final score refers to the sum of correct words spoken in each letter (Strauss, Sherman, & Spreen, 2006). In semantic modality used the Animals verbal fluency task, which refers to evoke the greatest possible number of animals within 60 seconds. The total score refers to the number of animals cited correctly (Strauss et al., 2006).

The evaluations were conducted by students and professionals in the health field such as medicine, psychology and speech therapy, trained for administration tasks. Corrections of tests were performed by a professional who did not participate in the data collection stage.

Data Analysis

Data were analyzed descriptively and inferentially. We used a multiple linear regression analysis with step-wise variable selection to assess the participation of the variables age, education and gender on performance in both verbal fluency tasks. The dependent variables presented a normal distribution in the Kolmogorov-Smirnov Test ($p \geq .05$). To compare the performance between age groups and gender on verbal fluency tasks, FAS and

Animals, we used the Student *t* Test for independent samples. To compare the schooling groups in semantic verbal fluency task we use the One Way ANOVA analysis with Scheffe *post hoc* test. This same procedure was used to analyze the performance of different age groups distributed across schooling groups. Results were considered significant when $p \leq .05$. The statistical package used was the Statistical Package for the Social Sciences (SPSS) version 17.

Results

Table 1 presents the mean age, education, MMSE and GDS-15 scores of participant samples of verbal fluency tasks. Regarding the distribution of gender, 139 (64%) were women and 79 (36%) were men among the participants who answered the FAS task. In the Animals task distribution was 164 (62%) and 101 (38%), respectively.

Table 1
Description of Sociodemographic and Clinical Data of the Participants

	FAS (<i>n</i> = 218)		Animals (<i>n</i> = 265)	
	Mean	SD	Mean	SD
Age (years)	67.75	±5.93	68.35	±6.11
Education (years)	4.53	±1.93	3.82	±2.35
GDS-15	2.67	±1.64	2.70	±1.63
MMSE	25.56	±3.06	24.55	±3.84
Marital state				
Single (%)	33 (15.14%)		42 (16.98%)	
Married (%)	82 (37.61%)		100 (37.74%)	
Widower (%)	64 (29.36%)		78 (29.43%)	
Divorced (%)	37 (16.97%)		41 (15.47%)	
NR (%)	2 (.92%)		4 (.38%)	
Present occupation				
Retired (%)	94 (43.12%)		120 (45.28%)	
Formal work (%)	119 (54.59%)		139 (52.45%)	
NR (%)	5 (2.29%)		6 (2.27%)	
Socioeconomical state				
Up to 1 minimum wage (%)	63 (28.90%)		85 (32.08%)	
Up to 3 minimum wage (%)	103 (47.25%)		126 (47.55%)	
Greater than or equal to 6 minimum wage (%)	17 (7.80%)		17 (6.42%)	
NR (%)	35 (16.05%)		37 (13.95%)	

Note. NR = Not respond.

Table 2
Multiple Linear Regression Analysis for the Variables Education, Age and Gender on Verbal Fluency Tasks

	FAS			Animals		
	B±SE	β	R ²	B±SE	β	R ²
Age (years)	-.26±.10	-.17	.026**	-.09±.04	-.13	.014***
Education (years)	1.36±.30	.30	.800*	.36±.10	.22	.042*
Gender	-.97±1.26	-.05	.004	.00±.50	.00	.004

Note. B = Regression coefficient; SE = Standard error; β = Standardized regression coefficient; R² = variance explained.

* = $p \leq .001$; ** = $p \leq .01$; *** = $p \leq .05$.

Table 2 shows stepwise multiple regression analysis. According to the model investigated, the variables age and education demonstrate a significant contribution to performance in both verbal fluency tasks, and the number of years studied got greater influence than the age variable. However, the gender variable showed no significant influence.

Comparisons between age groups, education and gender are presented in Table 3. According to analyzes for the FAS task, the elderly group aged 60-69 had significantly higher performance at age ≥ 70 . The group with more years of schooling achieved better results than those participants who studied only between 1 and 4 years of formal educa-

tion. No significant statistical differences were observed in relation to gender.

In the Animals task, there were no significant differences between age groups and gender. However, the illiterate participants demonstrated significantly lower scores than participants who had between 1-4 ($p \leq .001$) and 5-8 ($p \leq .001$) years of formal education.

Finally, in Table 4 sets out the normative data according to age groups and distributed as years of formal education. According to the ANOVA analysis significant differences are observed when comparing the groups on both tasks verbal fluency.

