

MentalPlus® Digital Game Application for Memory Assessment in the Elderly

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Abstract

Introduction: The study evaluated the cognitive function - short and long- term memory through the application of the MentalPlus® digital game, in three elderly groups: institutionalized, stimulated / non-institutionalized, and non-stimulated / non-institutionalized. Cognitive decline occurs in high frequency in this phase of human development so that the stimulation can be applied later. The study's relevance is to identify the impact of cognitive stimulation in the elderly population. **Objectives:** To identify the possible memory dysfunction of elderly Brazilians, comparing results obtained through digital gaming among the three different groups evaluated.

Method: A sample of 45 elderly individuals (aged 60 to 92 years old) was selected. Among these, 40 participated in the study through the application of the MentalPlus® digital game. The results of the application of the instrument regarding short-term memory (STM) and long-term memory (LTM) were described using summary measures (mean, standard deviation, median, minimum and maximum) and according to the three research groups compared with Kruskal-Wallis tests, followed by multiple Dunn comparisons when significant. IBM-SPSS for Windows version 20.0 software was used to perform the analysis, and Microsoft Excel 2013 software was used to tabulate the data. The tests were performed at a significance level of 5%. **Conclusion:** The results showed a significant difference between the institutionalized elderly and stimulated elderly groups. It is evident that the more significant impairment of cognitive functions - short and long-term memory - in the institutionalized elderly.

Keywords: elderly patient, neuropsychology assessment, cognitive function, MentalPlus®

Introduction

There is an increase in life expectancy and demand for global care for the elderly (population aged over 60 years, making up 13% of Brazilians). The need for institutionalization is often considered (Canini et al., 2014). This development stage is marked by physical and cognitive decline, having a reflex in the quality of life and well-being (Shtompel et al., 2014).

As part of the life cycle, senescence remains a continually changing phase (Coimbra et al., 2018). Considering fatigue as a symptom present in the elderly, accentuated with increasing age, physical, emotional, and cognitive impairments affect daily activities (Soares et al., 2015). Institutionalization and the decreases in performance can lead to or intensify chronic and psychiatric diseases, which also corroborate cognitive disorders (Santiago et al., 2014; Schlindwein-Zanini, 2010).

As Neuropsychology is an area of scientific knowledge, the present work aimed to comprehend memory as one of the cognitive functions in three groups of elderly: institutionalized, stimulated / non-institutionalized, and non-stimulated / non-institutionalized, through MentalPlus®, a digital game designed for neuropsychological assessment and rehabilitation. The study aimed to identify the possible memory dysfunction among the participating groups and compare them concerning the stimulation received.

MentalPlus® is used through electronic devices with a touch-screen feature. It can be combined with other traditional neuropsychological assessment methods, even in people with low familiarity with this type of technology, including the elderly. The touch-screen device was suitable for applying the computerized instrument by reducing the application time and the Neuropsychological Battery.

Older people benefit from being submitted to programs aimed at cognitive stimulation

and present gains in immediate associative learning and reducing depressive and anxious symptoms. Such programs promote brain health and plasticity, requiring and developing new understanding and cognitive strategies (Gil et al., 2015).

Thus, cognitive rehabilitation (specific techniques to improve functional activities) and neuropsychological rehabilitation (assistance to the elderly and their families) becomes feasible. Although distinct, both complement each other to improve the quality of life and well-being, bringing back skills and abilities usually forgotten in the context of the elderly (Viola et al., 2011).

MentalPlus® corroborates the study because it is an instrument indicated in the decrease of cognitive dysfunctions in general health, from childhood to senescence, regardless of the educational level or culture. The tool brings new forms of rehabilitation to people with neurological disorders.

Objective

Identify the possible memory dysfunction of elderly Brazilians, comparing the results between the three different groups evaluated.

