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Elderly online: Effects of a digital inclusion program in cognitive performance

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ABSTRACT

There is little empirical data about the impact of digital inclusion on cognition among older adults. This paper aimed at investigating the effects of a digital inclusion program in the cognitive performance of older individuals who participated in a computer learning workshop named "Idosos On-Line" (Elderly Online). Forty-two aged individuals participated in the research study: 22 completed the computer training workshop and 20 constituted the control group. All subjects answered a sociodemographic questionnaire and completed the Addenbrooke's cognitive examination, revised (ACE-R), which examines five cognitive domains: orientation and attention, memory, verbal fluency, language, and visuo-spatial skills. It was noted that the experimental group's cognitive performance significantly improved after the program, particularly in the language and memory domains, when compared to the control group. These findings suggest that the acquisition of new knowledge and the use of a new tool, that makes it possible to access the Internet, may bring gains to cognition.

1. Introduction

Changes in the demographic pyramid of several countries demonstrate the increase in the population of older adults worldwide (Lutz et al., 2008). Research studies point out that the elderly have an interest in and the capacity to gain autonomy in activities such as the use of computers. These studies also underscore that Internet access can bring about advantages, for instance, increase in social interaction and in cognitive performance (Czaja et al., 1993; McConatha et al., 1994; Jones and Bayen, 1998; Morrell et al., 2000; Kachar, 2003; Balboni and Schwartz, 2005; Sales et al., 2009).

Older adults might experience some decline in their social functions or leisure activities due to physical illness or due to social isolation associated to retirement. However, by means of the Internet they can develop new social networks with people who share the same interests (Lee et al., 2003). For instance, the study of a group of elderly Israeli subjects by Shapira et al. (2007), documented that the group who learned to use computers and the Internet showed significant improvement in psychological aspects such as depression, loneliness, and feelings of control. The authors observed that Internet use enhanced the subjects' well-being and positive feelings related to social interaction, in addition to assisting in cognitive functioning and preservation of autonomy and independence.

Previous papers have already pointed out that the use of computers and Internet access can generate cognitive stimulation, which is of major importance for the elderly, since browsing the Internet requires a set of cognitive and motor abilities. Table 1 highlights the cognitive capabilities that may be recruited when one browses the Internet (Slegers et al., 2009).

A recent research study by Small et al. (2009), involving 24 elderly and mature adult subjects showed that searching the Internet may change cognitive functioning. When the authors compared reading a book versus actively searching the Internet, neuroimaging demonstrated that similar brain areas were activated in both cases. However, the active search on the Internet more intensely activated the prefrontal cortex, an area that enables the individual to make decisions quickly while assessing complex information (West, 1996). This study suggests that learning to use a computer can be associated with neuroplasticity.

The study by McConatha et al. (1994) found cognitive gains after a sample of 14 subjects aged 59–89 used computers with Internet access for six months. The available services were e-mail, access to a digital encyclopedia, and educational and recreational games. Results pointed to significant improvement in the Mini-Mental State Examination (MMSE) scores, in activities of daily living, and in overall cognitive functions. Despite not having included a control group, the results from this research study suggest that computers may bring significant gains to the mature user.

On the other hand, research studies have shown that computer use and Internet access can lead to conflict among older users. Verona et al. (2006), for example, pointed out that the diversity and excessive amount of information found on the Internet can cause confusion and difficulties while seeking information.

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Table 1
Cognitive skills that are mobilized when using the Internet with examples of matching operations.

Cognitive skill	Matching operation
Long term (procedural) memory	Remembering the appropriate procedure to launch a browser
Short term or working memory	Keep track of already attended i nformation and already performed actions
Executive functions	Structuring necessary actions in the correct order
Visual search	Finding relevant information cues on a Web page
Information processing	Evaluate which information on a Web page is relevant
Attention	Focus on relevant cues on a Web page and ignore irrelevant cues

Source: Slegers et ?al. (2009).

