

Accessibility of Web Financial Content for People with Dementia and Mild Cognitive Impairment. A Pilot Study in Greece.

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Abstract

The Web-applications for everyday financial transactions expand constantly. The SARS-COV-2 pandemic contributed further to this evolution of electronic services. However, the use of these applications by the elderly and the people with neurocognitive disorders remains challenging.

Object: The aim of this study is to develop an elderly friendly application that will result in effective and safe electronic purchases.

30 participants, 29 with minor and 1 with major neurocognitive disorder participated in the trial. They were asked to visit a virtual supermarket, find and collect specific products and then perform an electronic payment. The whole task was guided by a trained psychologist and evaluated.

Although the majority was familiar with the personal computer use, about 86,67% made mistakes regarding the list of products they needed to collect. 44,82% overcame the budget and about 26,67% could not complete the electronic payment with a credit card. The subject with the major neurocognitive disorder could not perform most of the

guided tasks. All subjects improved their performance when digitally guided help was offered.

Electronic purchases remain a challenging field for patients with neurocognitive disorders. However, patients with minor neurocognitive deficits within a proper digital environment and after training could be able to perform safe electronic purchases. This pilot study enlightens a major issue for our society and future larger studies should be performed to confirm these results.

Key words: Mild Cognitive Impairment, Online shopping, Dementia, Internet accessibility, Artificial Intelligence

Introduction

Web-based applications have been gaining ground nowadays. COVID-19 pandemic forced this field to expand in all the aspects of every day financial transactions, from supermarket purchases to all the home and business economic management. But how user-friendly is this innovative digital opportunity to the elderly and more specifically the elderly with cognitive deficits remains to be studied.

According to World Health Organization, currently, more than 55 million people live with dementia worldwide, and there are nearly 10 million new cases every year as world population gets older. Dementia is currently the seventh leading cause of death among all diseases and one of the major causes of disability and dependency among older people globally. The physical, psychological, social and economic impacts, for the patients, their families and the society are huge [1].

A number of digital applications try to detect early symptoms of cognitive impairment, to accomplish management of dementia neuropsychiatric symptoms, and to provide patients and caregivers with e-training [2-8]. Although their existence provides an opportunity to all those that cannot participate in a person-to-person evaluation and training, their results, their efficacy and their duration in time are still debatable. Therefore, although they are abundant in the web and they constitute a favorite research subject, they are still not used in everyday clinical practice.

In mild cognitive impairment stage (MCI) and later in dementia, as cognitive impairment develops and deteriorates, complex functionality tasks can be challenging raising the need for patient's supervision and help from others. In this regard, the belief of unassisted use of web-based applications, especially with financial context, can be rather unsafe.

The purpose of the European project "Accessibility of Web Content for People with Dementia and Mild Cognitive Impairment – WCACD" (project code: KMP6 -

0077944), is to detect these difficulties in early and later stages of cognitive impairment and assess how modifiable using artificial intelligent applications designed for this cause can be.

This paper reports on the results of a pilot study in Greece. More specifically, the results indicate that, with proper guidance, people with mild cognitive impairment can carry out electronic shopping efficient.

Materials and methods

Thirty participants with neurocognitive impairment, 29 with mild cognitive impairment and one with moderate dementia were recruited via Google forms, skype sessions, person-to-person contact and through databases of participants of web-based guided interventions in Greek Alzheimer's Association Day care center "Agios Ioannis", in Thessaloniki, Greece. The WCACD took place from All participants were informed about the goal of the research and the whole procedure orally and by provided inform consent. The protocol was approved by the Bioethical Committee of Greek Association of Alzheimer's Disease and Related Disorders protocol number: 2/11-11-21.

From the 30 participants 29 had the diagnosis of MCI and one the diagnosis of AD (moderate stage), so the evaluation performed separately in the two diagnostic entities. From all the participants, 93,33% (28/30) had used computer previously. Only 50% (15/30) had performed electronic purchases previously.

All participants were subjected to, neurological clinical examination, a structured medical history interview, blood tests (CBC, ESR, Urea, Creatinine, Electrolytes, SGOT, SGPT, Thyroid hormones, Vitamin B12, vitamin D, folic acid, homocysteine, RPR) and brain imaging (CT or MRI). The imaging aimed to exclude participants with structural abnormalities (such as tumors, arachnoids cysts, large/ or strategically located previous infarcts or hemorrhages

etc.), demyelinating lesions, and extended vascular lesions (Fazekas ≥ 2).