Method

Participants

Forty-five participants were selected in this sample. Among these, 40 people aged between 60 and 92 years from private long-term care facilities and non-institutionalized participated in the study. The participants were ten males and 30 females. Three groups were evaluated: 10 participants are institutionalized, some still have the autonomy, but none has the necessary independence to carry out daily

activities; 15 are stimulated through participation in a group called "Memory Workshop," conducted by a neuropsychologist in order to carry out cognitive stimulation activities; and 15 older people who are not institutionalized and are not cognitively stimulated by specific activities, but who maintain autonomy and independence in carrying out daily tasks.

The recruited participants were 45 where five refused to participate in the research before starting or during the instrument's application. (Fig. 1)

In the inclusion criteria, participants should necessarily be aged over 60 years. Among the participants, the level of education fluctuates from incomplete elementary (1 to 3 years) to complete higher education (10 to 12 years). (Tab. 1)

Figure 1. Flowchart of Participants Recruited, Assessed and Analysis

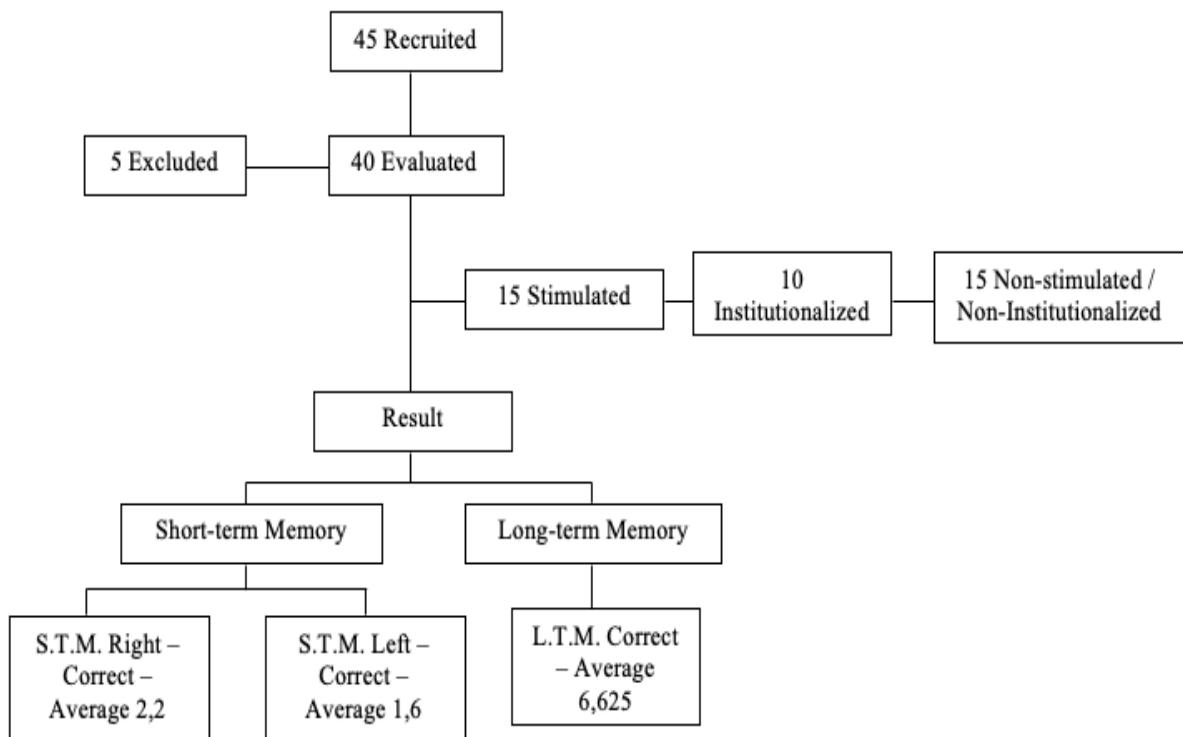


Table 1. Description of the characteristics of the evaluated participants.

