UNIVERSITAS PSYCHOLOGICA Univ. Psychol. 13(1). 2014. Bogotá, Colombia. ISSN: 1657-9267 / EISSN: 2011-2777

Cognitive Development across Different Age Ranges in Late Adulthood

Irani Lima Argimon / Tatiana Quarti Irigaray
Lilian Milnitsky Stein

doi:10.11144/Javeriana.UPSY13-1.cdad

Para citar este artículo / To cite this article:
Lima Argimon, I., Quarti Irigaray, T., & Milnitsky Stein, L. (2013). Cognitive development across different age ranges in late adulthood. *Universitas Psychologica*, 13(1). doi:10.11144/Javeriana.UPSY13-1.cdad

Publicación preliminar
El comité editorial de *Universitas Psychologica: Panamerican Journal of Psychology* ha evaluado, revisado y aceptado el presente artículo según los criterios de la revista y siguiendo el proceso de revisión doble ciego por pares académicos externos. De la misma forma, este artículo ha iniciado el proceso de edición y la presente versión ya cuenta con la revisión de estilo final con la que aparecerá en la versión electrónica, faltando únicamente el proceso de diagramación.
Con miras a facilitar y agilizar el proceso de publicación de los contenidos de la revista, el presente artículo se publica de forma anticipada. En este punto, puede ser utilizado para su lectura, consulta, citación o distribución y deberá ser citado tal como aparece a continuación.
Finalmente, tenga en cuenta que la versión electrónica final reemplazará esta versión del archivo y se actualizarán los metadatos asociados al mismo en los diferentes sistemas de información.

Online First
The Editorial Board of *Universitas Psychologica: Panamerican Journal of Psychology* has evaluated, reviewed and accepted the article herein in accordance with the establised criteria and by means of double-blind peer review performed by external scholars. This article has likewise started the editing process. The following version has been object of copyediting; layout and proofreading are the only pending processes.
This journal makes use of Online First procedures in order to ease and fasten content release. This version can be used for reading, documentation, citing and distribution purposes, and should be cited as indicated.
Please regard this as a preliminary document that will be replaced by the final version in due time. All metadata sets related to this contribution will be updated in every applicable index and abstract service.

Cognitive Development across Different Age Ranges in Late Adulthood*

Desarrollo cognitivo de personas mayores en diferentes grupos de edad

Recibido: mayo 10 de 2012 | Revisado: enero 13 de 2013 | Aceptado: abril 27 de 2013

Irani Lima Argimon**

Tatiana Quarti Irigaray***

Lilian Milnitsky Stein****

Pontificia Universidade Católica do Rio Grande do Sul, Brasil

Para citar este artículo: Lima Argimon, I., Quarti Irigaray, T., & Milnitsky Stein, L. (2013). Cognitive development across different age ranges in late adulthood. *Universitas Psychologica, 13*(1). doi:10.11144/Javeriana.UPSY13-1.cdad

Abstract

This study sought to assess the cognitive development of older adults in different age groups, examining subjective perception of memory, verbal fluency, orientation in time and space, memory, and attention. The sample consisted of 121 subjects randomly selected, between the ages of 60 and 95 years, of both sexes and with varied educational attainment, took part in the study. Data were collected with a sociodemographic questionnaire, the Geriatric Depression Scale (GDS), the subjective Memory Complaint Questionnaire (MAC-Q), the Mini-Mental State Examination (MMSE), the Digit Span subtest of the Wechsler Adult Intelligence Scale, Revised (WAIS-R), the Buschke Selective Reminding Test, and a category verbal fluency test (animals). Results showed an

---

* Research support by CNPq

**Graduate Teacher and Postgraduate (PUCRS). Pontificia Universidade Católica do Rio Grande do Sul, Brasil. E-mail: argimoni@pucrs.br

*** Collaborative Teacher in Postgraduate in Psychology, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). E-mail: tatiana.irigaray@superig.com.br

**** Titular Professor in Postgraduate programm in Psicologia, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). E-mail: lilian@pucrs.br

inverse correlation between subjective perception of memory complaints and cognitive test performance. Age and educational attainment influenced cognitive test performance. Younger subjects and those with a higher educational attainment scored better on the verbal fluency test, MMSE, and digit span.
Key words authors: Cognition, aged, subjective perception of memory, memory, attention, executive function.

Resumen

El actual estudio tiene como objetivo verificar el desarrollo cognitivo de las personas mayores en los diversas grupos de edad, examinando memoria, fluidez verbal, orientación secular y de espacio, memoria y atención subjetiva. Participaron en la muestra 121 personas mayores, seleccionadas aleatoriamente, entre 60 y 95 años, de ambos sexos y escolaridad variada. Para la recolección de los datos se utilizó un cuestionario sociodemográfico, Escala de Depressão Geriátrica (GDS), el cuestionario de quejas subjetivas de Memória (MAC-Q), Mini-Examinación de Estado mental (MEEM), la Secundario-prueba Span de Números (WAIS-R), la prueba libre del mandato selectivo y con las pistas (Buschke) y la fluidez verbal (categoría animal). Los resultados mostraron una correlación inversa entre la opinión subjetiva de las quejas de la memoria y las pruebas de los cognitivos. La influencia de la edad fue verificada y la escolaridad en las pruebas cognitivas, así, las personas mayores con menos edad y mayor escolaridad presentaron una mejor puntuación en la prueba de fluidez verbal, del MEEM y del palmo de números.
Palabras clave autores: cognitiva, personas mayores, quejas subjetivas de memoria, memoria, atención, función ejecutiva.