The neuropsychological, medical and laboratory results were evaluated by the expertise personnel of Greek Alzheimer's Association and related disorders, Neuropsychologists and Neurologists. The diagnosis and categorization were based on clinical criteria. Alzheimer's Disease (AD) patients met the National Institute of Neurological and Communicative Disorders and Alzheimer's Disease and related disorders (NINCDS-ADRDA) and DSM-V criteria for the probable AD [9-11]. MCI patients met the Petersen criteria for MCI and DSM V for minor cognitive impairment [11-14]. The final diagnosis was made by a dementia expert neurologist.

All participants underwent a detailed neuropsychological evaluation prior to their participation with a standardized neuropsychological battery (Functional Cognitive Assessment (FUCAS) [15], Montreal Cognitive Assessment (MoCA) [16], Mini Mental State Examination (MMSE) [17], Geriatric Depression Scales (GDS) [18], SAST, Rey Auditory Verbal Test (RAVLT) [19], Functional Rating Scale for Dementia (FRSSD) [20], Clinical Dementia Rating (CDR), Rivermead Behavioural Memory Test (RBMT) [21], Beck Depression Index (BDI) [22], Rey-Osterrieth Complex Figure (ROCF) [23]) and an insightful psychological interview, as well as physical and neurological examination. A neuropsychological battery was implemented to assess cognitive status comprehensively and evaluate aspects like working memory, executive functioning, attention, memory and language. In particular, the MCI group of 29 participants had an Age Mean= 68.07 (SD=7.18) and Education level of Years= 13.04 (SD= 3.43) including 22 females and 7 males. The 82-year-old female AD patient had nine years of education. Mean values and Standard deviations of participants' neuropsychological performances are shown in Table 1.

Table 1 Study participants' demographics

| Subjects | Diagnosis | Age | Education | Gender | MMSE |
|----------|-----------|------------------|------------------|--------|-----------------|
| N=30 | | Mean \pm SD | Mean \pm SD | F/M | Mean \pm SD |
| 29 | MCI | 68,07 \pm 7,18 | 13,04 \pm 3,43 | 22/7 | 28,8 \pm 1,24 |
| 1 | AD | 82 | 9 | F | 16 |

The trial was performed via the Zoom meeting platform due to the COVID-19 special safety reasons. After psychologist and a patient met digitally, a special link was made available to the patient to enter the virtual supermarket environment (see Figure 1). Then, a patient

was instructed to to perform specific purchases of a provided list of products in a specific amount that should remember byheart. In the end they should complete the electronic payment with a provided digital credit card.

All participants evaluated their experience in the end. The psychologist evaluated the whole procedure, from the platform connection to the payment procedure, and intervened during the process to help when it was necessary. Qualitative indexes such as connection efficacy-, effective product list recall-, effective budget management-, effective payment- correction provided, were evaluated separately..