Variable	Description (N=40)
Age (years) – mean ± SD*	72,1 ± 8,403
Condition – Freq. (%)	
Institutionalized	10 (25)
Stimulated	15 (37,5)
Non-Stimulated	15 (37,5)
Schooling – Freq. (%)	
< 1 year	3 (7,5)
1 to 3 years	12 (30)
4 to 6 years	12 (30)
10 to 12 years	6 (15)
> 12 years	7 (17,5)
Gender – Freq. (%)	
Male	10 (25)
Female	30 (75)
Salary – Freq. (%)	
< \$35.000	40 (100)
Marital Status – Freq. (%)	
Single	8 (20)
Married	23 (57,5)
Widow / Widower	7 (17,5)
Divorced	2 (5)

*SD (Standard Deviation)

Instrument

MentalPlus® was used, which is a digital game developed to assess and stimulate neuropsychological functions, patented and registered at the National Library Foundation according to Law N. 9,610 / 98, under copyright No. 663,707. This digital game identifies neuropsychological deficits in the functions - Executive / Attention / Memory. The task consists of executive function activities, planning, strategy, inhibitory control, attention, and memory. The task takes 25 minutes from start to finish, fulfilling all the game stages, created with 12 different themes; Mentalplus® can reduce the learning effect (Valentin, 2017).

Procedures

After the research being approved by the Research and Ethics Committee,

contact was established with the research groups from FMUSP / CAAE n.49463315.5.1001.0068. The sample was for convenience. The stimulated group was invited during one of the meetings of the "Memory workshop." For institutionalized older people, the research presentation was referred to the institution's Psychologist, who also accompanied us throughout the applications. For non-institutionalized and unstimulated older people, the invitation was made randomly by each of the researchers.

After contact with the groups, data collection was carried out. Each participant filled out the Free and Informed Consent Form (ICF), except for institutionalized elderly, because due to their limitations, authorization was given through the coordination responsibility for the institution.

Results

The following tables show that the most significant discrepancy occurs between the institutionalized and stimulated groups. The non-stimulated /

non-institutionalized group maintains sufficient autonomy with daily cognitive stimulation, which brings it closer to the stimulated group.

Table 2. Description of the results of the MentalPlus® domains regarding the short-term memory (STM) and long-term memory (LTM) of the evaluated participants.

Variable	Average ± SD	Median (Min.; Max.)
Long-term Memory - Correct	6,625 ± 3,102	7 (2; 12)
Long-term Memory – Error	2,8 ± 1,682	3 (0; 8)
Long-term Memory – Omission	8,225 ± 3,355	8 (0; 13)
Short-term Memory – Correct Practice	0 ± 0	0 (0; 0)
Short-term Memory – Error Practice	0 ± 0	0 (0; 0)
Short-term Memory – Omission Practice	0 ± 0	0 (0; 0)
Short-term Memory – Dropped Out Practice	0 ± 0	0 (0; 0)
Short-term Memory – Click Practice	0 ± 0	0 (0; 0)
Short-term Memory – Click on Distractor Practice	0 ± 0	0 (0; 0)
Short-term – Right Correct	2,2 ± 1,883	2 (0; 7)
Short-term – Left Correct	1,6 ± 1,661	1 (0; 6)
Short-term Memory – Total	3,8 ± 3,244	3,5 (0; 11)
Short-term Memory – Left Error	1,95 ± 1,413	2 (0; 6)
Short-term Memory – Left Omission	3,525 ± 2,112	4 (0; 7)
Short-term Memory – Right Correct	2,2 ± 1,884	2 (0; 7)
Short-term Memory – Right Error	1,875 ± 1,265	2 (0; 5)
Short-term Memory – Right Omission	2,975 ± 2,006	3 (0; 7)
Short-term Memory – Dropped Out Right	3,825 ± 2,986	3 (0; 12)
Short-term Memory – Click Right	0,225 ± 0,768	0 (0; 4)
Short-term Memory – Click on Distractor Right	0 ± 0	0 (0; 0)

In table 2, the margin of correct answers to LTM is greater than the margin of errors among the participants. To STM, the excellent memory showed a higher average

of correct answers than the left. As for the average omission, this is higher in LTM compared to STM.