Introduction

The human aging process is characterized by bodily changes occurring at the physical and cognitive level, as well as changes in one's subjective perception of these transformations. Change is the core aspect of this process (Parente, 2006). Our current understanding is that the normal cognitive changes of aging may be regarded as gains as well as losses, as, whereas some cognitive skills decline with age, others remain steady and some even improve (Parente & Wagner, 2006).

According to Ribeiro et al. (2010), over the course of the aging process, the decline or stability of different cognitive functions are directly influenced by between-person differences, such as sociodemographic and genetic characteristics, lifestyle, and health. Studies have shown a relationship between age and educational attainment and cognitive performance in older adults. More advanced age and less formal education correlate with poorer cognitive functioning in older adults (Argimon & Stein, 2005; Brito-Marques & Cabral-Filho, 2005; Brucki & Rocha, 2004; Foss, Vale, & Speciali, 2005; Ribeiro et al., 2010).

Specifically with regards to memory function, studies have shown that memory performance declines throughout the aging process; nevertheless, some types of memory are preserved (Argimon & Stein, 2005; Stuart-Hamilton, 2002). Aging is associated with major impairment of working memory, which translates into difficulties in divided attention, affecting information processing rather than working memory itself. These difficulties arise in response to episodic and prospective memory tasks alike. The effects of age on speed of information retrieval and in recall tasks can also be observed. Conversely, recognition and implicit memory performance is preserved. Episodic memory is most affected by age, whereas semantic and procedural memory are affected, but less so (Taussik & Wagner, 2006). To Yassuda (2006), semantic memory is little affected by aging, probably due to uninterrupted experiences with language throughout the life course, which would act as a protective factor against decline.

As mentioned above, there is no uniform decline of all memory systems over the course of the aging process. Studies have demonstrated decline and stability of different systems (Argimon & Stein, 2005; Ribeiro et al., 2010). Malloy-Diniz, Lasmar, Gazinelli, Fuentes, and Salgado (2007) evaluated verbal episodic memory in 223 older adults using the Rey Auditory Verbal Learning Test and found an inverse correlation between age and performance and a positive correlation between educational attainment and performance. In short, the oldest subjects performed worst and those with the highest educational attainment performed best on the verbal episodic memory task. Another study (Ribeiro et al., 2010) assessed the influence of age on cognitive performance in late adulthood with the CERAD battery.

The youngest subjects (aged 60–69) significantly outperformed older subjects in all CERAD tests with the exception of the recognition test, in which there was no between-group difference. Likewise, in Zibetti et al. (2010), the oldest group (subjects aged 76–90) exhibited poorer performance in the working memory, verbal episodic memory, and prospective memory tasks of the Brazilian Brief Neuropsychological Assessment Battery (NEUPSILIN). Fonseca, Zimmermann, Scherer, Parente, and Ska (2010) evaluated differences in episodic memory processing, focused attention, and processing speed between four age groups: young, middle-aged, older, and old-old adults. Results showed between-group differences, with a significant decline in episodic memory, focused attention, and processing speed performance after the age of 60.

Studies show that attention is also sensitive to the aging process (Brucki, 2004; Woodruff-Pak, 1997). Therefore, the elderly would have less efficient search systems and greater difficulty inhibiting irrelevant stimuli (Woodruff-Pak, 1997). Dias et al. (2010) assessed cognitive functioning in older adults with the Mini-Mental State Examination and concluded that the greatest cognitive difficulties involved attention, calculation, and constructional skills. To Brucki (2004), the inability to inhibit irrelevant stimuli would stem from the following aspects: a) the elderly are more easily distracted; b) they store irrelevant information longer; and c) they seem to most easily recall information that had been suggested and forgotten. Likewise, Jurado and Rosselli (2007) argue that inhibition of irrelevant information declines before verbal fluency in late adulthood. This decline will correlate with anatomical changes in the frontal lobe and in connections elsewhere in the brain (Jurado & Rosselli, 2007). Furthermore, older adults performed poorly in divided attention tasks as compared to youth performance. This impairment is believed to reflect a loss of information processing resources (Woodruff-Pak, 1997).

There is broad consensus that executive function is impaired over the course of the aging process, which eventually affects other cognitive skills. Throughout the human development process, executive performance is believed to follow an inverted U-shape (Kristensen, 2006). As a result, older adults would tend to perform worse on cognitive tasks that require processing speed (Salthouse & Ferrer-Caja, 2003), inhibitory control (Williams, Ponesse, Chacahr, Logan, & Tannock, 1999), and task coordination (Mayr, Kliegel, & Krampe, 1996). Studies show that performance on tasks that measure executive function tends to decline over age and improve with educational attainment (Ribeiro et al., 2010; Souza, Ignácio, Cunha, Oliveira, & Moll, 2001; Tombaugh, Kozak, & Rees, 1999; Zibetti et al., 2010). Therefore, the oldest elderly and those with the least educational attainment tend to perform poorly on executive function tests.

In view of the foregoing, the objective of this study was to assess cognitive development across different age ranges in late adulthood, analyzing cognitive skills associated with verbal fluency, time and space orientation, memory, and attention in older adults. We also outlined a sociodemographic profile of participants and assessed their subjective perception of memory conditions and of the presence or absence of symptoms of depression.

Method

Design

This was a cross-sectional quantitative study.

Sample

A random sample of 121 older adults (age 60–95 years), of both sexes, middle socioeconomic level, and varying educational attainment was recruited in the municipality of Veranópolis, state of Rio Grande do Sul, Brazil. Participants were identified from a named list of all citizens aged 60 years or older according to the record of the Veranópolis municipal government. At the time of the study, this universe comprised 2200 people. Of these, 660 were aged 60–64 and 1540 were 65 or older. Random selection was performed by the municipal Department of Health and Social Action.

