

# Cognitive effects of videogames on older people

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## ABSTRACT

In these days the percentage of older people in the population is growing worldwide. It is therefore urgent to decrease the morbidity resulting from biopsychosocial losses associated with old age. The preservation and recovery of cognitive functions and of physical, psychological and social autonomy are provided through new mental and physical activities. As have other activities, the use of video games has shown benefits for this ageing population, in particular at the cognitive level. Although there are only few studies which studied this videogames' application. In this study we studied the cognitive effects of videogames on the elderly people. And we also studied these effects on self-concept and on the quality of life. The instruments used are the Cognitive Sub-scale of Alzheimer's Disease Assessment Scale, the Clinical Inventory of Self-Concept and the WHOQOL-Bref. The study involved the participation of 43 elderly people distributed between 3 experimental conditions (n = 15 used videogames, n = 17 relaxation and n = 11 had no intervention). There were two moments of assessment, before the intervention (Pre-test) and after eight weeks of it (Post-Test). Old people shows to be able to use videogames as well as to like to use it. Although they faced some difficulties using key board and mouse. They show to prefer games without time challenge and without fast and exact movements. They also show to prefer videogames with a real story behind the play activity. It was found that the videogames participants showed a decline in cognitive deterioration from the pre to post intervention tests ( $t(14) = 3,505$ ,  $p = .003$ ,  $r = .68$ ), unlike the control groups. The self-concept deteriorated up significantly under relaxation condition ( $t(16) = 2.29$ ,  $p = .036$ ,  $r = .50$ ) and on passive control group ( $t(10) = 3.44$ ,  $p = .006$ ,  $r = .74$ ). The quality of life did not show any differences from the start to the end of the study. Nor were any correlations found between the time of use of videogames and larger effects. The mediator effect of self-concept on differences obtained in the ADAS-Cog ( $r_s = .57$ ,  $p = .014$ ) and in the ICAC ( $r_s = -.47$ ,  $p = .039$ ) was confirmed. In sum, the results show that the use of videogames leads to the improvement of cognitive functioning and to the maintenance of the self-concept and the quality of life of elderly people. They also suggest that the higher the self-concept, the better are the cognitive effects achieved.

## 1. INTRODUCTION

The improvements of hygienic conditions and medical knowledge led to the individual aging enlarge. The twenty-first century are even called of the aging century, because it is characterized by the abrupt increase in the proportion of elderly population.

United Nations (2001) expects that in 2050 the elderly population will represent 15.6% of the world population against 21% of young adults.

It is consensual that elderly population is more vulnerable to bio psychosocial losses, despite the fact that the aging process is very heterogeneous. At a physiological point of view, every system can reflect their organs aging. There are several changes in the nervous system: neurotransmitters levels changes, the brain atrophy, neuronal cells modifications, oxygen and blood flood decrease (Kaplan and Grebb, 1997). There is even evidence that the brain atrophy is linked to age-related cognitive decline (Albert and Killianny, 2001). And the age-related cognitive decline (especially the moderate decline) is related to psychological symptoms as clinical depression (e.g., Forsell, Jorm and Winblad, 1994), low self-concept and quality of life. The rest of the related aging losses also contribute to these psychological symptoms. These losses are especially social

losses. During the aging process elderly people lost significant others. These losses are related to deaths, to the end of professional relationships and to the distance of others (which is more difficult to overcome) (Giddens, 1997). Consequently, older people are submitted to a loss of social support. And these losses are intensified by *ageism* (the word Ageism was created by Butler (2005) based on words to designated discrimination against black people (racism) and against women (sexism). It is related to prejudices against older people).

Regarding cognitive decline, many studies have demonstrated that certain cognitive functions diminish with increasing age. Information processing speed is compromised, as is memory, verbal fluency, efficient consolidation on newly learned information and executive functions such planning and behavioural organization (Hooren et al, 2007).