Caution is required when the objective is to develop aged individuals' competence in using digital tools, particularly while planning the course. Older learners who express an interest in being trained to use a computer need more time to attain this goal. Their training must be provided step by step and at a slower pace, and the topics must be constantly reviewed for better retention, due age associated changes in cognition (Kachar, 2003).

A number of computer training workshops have been developed for aged individuals, though they are still rather technical. Authors, such as Passerino et al. (2006), have pointed out that the elderly need distinct pedagogical strategies, in line with their expectations and skills. Another key but often neglected issue is the contextualization of classes, since the learning process becomes more effective insofar as it is significant to the learner. Accordingly, it is necessary to work with topics of interest to the apprentice, such as health, travel, politics, cuisine and sports, to name just a few that might interest seniors (Freire, 1996).

Given the scarce empirical evidence about suitable pedagogical strategies for digital inclusion of older people, the present study aimed at developing a protocol for digital inclusion of older individuals, part of a Third Age University, based on a public university. The purpose of the present study was to assess the possible cognitive gains associated with participating in the program.

2. Subjects and methods

2.1. Subjects

From the 50 older individuals who initially agreed to participate in this study, only 42 completed the pre and the post-test. Therefore, 22 individuals participated in the digital inclusion workshop (Experimental group: EG), and 20 comprised the Control group (CG).

To qualify for this study, the applicant should be 60 years and older and to be able to read and write. Individuals who were familiar with the use of personal computers and/or the Internet, and with MMSE scores below the cutoff point for dementia, according to educational level, were not accepted as participants. These criteria are justifiable, respectively, because the planned activities require reading and writing skills, and because participants needed to be able to learn and follow instructions.

2.2. Materials

The protocol included a sociodemographic questionnaire and a brief battery of cognitive tests, namely the ACE-R adapted to Brazilian Portuguese and validated by Carvalho and Caramelli (2007). This tool consists of a brief cognitive assessment battery, and it tests five cognitive domains separately. The maximum score is 100, allocated as follows: Orientation and attention (18); memory (35); verbal fluency (14); language (28); and visuo-spatial skills (5). The scores relative to each of the six cognitive domains can be computed separately, and their sum corresponds to the participant's total score on the ACE-R. Within this sum there are 30 points referring to the MMSE score. A recent study confirmed that the Brazilian version of the ACE-R maintains high accuracy in identifying Alzheimer's disease, when the cutoff point is set at 78 (Carvalho et al., 2010).

2.3. Procedures

Applicants were contacted during the enrollment stage, after the research project was advertised. Only upon approval by the Institute of Psychology Research Ethics Committee, University of Sao Paulo, did the data gathering activities begin.

During a 35-min personal interview, applicants read and signed the Informed Consent Form, and afterwards, the proposed questionnaires were applied. After the screening tests, participants received a detailed schedule of the workshop. The first 25 individuals enrolled were allocated in the EG, and the next 25 in the CG.

The workshop included fifteen 120-min lessons. All classes were conducted in a conveniently located computer lab. At the digital inclusion workshop, participating older learners received instructional content on the basics of computing, including exploring the equipment and its functions, and using basic word processing, drawing and Internet browsing software. The topic of each lesson was always associated with health-related issues and the aging process.

All participants were retested using the ACE-R. In order to offset the retesting effect, new items were devised for episodic memory testing, as it has been done earlier with the alternate English versions of this tool. These new items were previously discussed with the authors of the Brazilian version of ACE-R. After the post-test stage, members of the CG also attended digital inclusion classes.

2.4. Statistical analysis

In order to describe the profile of the sample, frequency tables are presented for the categorical variables, and descriptive statistics, such as measures of position and dispersion, i.e., average and standard deviation, were produced for the continuous variables.

The continuous variables were examined for normality with the Shapiro–Wilk test, and none of them displayed normal distribution ($p < 0.05$). The EG and the CG were compared at pre and post-test with the Mann–Whitney test.

The data were fed into the Epidata 3.1 software, and later analyzed using the computational statistics software Statistica 7.0. The adopted significance level for the statistical testing was 5%, that is, $p < 0.05$.