Instruments

The following instruments were used for assessment:

A *sociodemographic data collection questionnaire* consisting of items on personally identifying information, such as age, sex, educational attainment, and marital status, as well as data on cultural background, financial status, leisure, health conditions and medications, prior hospitalizations, and drinking and smoking habits.

Geriatric Depression Scale (GDS-15). The GDS questionnaire consists of 15 yes-or-no items designed to identify and quantify symptoms of depression in older adults (Yesavage et al., 1983).

Memory Complaint Questionnaire (MAC-Q). This self-report instrument seeks to investigate the respondent's perceptions of his or her own memory at the time of administration and compare it to his or her memory at the age of 40. The version of the instrument used in our pilot study was that used in a previous investigation by the Federal University of São Paulo (Bertolucci, Brucki, Campacci, & Juliano, 1994), where a score of 25 points or higher is considered indicative of subjective memory loss.

Mini-Mental Status Examination (MMSE). The MMSE comprises a set of questions that assess orientation to time and space, immediate and delayed recall, attention, concentration, language, naming, comprehension, and constructional skills. The maximum overall score is 30 points. We used the Brazilian Portuguese version developed by Bertolucci et al. (1994).

WAIS-R digit span subtest. To measure attention, used the Digit Span subtest of the Wechsler Adult Intelligence Scale, Revised (Wechsler, 1981), which consists of two different (forward and backward) digit span tasks.

Buschke Free and Cued Selective Reminding Test (visual memory). This test assesses learning and was administered according to the operationalization proposal developed by the Mayo Clinic, in which items are presented six times and the final score corresponds to the total number of recalls (sum total of free and cued recalls). The highest possible score is 96 points.

Category Verbal Fluency Test (animals). We used Spreen and Benton's version of the verbal fluency test (in Argimon & Camargo, 2000) as validated by Brucki, Malheiros, Okamoto and Bertolucci (1997). The score corresponds to the total number of animals the subject can name in 1 minute.

Procedures

Data collection

The study was approved by Pontifícia Universidade Católica do Rio Grande do Sul Research Ethics Committee with judgment number 023/01. Participants were randomly selected and contacted by mail. The objectives of the study were publicized on local radio. Participants first signed a written informed consent form and filled out the sociodemographic data collection questionnaire. We then administered the study instruments for assessment of attention, followed by the memory, problem-solving, vocabulary, and depression questionnaires.

Subjects were initially divided into four age ranges: 60–69 years; 70–79 years; 80–89 years; and 90–99 years. These ranges were then pulled into two larger subgroups: 60–79 and 80–95. Regarding educational attainment, subjects were allocated into four groups as follows (Hänninen et al., 1996): a) Group 1, up to three years of formal education; b) Group 2, four to six years of formal education; and c) Group 3, seven or more years of formal education.

Data analysis

Sociodemographic data were expressed as descriptive statistics, including means and standard deviations. We performed univariate exploratory analyses between the cognitive variables (Digit Span, Verbal Fluency, Mini Mental Status Examination, Free and Cued Recall), Depression and Subjective Memory Perception variables, and sociodemographic variables (age, educational attainment, sex, living in urban or rural area, and leisure).

To test predictive models of cognitive performance in our sample of older adults, we used Pearson's correlation coefficient (to test for association between cognitive variables and the Subjective Memory Perception variable) and stepwise multivariate linear regression analysis. Tukey's method was used as a post-hoc test. The significance level was set at 5% for all analyses.

Results

The results of this study will be presented in two sections. The first shall consist of a) a descriptive analysis of the sociodemographic profile of participants; b) an analysis of participants' subjective perceptions of their memory performance; and c) an analysis of the presence of symptoms of depression and of whether age and educational attainment have an influence on this presence. The second section shall present findings on cognitive aspects related to the study objectives.

Part I

Sociodemographic Characteristics

The study sample comprised 121 older adults living in the municipality of Veranópolis, Rio Grande do Sul, of whom 83 (68.6 %) were female and 38 (31.4 %) were male. Mean age was 79 years (*SD* ± 9.07 years). The age of male participants ranged from 60 to 94 years (mean, 78.08 ± 9.14 years), and that of female participants, from 61 to 95 (mean, 78.36 ± 9.10 years). Allocation of participants into age subgroups revealed that, of the female subjects, 21 (25.3%) were aged 60 to 69, 21 (25.3%) were aged 70 to 79, 34 (41%) were aged 80 to 89, and 7 (8.4%) were aged 90 to 95. Of the male participants, 9 (23.7%) were aged 60 to 69, 10 (26.3%) were 70 to 79, 14 (36.8%) were 80 to 89, and 5 (13.2) were 90 to 95.

Regarding marital status, 64 (52.9 %) participants were widowed, 50 (41.3%) were married, 5 (4.1%) were single, 1 (0.8%) was divorced and 1 (0.8%) other. Overall, educational attainment was distributed as follows: 61 (50.4%) participants had up to 3 years of formal education, 49 (40.5%) had 4 to 6 years of formal education, and 11 (9.1%) had 7 to 16 years of formal education. Mean educational attainment was 3 ± 2.73 years.

Of the female subjects, 43 (51.6%) had 0 to 3 years of formal education, 33 (39.8%) had 4 to 6 years, and 7 (8.4%) had 7 or more years of schooling. Among male participants, 18 (47.4%) had 0 to 3 years, 16 (42.1%) had 4 to 6 years, and 4 (10.5%) had 7 or more years of formal education.

Regarding the predominant activities of older adults in their leisure time (defined as activities that are not part of their daily routine), churchgoing was the preferred activity in both sexes, with 52 women (62.7 %) and 25 men (65.8%) regarding it as their leisure activity of choice, followed by “watching television” (soaps, Mass broadcasts, news, football) and “listening to the radio” (music, news, football), in 51 (61.4%) female participants and 20 (52.6 %) male subjects.