Table 3

Comparison of Performance on Verbal Fluency Tasks according to Age, Education and Gender Groups

	FAS				Animals				
	Mean±SD	n	F	p	Mean±SD	n	F	p	
Age (years)									
60-69	21.48±8.63	141	.31	.03	11.42±4.14	163	2.27	.09	
≥ 70	18.79±9.20	77			10.56±3.60	102			
Education (years)									
Illiterate	-	-	4.40	≤.001	8.50±2.79	30	19.52	≤.001	
1-4	18.06±9.24	108			11.40±4.16	125			
5-8	22.95±7.88	110			11.44±3.75	110			
Gender									
Masculine	21.15±9.12	79	.14	.44	11.09±4.51	101	2.69	.99	
Feminine	20.18±8.80	139			11.09±3.59	164			

Note. Bold indicates significant values.

Table 4

Normative Data according to Age Group and Distributed by Schooling

	FAS					Animals				
	60-69		≥70		Illit.	60-69		≥70		Illit.
	1-4	5-8	1-4	5-8		1-4	5-8	1-4	5-8	
Mean	19.58	23.20	15.59	22.44	8.77	11.76	11.53	8.29	10.84	11.25
SD	±9.37	±7.55	±8.57	±8.60	±3.09	±4.50	±3.78	±2.62	±3.56	±3.71
Percentil 5	6.00	10.00	2.20	9.00	3.00	5.00	6.00	1.00	5.00	4.00
N	67	74	41	36	13	76	74	17	49	36

Discussion

The objective of this study was to investigate the effect of varying age, years of education and gender on performance on two tasks of verbal fluency (FAS and Animals) in Brazilian elderly population neurologically

preserved. From these data, we intended to present normative data adjusted for variables that were influential in the scores of these tasks.

In this study, the performance in both tests was associated with age and education, but not with sex. Still, the education variable was shown to have a greater

impact on scores in phonemic and semantic tests than age, suggesting that the number of years of education predicts better results, like the lower the age. These results are similar to other studies that did not find association between gender and the number of words generated, but the influence of age and education (Amaral-Carvalho & Caramelli, 2012; Munro et al., 2012; Ryu et al., 2012; Snitz et al., 2009; Venegas & Mansur, 2011).

The influence of education in the maintenance of cognitive abilities has received increasing attention (Meijer, van Boxtel, Van Gerven, van Hooren, & Jolles, 2009; Santos et al., 2012; Strout & Howard, 2012). This is due to the fact that the number of years of study could be a factor of cognitive reserve (Stern, 2009, 2012). According to the hypothesis of cognitive reserve activities such as reading, writing, learning languages, physical activity and recreation, for example, help to decrease the decline of cognitive functions. Thus, this could explain how some patients with sequel brain would show good results (Beausoleil, Fortin, Le Blanc, & Joannette, 2003).

However, Zahodne et al. (2011), through a longitudinal study, found that number of years of education influence performance on cognitive tasks, especially verbal fluency, but not related to the changes over the years in any cognitive domain (verbal processing speed, working memory, verbal fluency and verbal episodic memory). That is, the years of study are related to performance, but not with cognitive decline. Thus, individuals with higher education levels continue to show better cognitive performance than people with the same age and with less education, but decline at similar rates.

Regarding age, there is controversy between the results that combine the best results in cognitive abilities. Studies show that age is not a predictor of performance on tests of verbal fluency (Brucki & Rocha, 2004; Venegas & Mansur, 2011). In contrast, Amaral-Carvalho and Caramelli (2012) found an association between age and performance of verbal fluency tasks, as well as the results of other studies (Ryu et al., 2012; Silva et al., 2011; Snitz et al., 2009) corroborate the idea that the greater the age of the person, the smaller the words production of animals.

The difference in the effect of age on verbal fluency tasks may have occurred because the categorical and semantics modalities activate different brain regions (Ryu et al., 2012). Robinson, Shallice, Bozzali and Cipolotti (2012) investigated how the frontal cortex behaves in different fluency tasks (verbal, drawings, gestures, for example) with neurological patients (tumor and stroke). In verbal fluency tasks observed that both types of verbal fluency activates the frontal lobe, although the phonemic task was more specific in differentiating patients with frontal lesions of posterior lesions. This may have occurred because of the phonological modality requiring the creation of search strategies of words from a letter, making this task unusual and less automated search, resulting in increased activation of the frontal lobe (Rodrigues et al., 2008).

The results of this study demonstrate its importance in that it presents normative data on two tasks widely used in clinical practice and research to the cognitive assessment of older adults. Moreover, the performance standards that have been presented are appropriate for comparing clinical populations, since they were not included elderly with cognitive decline and depressive symptoms in the sample. A limitation of this study can highlight the lack of seniors with more years of schooling and the division of the sample into smaller age ranges.

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