3. Results

The EG consisted of 15 women and 7 men, and the CG, 15 women and 5 men. The EG mean age and years of schooling and ($\pm$S.D.) were 67.55 ± 4.37 and 8.64 ± 4.10, respectively. The CG mean age was 67.20 ± 5.31 and mean education was 10.00 ± 4.34 years of schooling. Table 2 shows sociodemographic data with regards to the EG, the CG, and the entire sample. EG and CG participants were statistically similar concerning the sociodemographic variables. There was no significant difference between the two groups regarding

Table 2
Sociodemographic profile of participants, *n*, %, mean ± S.D.

Variables	Total	EG[a]	CG[b]	$p <$
Number	42	22	20	
Gender (%)				
Women	71.43	68.18	75.00	
Men	28.57	31.82	25.00	0.738[a]
Age (years)	67.38 ± 4.78	67.55 ± 4.37	67.20 ± 5.31	0.520[b]
Education (years)	9.29 ± 4.22	8.64 ± 4.10	10.00 ± 4.34	0.369[b]
Family income in minimum wage (%)				
Up to one	9.52	13.64	5.00	
1–2	14.29	9.09	20.00	
2–3	19.05	18.18	20.00	
3–4	16.67	22.73	10.00	
4–5	21.43	18.18	25.00	
5–10	2.38	4.55	20.00	
>10	16.67	13.64	5.00	0.788[b]

[a] χ^2-test.
[b] Mann–Whitney-test.

Table 3
EG and CG performance in the ACE-R at pre-test, *n*, mean ± S.D.

Variables	Total	EG	CG	[a]$p <$
Number	42	22	20	
Orientation and attention	16.52 ± 1.58	16.60 ± 1.43	16.40 ± 1.76	0.715
Memory	21.67 ± 3.62	22.10 ± 3.50	21.15 ± 3.77	0.381
Verbal fluency	8.60 ± 2.02	8.90 ± 1.78	8.30 ± 2.27	0.380
Language	24.74 ± 1.70	24.40 ± 2.06	25.10 ± 1.12	0.326
Visuo-spatial	14.24 ± 1.75	14.40 ± 1.40	14.05 ± 2.09	0.867
MMSE scores	27.40 ± 1.99	27.50 ± 1.97	27.30 ± 2.05	0.808
ACE-R (total)	85.76 ± 7.52	86.50 ± 7.31	85.00 ± 7.87	0.614

[a] Mann–Whitney test.

Table 4
EG and CG performance in the ACE-R at post-test, *n*, mean ± S.D.

Variables	Total	EG	CG	[a]$p <$
Number	42	22	20	
Orientation and attention	17.43 ± 1.11	17.32 ± 1.29	17.55 ± 0.89	0.732
Memory	22.74 ± 2.76	23.59 ± 2.38	21.80 ± 2.89	0.030
Verbal fluency	9.60 ± 1.78	9.77 ± 1.72	9.40 ± 1.88	0.565
Language	25.48 ± 1.02	25.59 ± 1.18	25.35 ± 0.81	0.028
Visuo-spatial	14.67 ± 1.65	15.14 ± 1.21	14.15 ± 1.93	0.046
MMSE scores	28.62 ± 1.55	28.86 ± 1.75	28.35 ± 1.27	0.048
ACE-R (total)	89.83 ± 5.92	91.27 ± 5.84	88.25 ± 5.74	0.042

[a] Mann–Whitney test.

gender, age, years of schooling and income, with a 95% confidence interval (CI).

Table 3 refers to EG and CG cognitive performance in the pre-test assessment. Statistical comparisons indicated that they had similar cognitive performance levels at pre-test.

Table 4 shows the post-test cognitive scores of the EG and the CG. Statistical analyses point out that, after participation in the digital inclusion workshop, EG members achieved significantly higher scores in the domains of memory, language and visuo-spatial skills, as well as in the MMSE and in the ACE-R overall score. Results suggest that the groups drifted apart in scores for some cognitive functions after intervention.