Table 3. Description of the results of the MentalPlus® domains to the LTM and STM of the evaluated groups.

Variable	Institutionalized	Stimulated	Non-Stimulated	p
Long-term Memory – Correct	4,5 (2; 7)	8 (2; 12)	8 (2; 12)	0,030
Long-term Memory – Error	1,5 (0; 3)	2 (1; 4)	4 (1; 8)	0,003
Long-term Memory – Omission	10,5 (8; 13)	7 (0; 13)	7 (3; 13)	0,030
Short-term Memory – Correct Practice	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Short-term Memory – Error Practice	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Short-term Memory – Omission Practice	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Short-term Memory – Dropped Out	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Practice				
Short-term Memory – Click Practice	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Short-term Memory – Click on Distractor	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Practice				
Short-term Memory – Right Correct	0,5 (0; 2)	3 (0; 5)	3 (0; 7)	0,006
Short-term Memory – Left Correct	1 (0; 2)	1 (0; 6)	2 (0; 5)	0,106
Short-term Memory – Total	1 (0; 3)	4 (0; 10)	5 (0; 11)	0,017
Short-term Memory – Left Error	3 (0; 4)	1 (0; 3)	2 (1; 6)	0,099
Short-term Memory – Left Omission	3,5 (2; 7)	5 (0; 7)	3 (0; 7)	0,211
Short-term Memory – Right Correct	0,5 (0; 2)	3 (0; 5)	3 (0; 7)	0,006
Short-term Memory – Right Error	2 (0; 4)	2 (0; 5)	1 (0; 3)	0,145
Short-term Memory – Right Omission	4,5 (2; 6)	2 (0; 6)	3 (0; 7)	0,027
Short-term Memory – Dropped Out Right	5 (1; 12)	3 (0; 6)	3 (0; 11)	0,048
Short-term Memory – Click Right	0 (0; 2)	0 (0; 4)	0 (0; 2)	0,540
Short-term Memory – Click o Distractor	0 (0; 0)	0 (0; 0)	0 (0; 0)	> 0,999
Right				

Data expressed as median (Min., Max.) – Kruskall-Wallis Test

Table 3 shows that the domains of MentalPlus® LTM and STM - Right answers do not differ between the stimulated and non-stimulated groups. The institutionalized group is inferior to the other groups concerning the correct

answers. In the total STM, the stimulated group stood out ($p = 0.017$). In the omission criterion, this was higher in the institutionalized group than the other groups that did not present a discrepancy.

Table 4. Description of MentalPlus® results to LTM and STM from the comparison between the groups evaluated.

Variable	Comparisons	Value Z	p
Long-term Memory – Correct	Institutionalized vs Non-Stimulated	-2,365	0,054
	Institutionalized vs Stimulated	-2,365	0,054
	Non- Stimulated vs Stimulated	0,000	> 0,999
Long-term Memory – Error	Institutionalized vs Non-Stimulated	-1,166	0,731
	Institutionalized vs Stimulated	-3,297	0,003
	Non- Stimulated vs Stimulated	-2,383	0,052
Long-term Memory – Omission	Institutionalized vs Non-Stimulated	-0,173	> 0,999
	Institutionalized vs Stimulated	2,440	0,044
	Non- Stimulated vs Stimulated	2,286	0,067
Short-term Memory – Right Correct	Institutionalized vs Non-Stimulated	-2,741	0,018
	Institutionalized vs Stimulated	-2,997	0,008
	Non- Stimulated vs Stimulated	0,286	> 0,999
Short-term Memory – Total	Institutionalized vs Non-Stimulated	-2,440	0,044
	Institutionalized vs Stimulated	-2,658	0,024
	Non- Stimulated vs Stimulated	-0,244	> 0,999
Short-term Memory – Right Omission	Institutionalized vs Non-Stimulated	-2,471	0,018
	Institutionalized vs Stimulated	-2,997	0,008
	Non- Stimulated vs Stimulated	0,286	> 0,999
Short-term Memory – Right Omission	Institutionalized vs Non-Stimulated	-0,994	0,960
	Institutionalized vs Stimulated	2,675	0,022
	Non- Stimulated vs Stimulated	1,786	0,222
Short-term Memory – Dropped Out Right	Institutionalized vs Non-Stimulated	-0,910	> 0,999
	Institutionalized vs Stimulated	2,459	0,042
	Non- Stimulated vs Stimulated	1,645	0,300