Male and female participants regarded some leisure activities differently. There was a significant gender difference in mental activities (reading, crossword puzzles, card games, checkers, bingo), which was the preferred activity of 44 (53%) female subjects versus 29 (76.3%) male subjects. Conversely, handiwork (crochet, embroidery, knitting, crafts) was preferred by 43 (51.8%) of female participants, versus only 8 (21.1%) male subjects—again, a significant difference. Physical activities (defined as fishing, walking, snooker, relaxation exercises, bocce, gardening) were preferred by a significantly lower percentage of women (47%, 39 participants) as compared to men (78.9%, 30 participants). It bears stressing that many participants did not include walking as a leisure activity because it was part of their daily routine. Social activities (dances, community groups for senior citizens, visiting the sick) were the preferred entertainment of 9 women (10.8%) and 2 men (5.3%) in the sample.

Memory Complaint Questionnaire (MAC-Q)

ANOVA-based comparison of MAC-Q performance by age group revealed no significant effect of age range on subjective perception of memory complaints ($F(3,115) = 1.328$, $p > 0.05$). Pearson’s correlation coefficient was used to test for association between the MAC-Q variable and the factors age, educational attainment, leisure, depression, and cognitive assessment scores (Verbal Fluency, Free and Cued Recall, Digit Span, Mini-Mental Status Examination), revealing a significant inverse correlation between the following variables: *Verbal Fluency* ($p < 0.01$), *Free and Cued Recall* ($p < 0.01$), *MMSE* ($p < 0.01$), leisure ($p < 0.01$), and depression ($p < 0.01$). Furthermore, there was a negative correlation between MAC-Q performance and verbal fluency, as increasing MAC-Q scores were associated with declining Verbal Fluency scores (r = -0.272, $p < 0.05$).

The correlation between MAC-Q and *Leisure* was also negative—that is, the fewer leisure alternatives subjects had, the greater their subjective perception of memory complaints (r = -0.248, $p < 0.05$). We also found inverse correlations between MAC-Q and Free and Cued Recall and between MAC-Q and MMSE, with higher MAC-Q scores being associated with lower scores on the Free and Cued Selective Reminding Test (r = -0.269, $p < 0.05$) and lower MMSE scores (r = -0.364, $p < 0.05$).

There was a positive correlation between MAC-Q and Depression, with higher MAC-Q scores being associated with more symptoms of depression (r = 0.368, $p < 0.05$). No correlations were identified between MAC-Q and age (r =0.142, $p > 0.05$), educational attainment (r = -0.117, $p > 0.05$), or Digit Span (r = -0.183, $p > 0.05$).

Depression

Table 1 shows the distribution of older adults in the sample by educational attainment and Geriatric Depression Scale (GDS-15) score. ANOVA-based comparison of educational attainment and GDS scores revealed a significant effect of duration of formal schooling on the GDS ($F(2,109) = 6.798$, $p < 0.01$). Post-hoc testing revealed that older subjects with an educational attainment of 0–3 years scored higher on the depression scale (5.62 ± 3.84 points) than those with 4 to 6 years of formal education (3.43 ± 3.04 points) (k = 2.19, $p < 0.05$) and those with 7 or more years of schooling (2.70 ± 1.57) (k = 2.92, $p < 0.05$). There were no statistically significant differences on comparison between subjects with 4–6 years and those with ≥7 years of educational attainment (k = 0.73, $p > 0.05$). ANOVA showed no effect of age range on symptoms of depression as measured by the GDS-15 score ($F(3,108) = 1.990$, $p > 0.05$).

Table 1

Distribution of older subjects by educational attainment and mean Geriatric Depression Scale (n = 112)

		Geriatric Depression Scale (GDS-15)	
Ed. Attainment	*N*	Mean	*SD*
0–3 years	55	5.62	3.84
4–6 years	47	3.43	3.04
≥7 years	10	2.7	1.57
Total	112	4.44	3.55

Part II – Cognitive skills

Category Verbal Fluency test (animals)

Source: Own work.

The total number of animal names each subject could produce in 1 minute assessed verbal fluency. Table 2 shows the results of linear regression analysis between age, educational attainment, leisure, depression, and subjective memory perception (MAC-Q) variables and performance on the Verbal Fluency Test, Buschke Free and Cued Selective Reminding Test, Mini-Mental Status Examination, and Digit Span test. ANOVA-based comparison of age ranges and test performance showed an effect of age group on verbal fluency ($F(3,115) = 8.939$, $p < 0.001$). Tukey's post hoc test showed that older adults in the 6069 age range had significantly higher verbal fluency scores (14.83 ± 4.5) as compared to those in the 80-to-89-year group (10.34 ± 4.09) ($k = 4.49$, $p < 0.001$) and the 90-to-95-year group (9.55 ± 3.27) ($k = 5.29$, $p < 0.01$). Comparison between the 60-to-69 and 70-to-79 age ranges (12.32 ± 3.74) showed no statistically significant differences ($k = 2.51$, $p > 0.05$).

ANOVA-based comparison between educational attainment and performance on the verbal fluency test showed a significant effect of this variable ($F(2,116) = 7.707$, $p < 0.005$). Tukey's post-hoc test showed that subjects with up to 3 years of formal education had significantly lower scores (10.47 ± 3.83) as compared to those with 4 to 6 years of formal education (13.13 ± 4.56) ($k = 2.66$, $p < 0.01$) and those with 7 or more years of educational attainment (14.55 ± 4.5) ($k = 4.08$, $p < 0.05$). Comparison between subjects with 4 to 6 years of formal education and those with 7 or more years of educational attainment showed no significant difference (k =1.42, $p > 0.05$).