4. Discussion and conclusions

One major challenge for the aging individual today is to adjust to the demands of a modern world, among them is the need to use computer technology and to have Internet access. The Internet makes it possible for older people to communicate with relatives and friends who live far away, and to broaden their circle of friends and leisure options. The digital barriers can become an element of exclusion for the elderly, which may take away their opportunity to participate in the present time, and entrap them in the previous generation. According to Kachar (2003), in order to step into the current technological society, one must have access to the computer dialect, or else risk being regarded as outdated and out of pace with today's world. In this context, the present paper aimed at examining the efficacy of a digital inclusion workshop directed to older individuals, examining possible effects of this intervention in their cognitive performance. The results indicated that seniors who participated in the 15 lessons achieved significant cognitive improvement as to memory, language and visuo-spatial skills. These data suggest that learning new technologies may lead to cognitive enhancement among older individuals.

One possible explanation for these results could be the program outline, which offered opportunities for the participants to exercise their creativity, build new knowledge, develop their reasoning, challenge memory skills, and solve problems. Similar results were observed in a previous Brazilian study, conducted by Iragaray and Schneider (2008), who assessed the participants of a digital inclusion workshop using the MMSE, though not including a control group.

In the present study, it must be pointed out that the EG, upon practicing with computers, showed significant improvement, particularly in language and memory skills, when compared to the CG. It can be suggested that members of the EG became faster in semantic search, since a verbal fluency test is part of the language domain, as does picture naming. Gains in verbal episodic memory were recorded, and they may be associated with the memory tasks, which were inherent to the digital intervention.

Research by Small et al. (2009) verifying that Internet use potentiates cognitive skills, confirms current findings. Small et al. (2009) found that some areas of the brain were more active in decision making tasks and in complex reasoning tasks, after several Internet search sessions. These results suggest that, despite the changes in neurobiological functioning brought about by aging, complex activities such as Internet searching may improve brain functions in older individuals, and consequently enhance their cognitive skills, especially executive functions.

Studies that address the impact of computer and Internet use on the cognitive performance of older individuals are still scarce (McConatha et al., 1994; Small et al., 2009). More studies are also necessary to investigate the psychosocial implications of digital inclusion. Psychosocial skills may also improve when one uses a computer with Internet access, or when one learns how to use a computer in group lessons. Some studies have suggested that self-confidence, loneliness, social interaction, satisfaction with one's life, and depression can be enhanced when seniors learn how to use computers and gain Internet access (Chen and Persson, 2002; Shapira et al., 2007).

As to methodology, the purpose of the present study was to develop a digital inclusion protocol for older individuals. Therefore, a course handout was developed, which aided participants' learning process, by making it possible to organize information and review the topics at home. At each lesson, participants were encouraged to make comments and express their doubts about the covered topics. Participant feedback and advance preparation of activity objectives and instructions in a simple, easy to understand format, were found to be vital elements for teaching older individuals how to use the Internet. These findings are in agreement with Aleven et al. (2003).

In sum, the present paper suggests that digital inclusion can represent an important strategy for cognitive enhancement for older adults, which may assist them to continue to perform daily activities independently. It also proposes that computer use can also contribute to their physical and mental health and to their quality of life, given that computer use can render it easy for an older person to access relevant information.

On the whole, the Elderly Online project produced satisfactory results, and it might be pointed out that digital inclusion workshops may lead to similar gains as the ones reported in cognitive training studies (Yassuda and Nunes, 2009).

Among the limitations of the present study, it should be noted that it involved a relatively small sample. Therefore, implementing replication studies is recommended. Future studies should employ the same intervention protocol, in order to further examine the association between cognition and older individuals' participation in a digital inclusion workshop. Future studies should also comprise a larger number of lessons, as well as involve more participants. As to outcome measures, studies should include an objective assessment of participants' satisfaction, motivation, and attitudes and beliefs regarding computers.

Conflict of interest statement

None.

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