At the same time, several studies argue that Information and Communication Technologies (ICT) have benefits to the older people. It is argued that TIC can improve social support (e.g. Wright, 2000; White et al, 1999), cognitive functioning (e.g. Bond, et al, 2001), quality of life (e.g., Leung and Lee, 2005; McConatha, McConatha and Drmigny, 1994) and diminish depressive symptoms (e.g. Whyte and Marlow, 1999). There are also studies that refer the benefits of videogames, which are specific ICT instruments. Visual improvement (Green and Bavelier, 2006, 2007; Risenhuber, 2004), spatial visualization (Subrahmanyam and Greenfield, 1994), reaction time (Bialystok, 2006), visuo-motor coordination (Griffith et al, 1983) and quality of life (Leung and Lee, 2005) are some of the benefits verified. The videogames' studies with older people verified several benefits too, although there is only few studies until now. The benefits achieved with videogames by older people are: reaction time(e.g., Dustman et al, 1992; Clark, Lanphear and Riddick, 1987; Goldstein, 1997); cognitive functioning (Farris et al,1994), intelligence (Drew and Waters, 1986), visuo-motor coordination (Drew and Waters, 1986), attention and concentration (Weisman, 1983), self-esteem and quality of life (McGuire, 1984; Goldstein, 1997). Green and Bavelier (2006) adverts that a massive increase in the amount of dopamine released in the brain was indeed observed during video game play, in particular in areas thought to control reward and learning. They also adverts that the role of this surge in dopamine and its implications are not currently well known, but work in rats suggests that dopamine may be important in the modification of the brain following perceptual training.

The aim of this work is to test the acceptance of videogames of older people and their ability to use it. Our purpose is also to identify the factors which contribute to their acceptance level. Simultaneously we will evaluate the cognitive effects of the videogames use on older people, as well as, the effects on their self-concept and quality of life. We also evaluate the mediator effect of self-concept on cognitive results achieved. We believe that older people are able to use videogames and that instruments have beneficial effects to them. We expect that higher the self-concept higher will be the beneficial effects.

## 2. METHOD

### 2.1 Sample

Participants were 43 people (10 man and 33 woman). They are all Portuguese and belongs to a residential homes to older people (26 are resident, 8 are daily frequent and 9 are activities frequenters). Mean age of 78.33 (SD= 8.002, min=65, max=93).

Participants presented the following inclusion criteria: 65 years old or more, inexistence of aphasia, hearing and visual severe deficits or behavioural and perceptual disorders. They maintained the psychopharmacological therapy during the experiment period and before two months of its beginning. All of them gave their informed consent. The study followed the ethical standards of the American Psychological Association (APA, 2001).

On the beginning of the study we randomised the participants for 2 groups: experimental group (with videogames) and control group (with relaxation sessions). Although, some of them could not participate in the 2 kinds of activities, so we opted for to have 3 groups: experimental group (videogames – n=15), active control group (relaxation sessions, n=17) and passive control group (without experimental treatment, n=11). There is not significant statistical differences between the 3 sample groups regarding the age ( $F=.340$ ,  $p=.714$ ), the sexual genre ( $\chi^2(2)=4.38$ ,  $p>.50$ ), the education level ( $\chi^2(6)=5.5$ ,  $p>.50$ ), the previous occupational area ( $\chi^2(12)=20.74$ ,  $p>.50$ ) and the marital status ( $\chi^2(8)=4.47$ ,  $p>.50$ ).

### 2.2 Instruments

**2.2.1 Measures.** There are 2 evaluation stages: pre and post-tests. Each stage encloses different instruments full-fill. The instruments used are: a demographic questionnaire (age, occupational area, educational level,

marital status, physical and emotional disorders, medication and time of use); the cognitive part of the Alzheimer Disease Assessment Scale – ADAS-Cog (Rosen and Mohs, 1984; Portuguese version: Guerreiro, 2003); The clinical self-concept inventory – ICAC (Vaz-Serra, 1986); The World Health Organization Quality of Life Questionnaire – WHOQOL (WHOQOL Group, Portuguese Version: Vaz-Serra et al, 2006). In the first assessment the participants also full-filled the consent form and in the final assessment they answered to questions about the sessions satisfaction and about the occurrence of life parallel major problems. The instruments used showed good psychometric characteristics in our sample. The most important psicometric characteristic in our study (a pre and post test design) is the test-retest correlation, which is high in ADAS-Cog ( $r=.83$ ,  $p=.000$ ), in ICAC ( $r=.75$ ,  $p=.000$ ) and lower in the WHOQOL-Bref ( $rS=.55$ ,  $p=.000$ ).