Table 4 shows LTM - error ($p = 0.003$), LTM- omission ($p = 0.044$), STM - direct hit ($p = 0.008$), STM - total ($p = 0.024$), STM - right omission ($p = 0.022$) and the STM - right fell out ($p = 0.042$). The stimulated group, when compared to the institutionalized group, presents a higher performance, through statistically significant data.

Discussion

The present study confirmed that the participants had difficulties manipulating the instrument due to the lack of familiarity with the technology used for data collection (Tablet). This difficulty is because the elderly did not have access to

electronic devices and daily use (Camargo, 2018).

Anxiety was an emotional condition that intervened during the application, which increased frustration and disinterest (especially among those institutionalized). This population fears using the technologies or even leave the idea of being too complicated, being discouraged from learning as they face difficulties in handling the instrument and understanding the task (Camargo, 2018).

Considering memory as one of the most used cognitive function throughout life, we noticed a decline in the short-term memory (STM - cognitive ability to retain and process new information), long-term memory - semantics (LTM intelligence and

understanding of forms such as symbols and words), and - procedural (visuoperception and motor skills that over time become habits/routine) (Pinto, 1999).

As for the distinction between the participants, the institutionalized group had more difficulty understanding and carrying out activities throughout the game.

More significant impairment of this group may be associated with low self-esteem and a feeling of incapacity because there was not enough cognitive stimulation for a better quality of life at the institution.

There was no exaggerated discrepancy to the memory between the stimulated and unstimulated/non-institutionalized group since they present a healthier lifestyle, with behavioral factors that are co-determining, for the proper functioning of memory. Both take ownership of the performance of their daily life activities (ADL). Being active in their aging processes makes them the protagonists of their lives (Almeida et al., 2007).

In the institutionalized group, stimulation through the daily activities is impaired since they do not have the autonomy to perform them. After institutionalization, they lose their autonomy in their daily routine, which compromises their functionality and cognition. Thus, maintaining simple daily

Conclusion

On this basis, we conclude that there is a relevant difference between institutionalized and stimulated groups, being the most significant impairment of the cognitive functions STM and LTM occurring among the institutionalized ones. In general, there is a decline in memory due to the feebleness of low creative productivity.

The non-stimulated / non-institutionalized and stimulated groups'

tasks becomes vital for maintaining health and quality (De lima et al., 2017). It is worth mentioning that such difficulty in maintaining a functional capacity for such a group may not only be associated with institutionalization but with factors that precede it since they have significant disabilities, such as cognitive or physical impairment (Lini et al., 2016).

Observation during application indicates that they are not used to performing tasks requiring cognitive effort and are more frustrated than non-institutionalized groups. There is evidence that the institutional context does not provide sufficient cognitive stimulation to the elderly to preserve their cognitive functions and rehabilitate them as a form of prevention.

Given the results obtained in this research, the stimulated elderly has better performance in short and long-term memory than institutionalized ones.

The cognitive stimulation offered to these populations improvements to functional performance in activities that require memory, thus promoting greater autonomy and independence (Ramos et al., 2017). Rehabilitation includes contextual elements, image formation, elaboration, verbal association, and global cognitive function were stimulated (Pinto, 1999).

results did not show much difference, considering that they can leave their houses and develop other activities and collaborate to preserve their cognitive functions.

Notably, it is possible to reassess the cognitive stimulation in long-term care facilities to make it more useful and more rehabilitating, thus preserving their cognitive functions to reach senescence.

The focus would be to encourage the elderly to their cognitive abilities and skills, enabling greater independence (Pinto, 1999).

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