Stepwise multivariate linear regression analysis yielded the following estimated model: Verbal Fluency = 21.65 – 0.315 X Depression – 0.307 X Age + 0.231 X Leisure + 0.208 X Educational Attainment. The overall coefficient of determination (R^2) was 0.445, that is, 44.5% of variance in verbal fluency could be explained by the variables Depression, Age, Leisure, and Educational Attainment. Regarding the fit of the regression analysis model, we believe the explanatory variables—Depression, Age, Leisure, Educational Attainment—are well adjusted to the dependent variable (Verbal Fluency).

Mini-Mental Status Examination

MMSE scores are sensitive to educational attainment. ANOVA-based comparison between educational attainment and total MMSE scores showed an effect of educational attainment on these scores ($F(2,118) = 13.935$, $p < 0.001$). Post-hoc testing showed that subjects with up to 3 years of formal education had significantly lower MMSE scores (20.08 ± 5.25) as compared to those with 4 to 6 years of formal education (24.37 ± 4.56) ($k = 4.29$, $p < 0.001$) and those with 7 or more years of educational attainment (25.91 ± 3.33) ($k = 5.83$, $p < 0.05$). Again, comparison between subjects with 4 to 6 years of formal education and those with 7 or more years of educational attainment showed no statistically significant difference ($k = 1.54$, $p > 0.05$).

ANOVA-based comparison between age range and MMSE performance revealed an effect of age on MMSE scores ($F(3,117) = 11.217$, $p < 0.001$). Tukey's post hoc test showed that older adults in the 60-to-69-year age range had significantly higher MMSE scores (25.43 ± 4.38 points) as compared to those in the 80-to-89-year group (20.4 ± 5.25) ($k = 5.04$, $p < 0.001$) and the 90-to-95-year group (18.17 ± 6.21) ($k = 7.27$, $p < 0.001$). Therefore, the youngest elderly subjects exhibited fewer signs of dementia. Comparison between total MMSE scores and sex showed a mean score of 22.37 ± 5.45 in female subjects versus 22.29 ± 5.14 in male subjects, with no statistically significant between-group difference ($t(119) = 0.8$, $p > 0.05$).

Stepwise multivariate linear regression analysis (Table 2) yielded the following estimated model: MMSE = 37.776 – 0.351 X Depression – 0.352 X Age + 0.304 X Educational Attainment.

The overall coefficient of determination (R^2) was 0.444, that is, 44.4% of variance in MMSE scores could be explained by the variables Depression, Age, and Educational Attainment. Regarding the fit of the regression analysis model, we believe the explanatory variables—Depression, Age, Educational Attainment—are well adjusted to the dependent variable (*MMSE*).

Orientation to time (MMSE)

ANOVA-based comparison of scores on the orientation to time subtest of the MMSE and educational attainment (Table 2) showed that the duration of formal education had an effect on orientation to time ($F(2,118) = 4.970$, $p < 0.01$). Tukey's post hoc test showed that subjects with up to 3 years of formal education had significantly lower scores on this subscale (3.52 ± 1.46), as compared to subjects with 7 or more years of formal education (4.73 ± 0.47) ($k = 1.20$, $p < 0.05$). There was no significant difference on comparison between subjects with up to 3 years of formal education and those with 4 to 6 years of formal education (4.14 ± 1.41) ($k = 0.62$, $p > 0.05$), nor was there any such difference on comparison the latter group and subjects 7 or more years of formal education ($k = 0.58$, $p > 0.05$). In short, higher educational attainment was associated with better scores on the orientation to time subscale of the MMSE in our sample.

Orientation to space (MMSE)

ANOVA-based comparison of scores on the orientation to space subtest of the MMSE and educational attainment (Table 2) showed that the duration of formal education had an effect on orientation to space ($F = (2.118) = 7.337$, $p < 0.005$). Tukey's post hoc test showed that subjects with up to 3 years of formal education had significantly poorer spatial orientation as compared to those with 4 to 6 years of formal education ($p < 0.005$) and those with 7 years or more of formal education ($p < 0.05$). Comparison between subjects with 4 to 6 years of formal education and those with 7 or more years of educational attainment showed no significant difference ($p > 0.05$). In short, higher educational attainment was associated with improved spatial orientation in older adults.

Free and cued recall (Buschke)

ANOVA-based comparison of scores on the Buschke Free and Cued Selective Reminding Test and level of education showed no main effect of educational attainment on this cognitive test ($F(2,101) = 1.463$, $p > 0.05$). In this test, subjects with 0 to 3 years of formal education had a mean score of 90.20 ± 11.60; those with 4 to 6 years of formal education, a mean score of 92.57 ± 8.08; and those with 7 or more years of formal education, a mean score of 95.18 ± 1.25. Therefore, there was no significant difference between any of the three levels of educational achievement, as confirmed by Tukey's post hoc test.

Analysis of the performance of different age ranges on the Buschke Free and Cued Selective Reminding Test showed a main effect of age range on test scores ($F_{(3,100)} = 5.290$, $p < 0.01$), as shown in Table 2. Tukey's post hoc test showed that the performance of the oldest participants (age 90–95) was not significantly different from that of the three other age ranges, although there was a trend toward higher scores in the two younger age ranges.

Older adults in the 60-to-69 age range scored significantly better than those in the 80-to-89 age range. Subjects in the 70-to-79 age range also performed better than those in the 80-to-89 age range. The performance of subjects in the 90-to-95 age range was not significantly different from that of any other age range. We found that, when the oldest old (age 90 to 95 years) had good quality of life and kept busy with cognitively demanding activities, physical activity, and social interactions, they were not significantly different from the younger elderly.