### 2.2.2 Intervention Sets.

**2.2.2.1 Videogames.** The videogames was selected based on their cognitive stimulation capacities. We opted to use causal games because they involve very simple rules and play techniques, making them easy to learn and play (IGDA, 2006). Participants of the experimental group are submitted to 8 videogames sessions (one weekly). It was selected 7 videogames after we use several videogames with a pilot-participant: QBeez, Supper Granny 3, ZooKeeper, PenguinPush, Bricks, Pingyn and memory games. The QBeez game was referred by Nicole Lazaro (2006) as being a game with emotional capacities and subsequently with capacity to develop a high interest level on users. In our opinion this games can improve the attention-concentration, the processing speed, the procedural tasks, the work memory and gnosis. The Supper Granny 3 game involves the resolution of problems and consenquently the attention-concentration, processing speed, the executive functions, the work memory and the spatial orientation. The Zookeeper seems to be able to stimulate attention-concentration, processing speed, the procedural tasks, the work memory, gnosis, and temproral orientation (because it has time challenging). PeguinPush seems able to stimulate attention-concentration, processing speed, spatial orientation and executive functions. Bricks were widely referred for being an exercise of knowledge of physic. We believe that it can exercise the attention-concentration, the processing speed, the procedural tasks and the work memory. Pingyin can improve attention-concentration, process speed, working memory, the procedural tasks and temporal orientation. The memory games can improve memory functions and also attention-concentration, process speed, gnosis and temporal orientation (in which there is time challenge).

**2.2.2.2 Relaxation Session.** The active control group was submitted to 8 relaxation sessions (one per week). The relaxation method used was the Jacobson's progression muscular relaxation training.

## 2.2 Procedures

After the videogames selection we try them in a pilot-participant, who selected the definitive 7 videogames which are the most adequate to his use. The participant-pilot was similar characteristics to the 43 study participants (the inclusion criterions). We also take advantage of his participant-pilot pre-study to test all the procedures to comply with during the assessment and intervention session. Then we selected the study participants through the clinical files analysis to confirm the inclusion criteria. After this selection we did a first interview in which the general aim of the study was introduced (to study the older people in two activities – we opted for being very general in the purposes presentation in order to avoid induce a bias of participants' behaviour (Hawthorne Effect)) and was full-filled the measures (Pre-Test). Then we randomised the participants by the experimental conditions. During 8 consecutive weeks the participants was submitted to the experimental conditions (videogames or relaxation sessions). And finally, we did a last interview to fulfill the second assessment of the measures (Post-Test) and to evaluate how the participants feel about the experiment and also to know if there are some life events relevant during the experiment period.

It is important to remark that as the participants did not have computer literacy, we had to do training on the beginning of the first session. The training consists on an introduction of the mouse and keyboard functioning and it was a duration of approximated 5 minutes (depend on the participant acquisition satisfaction).

In the first videogame session it was also presented all games to the participants, who can choose which they would which to play. In the following sessions we asked if they want to see all the games again or if they know which they wish to play already.

In all videogames' sessions the participants didn't have a period limited to use the games, they can use it how long they wish. During the sessions we give them reinforcements (“Well done”) and prompts (“Ok, lets see what you have to do now, you will find out.”).



Regarding the results achieved with ICAC, it was verified a decrease of self-concept in all the conditions, although the videogames conditions was not a significant decrease. In respect to quality of life, there wasn't any significant statistical differences (See Table 3). Differences between pre and post tests of the measures used in our study didn't showed to be significantly correlated to the time of use of videogames as we can see in the Table 4 below.

**Table 4.** Correlation between time of use of videogames and differences achieved in dependent variables.

		Dif. ADAS	Dif. ICAC	Dif. WHOQOL
Time of Use	Correlation	-.130 <sup>a</sup>	.071 <sup>a</sup>	.334 <sup>b</sup>
	Sig. (1-tailed)	.257	.362	.112
	N	15	15	15

a. Spearman Correlation

b. Pearson Correlation

The results obtained in our study confirm that there is a positive correlation between the initial ICAC overall result and the differences achieved at ADAS and ICAC. There is not however a significant correlation with the results of the WHOQOL.

**Table 5.** Correlation between Initial Self-concept and differences achieved at the Dependent Variables

		Dif. ADAS	Dif. ICAC	Dif. WHOQOL
ICAC_Total	Correlação	.566(*) <sup>a</sup>	-.469(*) <sup>a</sup>	.234 <sup>b</sup>
	Sig. (1-tailed)	.014	.039	.201
	N	15	15	15

a. Spearman Correlation

b. Pearson Correlation

The statistical tests also allow us to assure that the demographic variables didn't interfere in the differences achieved. Sex genre do not influence the differences achieved at ADAS-Cog ( $U=148$ ,  $p>.05$ ), at ICAC ( $U=165$ ,  $p>.05$ ) and at WHOQOL ( $U=155$ ,  $p>.05$ ). The educational level also didn't influence the results achieved at ADAS-Cog ( $H(3)=.62$ ,  $p>.05$ ), at ICAC ( $H(3)=3.45$ ,  $p>.05$ ) and at WHOQOL-Bref ( $H(3)=2.5$ ,  $p>.05$ ). Neither did the previous occupational area: ADAS-Cog ( $H(6)=5.78$ ,  $p>.05$ ), ICAC ( $H(6)=1.64$ ,  $p>.05$ ) and WHOQOL-Bref ( $H(6)=4$ ,  $p>.05$ ). As well as, the marital status didn't influence the results: ADAS-Cog ( $H(4)=4.37$ ,  $p>.05$ ), ICAC ( $H(4)=3.14$ ,  $p>.05$ ) and WHOQOL-Bref ( $H(4)=8.28$ ,  $p>.05$ ). Age didn't show any influence on the differences achieved at ADAS-Cog ( $rs=-.2$ ,  $p>.05$ ), at ICAC ( $rs=.04$ ,  $p>.05$ ) and at WHOQOL-Bref ( $r=-.1$ ,  $p>.05$ ).

### 3.1 Qualitative Results

During the experiment we registered also qualitative observations data.

The answers obtained to the final questionnaire, regarding participants satisfaction with sessions, show us that only one participant thinks that a part of the session are not very adequate to his cognitive skills (ADAS-cog tasks). He thinks that it is to people with worse cognitive difficulties. It was explained that the tasks have to be the same for all participants despite the cognitive skills (because it is a scientific study). The other participants think that the sessions was adequate.

We also observed that 2 women didn't want to participate in videogames sessions even before to see it. One did not want because she never had liked games, even traditional ones. The other women never had liked any kind of machines.

We observed that all of the videogames participants are able to use the computer after a brief introduction of use (5 minutes). Despite that their majority feels initially anxious about the computer use. Before the computer use they said that they are not able to do it and similar sentences. During the videogames use, participants expressed them self with sentences as "It is very funny!", "Can you give me this to put in my grandchild computer to allow me to play more?" and "This is really a good entertainment!" During the use it was also observed another kind of contentment expressions as laughter, especially when they achieve the

videogames purposes. Although we observed that they faced some limitations on computer use. They do not feel very confident in mouse and keyboard use, so they use it low and sometimes it is hard to them see the cursor.

It was interesting to observe that some videogames are more chosen than other. In Table 6 below we present a decreasing list of videogames preferences. The last three was equally chosen by the participants.

**Table 6.** *Videogames Used by decreasing order*

QBeez		
Super Granny 3		
Memória		
Pingyin		
Zoo Keeper	Bricks	Penguin Push

Regarding this observation the first two games are played without time challenge. The memory games chosen by participants are all without time challenge too. They demonstrated very interest for the Pingyin, because it is a videogame about the climate current world problems, but they give up to use it because they could not handle with the time challenge. Zookeeper has the time challenge difficult too and does not elicit as much interest as Pingyin did. Participants shows difficult to handle with the precision and fast of the movements. Despite they can manipulate the Penguin Push, they feel a little boring during its use.

It was also observed that some participants complained about excessive tears in the eyes during the game playing.

#### 4. CONCLUSIONS

The results achieved in this study supports that older people are able to use computers and that the videogames use can improve their cognitive skills. The results also supports that the videogames use maintain the self-concept and the quality of life of older people. Although it does not support that if older people play it during more time they can achieve better results. It seems, however, that when they have higher self-concept, they can achieve more cognitive improvements.

Our results are according the previous studies regarding cognitive effects of videogame playing by older people. We believe that if the intervention period was extended (longer than 8 weeks), the improvements would also have higher influence on the self-concept and quality of life.

We also observed that women show fewer predispositions for videogames playing than men as it is widely found. Any man refused to try videogames, in opposite to two women.

Despite the ability of older people to computer use, they have some anxiety about it and there is some interface limitations to this population too. We believe that it is necessary to demystify the prejudices about aging and about the use of computers by older people, in order to reduce the anxiety verified. At the same time it is necessary to improve ICT design to adequate it to this population. We think they would benefit with tangible interfaces as touch screens or Wii equivalents. We also think that they avoid videogames with very fast and precise movements and with time challenge. We think that our qualitative results also let us to conclude that they prefer videogames with a real and meaning story behind it.

We can not retire any conclusion about the tears effect observed, because we do not have how to know if it is related to the therapeutic visual effects referred (e.g. Green and Bavelier, 2007) or, in the other hand, if it is just related to a visual effort to see the videogames interfaces. This would be object of future research.

Our study would be better if we have a bigger sample, although it has already more than the previous ones. We hope that this study can have practical implications in older people daily living and in future research.

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