Stepwise multivariate linear regression analysis (Table 2) yielded the following estimated model: Buschke = 117.346 – 0.281 X Age + 0.208 X Leisure + 0.192 X Educational Attainment – 0.191 X MAC-Q. The overall coefficient of determination (R2) was 0.237, that is, 23.7% of variance in Buschke Free and Cued Selective Reminding Test scores could be explained by the variables Age, Leisure, Educational Attainment, and MAC-Q. Regarding the fit of the regression analysis model, we believe the explanatory variables—Age, Leisure, Educational Attainment, MAC-Q—are well adjusted to the dependent variable (Free and Cued Recall).

Attention

ANOVA-based comparison of attention skills, as measured by the Digit Span test, and level of education showed a main effect of educational attainment on Digit Span scores ($F_{(2,111)} = 17.661$, $p < 0.001$). In this test, subjects with 0 to 3 years of formal education had a mean score of 4.8 ± 2.26; those with 4 to 6 years of formal education, a mean score of 7.49 ± 2.56; and those with 7 or more years of formal education, a mean score of 8 ± 3.44. The difference between subjects with 0 to 3 years of formal education and those with 4 to 6 years or 7 or more years of formal education was statistically significant. Conversely, there was no significant difference in Digit Span scores between subjects with 4 to 6 years of educational attainment and those with 7 or more years of formal education.

ANOVA-based comparison between age range and score on the Digit Span test showed a main effect of age on these scores ($F_{(3,110)} = 8.894$, $p < 0.001$). Older adults in the 60-to-69-year age range scored significantly higher (8.14 ± 3.2) than their counterparts in the 80-to-89 and 90-to-95 age ranges (5.09 ± 2.38 and 5.1 ± 2.64 respectively). The Digit Span scores of subjects in the 70-to-79-year age range (6.48 ± 2.21) were statistically similar to those of all other age ranges.

Stepwise multivariate linear regression analysis (Table 2) yielded the following estimated model: Digit Span = 14.102 + 0.381 X Educational Attainment – 0.356 X Age – 0.232 X Depression. The overall coefficient of determination (R^2) was 0.409, that is, 40.9% of variance in Digit Span scores could be explained by the variables *Depression,* Age, and Educational Attainment. Regarding the fit of the regression analysis model, we believe the explanatory variables—Educational Attainment, Age, Depression—are well adjusted to the dependent variable (Digit Span).

Table 2

Linear Regression between Age, Educational Attainment, Leisure, Depression, and Subjective Memory Perception (MAC-Q) Variables And Performance on the Verbal Fluency Test, Buschke Free and Cued Selective Reminding Test, Mini-Mental Status Examination, and Digit Span Subtest of the Wechsler Adult Intelligence Scale-Revised

Cognitive test	Predictors	*R2*	*P*	Non standardized coefficient		Standardized coefficient
				Beta	Standard error	Beta
Verbal	Depression	0.236	0.001	-0.386	0.099	-0.315
Fluency	Age	0.359	0.001	-0.148	0.035	-0.307
	Leisure	0.406	0.01	0.695	0.237	0.231
	Ed. Attainment	0.445	0.01	0.364	0.133	0.208
Buschke	Age	0.101	0.01	-0.297	0.094	-0.281
	Leisure	0.164	0.05	1.476	0.638	0.208
	Ed. Attainment	0.203	0.05	0.748	0.345	0.192
	MAC-Q	0.237	0.05	-0.39	0.185	-0.191
MMSE	Depression	0.214	0.001	-0.479	0.102	-0.351
	Age	0.361	0.001	-0.189	0.039	-0.352

	Ed. Attainment	0.444	0.001	0.593	0.147	0.304
Digit Span	Ed. Attainment	0.234	0.001	0.42	0.086	0.381
	Age	0.359	0.001	-0.108	0.023	-0.356
	Depression	0.409	0.01	-0.185	0.062	-0.232

Source: Own work.

Discussion

Subjective memory complaints are common in older adults, although their clinical significance is still controversial. The results of this study show that subjective perceptions of memory complaints by the elderly are inversely correlated with cognitive test performance—that is, older adults who perceived more memory issues scored comparatively poorly on verbal fluency and free and cued reminding tests as well as on the MMSE, and had more restricted leisure options at their disposal. Furthermore, subjects who scored higher on the Geriatric Depression Scale reported more memory complaints.

Xavier, Ferraz, Argimon, and Moriguchi (2001) used the Memory Complaint Questionnaire (MAC-Q) in a study of 66 older adults, comparing it to specific memory tests to ascertain whether perceived memory loss was an accurate indicator of real memory disorders. The authors concluded that, although the MAC-Q is an isolated predictor of future dementia, there was no correlation between older adults' opinions of their memory and their performance on memory-specific tests. Likewise, Paulo and Yassuda (2010) found that memory complaints in late adulthood were not associated with educational attainment, cognitive performance, or symptoms of depression, although they were associated with symptoms of anxiety. In this study, memory complaints did not reflect potential age-associated cognitive deficits, but were associated with anxiety. Studies conducted by Bola, Lindgren, Banaccorsy, and Bleecker (1991) revealed a stronger association between MAC-Q scores and the presence of depression symptoms than between MAC-Q performance and cognitive test scores. Tobiansky, Blizard, Livingston, and Mann (1995) conducted a two-year longitudinal study and found that older adults with memory complaints were at a fourfold risk of developing dementia and a twofold risk of developing depression as compared to older adults with no such complaints.

As expected, younger subjects and those with higher educational attainment scored better on the verbal fluency test. Older adults with more leisure options at their disposal also preserve superior verbal fluency. In a study of 392 U.S. adults living in the community, Koivisto et al. (1992) found that educational attainment influenced performance on the category verbal fluency test (animals). Performance across different groups was 14.7 ± 0.86 named animals among subjects with up to 3 years of formal schooling, 16.46 ± 0.37 for those with 4–6 years of education, and 19.36 ± 0.44 among those with 7 years or more of education. Authors reported that age range (younger or older old) also correlated with test performance, but not as markedly as formal education. Likewise, Tombaugh et al. (1999) found the performance of older subjects on the category verbal fluency test (animal naming) to be influenced by both educational attainment and age. However, performance was most sensitive to the effects of age, which accounted for 23.4% of variance, in performance, whereas educational attainment explained only 13.6% of variance. In this study, the younger elderly and those with higher educational attainment outperformed their older and less educated counterparts.

In our study, MMSE scores were sensitive to educational attainment and age. This finding is corroborated by prior studies (Diniz, Volpe, & Tavares, 2007; Paulo & Yassuda, 2010), which maintain that both age and educational attainment can influence MMSE performance. Diniz, Volpe, and Tavares (2007) evaluated the impact of educational level and age on MMSE performance in older adults living in the community and found that greater educational attainment was associated with accordingly superior MMSE performance. Conversely, more advanced age was associated with correspondingly worse MMSE scores.

Although studies as widely known as Wechsler (1993) and Osterweil, Mulford, Syndulko, and Martin (1994) found no major differences in digit span performance according to age or educational attainment, in the present study, younger subjects and those with higher educational attainment scored better on this test. Banhato and Nascimento (2007) investigated the attention and working memory abilities of older adults using the digit span subtest of WAIS-III, evaluating associations with age, sex, and educational attainment. The authors found that age correlated inversely and significantly with performance, with statistically significant differences between the youngest elderly (6069 years) and the oldest (≥ 80 years) in this subtest.

Wechsler (1993) studied the performance of 475 subjects over the age of 60 and found a mean score of 8.82 ± 2.89 on the digit span test. In this study, there was no statistically significant difference in performance between the elderly and young adults. Likewise, Osterweil et al. (1994) found no differences in the performance of older adults.

Regarding the proposed objective of this study, which was to assess cognitive performance across different age ranges in late adulthood, we found an inverse correlation between subjective perception of memory complaints and cognitive test performance. Therefore, the greater one's perception of memory issues, the poorer one performs on verbal fluency and free and cued recall tests, as well as on the MMSE. In our sample, the older adults who reported the greatest subjective perception of memory complaints had the least leisure options at their disposal. Furthermore, older adults who scored higher on the Geriatric Depression Scale also reported more memory complaints.

Regarding cognitive performance of older adults across different age ranges, we ascertained that the younger elderly, those with higher educational attainment, and those with more leisure options at their disposal performed better on the category verbal fluency test (animals). In this study, MMSE scores were also sensitive to educational attainment and age: higher educational attainment and younger age correlated with superior MMSE performance. Furthermore, the younger elderly and those with higher educational attainment performed better on a digit span task.

References

Argimon, I. L., & Camargo, C. H. P. (2000). Avaliação de sintomas demenciais em idosos: questões essenciais. In J. A. Cunha et al. (Eds.), *Psicodiagnóstico* (pp. 177-182). Porto Alegre: Artes Médicas.

Argimon, I. L., & Stein, L. (2005). Habilidades cognitivas em indivíduos muito idosos: um estudo longitudinal. *Cadernos de Saúde Pública, 21*(1), 64-72.

Banhato, E. F. C., & Nacimento, E. (2007). Função executiva em idosos: um estudo utilizando subtestes da Escala WAIS-III. *Psico-USF, 12*(1), 65-73.

Bertolucci, P. H. F., Brucki, S. M. D., Campacci, S. R., & Juliano, Y. (1994). O mini-exame do estado mental em uma população geral: impacto da escolaridade. *Arquivos de Neuro-Psiquiatria, 52*(1), 1-7.

Bola, K. I., Lindgren, K. N., Banaccorsy, C., & Bleecker, M. L. (1991). Memory complains in older adults. *Archives of Neurology, 48*(1), 61-64.

Brito-Marques, P. R., & Cabral-Filho, J. E. (2005). Influence of age and schooling on the performance in a modified Mini-Mental State Examination version: A study in Brazil northeast. *Arquivos de Neuropsiquiatria, 63*(3), 583-587.

Brucki, S. M. D. (2004). Envelhecimento e memória. In V. M. Andrade, F. H. Dos Santos, O. F. A. Bueno (Orgs.), *Neuropsicologia hoje* (pp. 389-402). São Paulo: Artes Médicas.

Brucki, S. M. D., & Rocha, M. S. G. (2004). Category fluency test: Effects of age, gender and education on total scores, clustering and switching in Brazilian Portuguese-speaking subjects. *Brazilian Journal of Medical and Biological Research, 37*(12), 1771-1777.

Brucki, S. M., Malheiros, S. M. F., Okamoto, I. V., & Bertolucci, P. H. F. (1997). Dados normativos para o uso do teste fluência verbal (categoria animal), em nosso meio. *Arquivos de Neuropsiquiatria, 55*(1), 56-61.

Dias, M., França, M. Almeida, M. B., Dias, K., M., Moreno, M. L., & Bittencourt, A. M. (2010). Mini-exame do estado mental: em busca do conhecimento da alteração da cognição do idoso na zona oeste do municipio do Rio de Janeiro. *Revista de Pesquisa: Cuidado é Fundamental Online,* (Suppl. 2), 944-947.

Fonseca, R. P., Zimmermann, N., Scherer, L. C., Parente, M. A. M. P., & Ska, B. (2010). Episodic memory, concentrated attention and processing speed in aging: A comparative study of Brazilian age groups. *Dementia & Neuropsychologia, 4*(2), 91-97.

Foss, M. P., Vale, F. A. C., & Speciali, J. G. (2005). Influência da escolaridade na avaliação neuropsicológica de idosos: Aplicação e análise dos resultados da Escala de Mattis para Avaliação de Demência (Mattis Dementia Rating Scale –MDRS). *Arquivos de Neuropsiquiatria, 63*(1), 119-126.

Hänninen, T., Koivisto, K., Reinikainen, K. J., Helkala, E. L., Soininen, H., Mykkänen, L., et al. (1996). Prevalence of ageing-associated cognitive decline in elderly population. *Age and Aging, 25*(3), 201-205.

Koivisto, K., Helkala, E. L., Reinikainen, K. J., Aniñen, T., Mykkanen, L., Laakso, M. et al. (1992). Population-based dementia screening program in Kuopio: The effect of education, age and sex on brief neuropsychological tests. *Journal of Geriatric Psychiatry and Neurology, 5*(3), 162-171.

Kristensen, C. H. (2006). Funções executivas e envelhecimento. In M. A. M. P. Parente (Org.), *Cognição e envelhecimento* (pp. 97-111). Porto Alegre: Artmed.

Malloy-Diniz, L. F., Lasmar, V. A. P., Gazinelli, L. S. R., Fuentes, D., & Salgado, J. V. (2007). Teste de aprendizagem auditivo-verbal de Rey: aplicabilidade na população idosa brasileira. *Revista Brasileira de Psiquiatria, 29*(4), 324-329.

Mayr, U., Kliegel, R., & Krampe, R. (1996). Sequential and coordinative processing dynamics in figural transformations across the lifespan. *Cognition, 59*(1), 61-90.

Osterweil, D., Mulford, P., Syndulko, K., & Martin, M. (1994). Cognitive function in old and very old residents of a residential facility: Relationship to age, education and dementia. *Journal of the American Geriatrics Society, 42*(7), 766-773.

Parente, M. A. M. P. (2006). [Introdução]. In M. A. M. P. Parente (Org.), *Cognição e envelhecimento* (pp. 15-18). Porto Alegre: Artmed.

Parente, M. A. M. P., & Wagner, G. P. (2006). Teorias abrangentes sobre envelhecimento cognitivo. In M. A. M. P. Parente (Org.), *Cognição e envelhecimento* (pp. 31-45). Porto Alegre: Artmed.

Paulo. D. L. V., & Yassuda, M. S. (2010). Queixas de memória de idosos e sua relação com escolaridade, desempenho cognitivo. *Revista de Psiquiatria Clínica, 37*(1), 23-26.

Ribeiro, P. C. C., Oliveira, B. H. D., Cupertino, A. P. F. B., Neri, A. L. Anita, & Yassuda, M. S. (2010). Desempenho de idosos na bateria cognitiva CERAD:

relações com variáveis sociodemográficas e saúde percebida. *Psicologia: Reflexão e Crítica, 23*(1), 102-109.

Salthouse, T. A., & Ferrer-Caja, E. (2003). What needs to be explained to account for age-related effects on multiple cognitive variables? *Psychology and Aging, 18*(1), 91-110.

Souza, R. O., Ignácio, F. A., Cunha, F. C. R., Oliveira, D. L. G., & Moll, J. (2001). Contribuição à neuropsicologia do comportamento executivo. *Arquivos de Neuropsiquiatria, 59*(3), 526-531.

Stuart-Hamilton, I. (2002). *A psicologia do envelhecimento: uma introdução.* Porto Alegre: Artmed.

Taussik, I., & Wagner, G. P. (2006). Memória explícita e envelhecimento. In M. A. M. P. Parente (Org.), *Cognição e envelhecimento* (pp.67-84). Porto Alegre: Artmed.

Tobiansky, R., Blizard, R., Livingston, G., & Mann, A. (1995). The Gospel Oak Study stage IV: The clinical relevance of subjective memory impairment in older people. *Psychological Medicine, 25*(4), 779-786.

Tombaugh, T. N., Kozak, J., & Rees, L. (1999). Normative data stratified by age and education for two measures of verbal fluency: FAS and Animal Naming. *Archives of Clinical Neuropsychology, 14*(2), 167-177.

Wechsler, D. (1981). *WAIS-R- Wechsler Adult Intelligence Scale-Revised.* Cleveland, OH: Psychological Corporation.

Wechsler, D. (1993). *Test de inteligencia para adultos (WAIS)* (2nd. ed.). Buenos Aires: Paidós.

Williams, B. R., Ponesse, J. S., Chacahr, R. J., Logan, G. D., & Tannock, D. R. (1999). Development of inhibitory control across the life span. *Developmental Psychology, 35*(1), 205-213.

Woodruff-Pak, D. S. (1997). *The neuropsychology of aging.* Malden: Blackwell.

Xavier, F. M. F., Ferraz, M. P. T., Argimon, I. L., & Moriguchi, E. H. (2001). A relevância clínica da percepção subjetiva de perda de memória por pessoas de idade. *Revista Brasileira de Neurologia, 37*(1), 24-28.

Yassuda, M. S. (2006). Memória e envelhecimento saudável. In E. V. Freitas, L. Py, F. A. X. Cançado, J. Doll & M. L. Gorzoni (Eds), *Tratado de geriatria e gerontologia* (pp. 1245-1251). Rio de Janeiro: Koogan.

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., et al. (1983). Development and validation of a geriatric depression screening scale: A preliminary report. *Journal of Psychiatric Research, 17*(1), 37-49.

Zibetti, M. R., Gindri, G., Pawlowski, J., Salles. J. F., Parente, M. A. M. P., Bandeira, D. R., et al. (2010). Estudo comparativo de funções neuropsicológicas entre grupos etários de 21 a 90 anos. *Neuropsicologia Latinoamericana, 2*(1), 55-67.