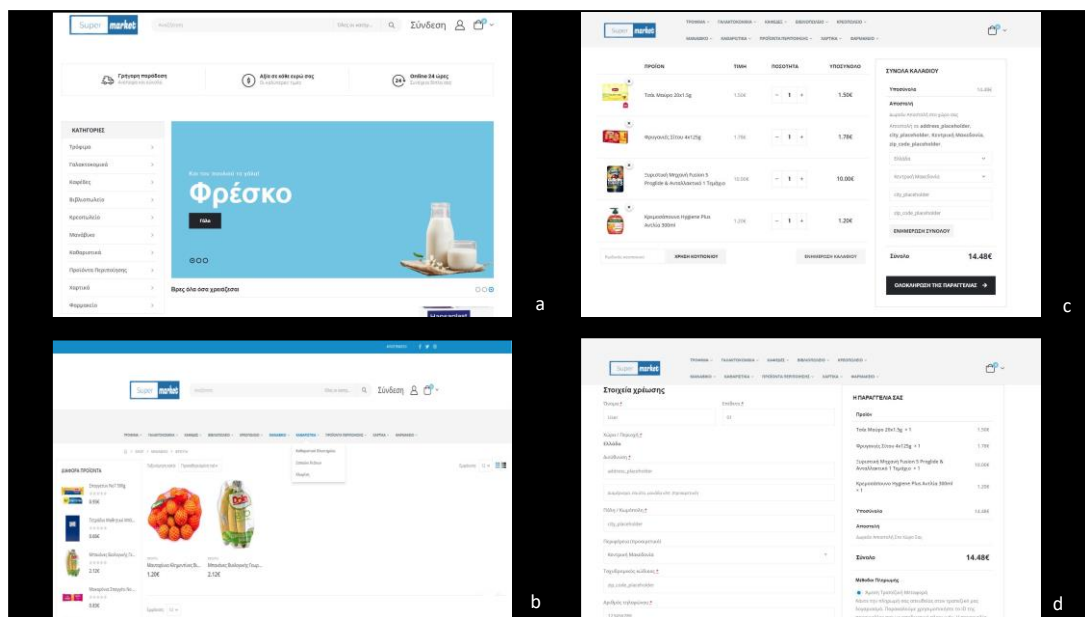


Figure 1. Supermarket online homepage (a), product categories (b), check out process (c), Billing information - payment (d)

Results

The 30 participants in our pilot study were split in two groups such that one group included 29 participants with MCI diagnosis, whereas the other group included 1 participant with AD diagnosis (moderate stage); then, evaluation was carried out separately in the two groups.

The majority 66,67 % (20/30) of the participants managed to connect without proper guidance and 30% (9/30) of the subjects succeeded to connect with guidance. The majority of 86,67% (26/30: 25/29 MCI and 1/1 AD) made mistakes regarding the list of products they needed to

collect but all the MCI subjects corrected when they were helped. The 70% (21/30: 20/29 MCI 1/1 AD) forget the amount of the demanded products but the 90,47% (19/21) from those, made the corrections when they were guided. The 53,33% were able to stay within the budget (16/30) and from those that overcame the budget (13/29) the 69,23% (9/13) managed to perform the suitable corrections. Finally, about 26,67% (8/30: 7/29 MCI and 1/1 AD) could not complete the electronic payment with a credit card. The 85,71% (6/7) of MCI subjects who failed the payment, were able to complete it with proper guidance. The subject with the major neurocognitive disorder performed the exercise with the help of her son and she could not understand the instructions or the corrections that were made.

Discussion

Electronic payments and Web-based services are part of the current lifestyle. COVID-19 pandemic had a huge impact on this change during the last two years.

Early in 2020 due to the COVID-19 risk, the elderly was considered as a high risk social group and they were instructed to limit all their social activities of daily living, including shopping. They were isolated even from their family members in order to protect them [24,25].

In the past, elderly rarely used Web-based application to perform their daily purchases, but recently, due to their forced isolation, elderly customers on-line have increased. According to the Swedish Internet Foundation about 10% of the Internet users in the third trimester of 2020, were elderly >66 years old, who performed for the first-time purchases online. About ¼ of the elderly 65-79 years old started to perform groceries purchases online in 2020 [26]. According to Eurostat, 32% of European Senior citizens aged 65-74 reported never having used the internet in 2020 [27]. Similar seem to be the numbers in Asia as well according to Chinese studies [28]. Although studies suggest similar technology acceptance between elderly and younger adults it is still underlined the need for assistance, encouragement and friendlier interface designs. And that can be provided by information and communication technologies and the use of artificial intelligence [29].

Most of the customer studies focused on the first year of pandemic, but changes continued in the next two years till now. Customer behavioral studies suggest that elderly (65+) consist still the

minority in electronic services although they suffer the most from the social restriction measures [30,31]

Shopping in the grocery shop is not only a daily need for the elderly, but also a social activity, a meeting point, an inspiration source of cooking schedule or homecare [32,33].

Considering all the above, a question rises; Can the online purchases replace these goals and fulfill these needs?

Current research present low percentage of elderly participation in online purchases but gradually they become an increasingly important potential market for e-shopping [34-36]. Furthermore, older adults are much less comfortable with online shopping than younger consumers, while also being more hesitant to use it raising issues such safety, accessibility, pleasure, usefulness, and trust [37,38]

Even though cognitive intact elderly is getting familiarized with new technologies and the opportunities that offer, the barriers are still considerable in people with cognitive impairment. The "Grocery Shop" virtual environment has been used for diagnostic and training purposes in people with cognitive impairment [39,40]. Would it be though possible for this elderly subgroup with cognitive impairment to actually use these applications in real life? Current literature provides no information about this part of the elderly population. Two possible reasons are either because it is considered incapable of safe internet transactions, or it is not studied yet.

Our pilot study suggests that the use of digital applications for electronic shopping can be challenging for people with mild cognitive impairment. However, with a proper guidance can be efficient. The aim of the WCACD project is to create a safe and effective environment with the use of artificial intelligence to provide safe access for patients with mild cognitive impairment to on-line services and shopping.

Conclusion

Elderly participation in online purchases is limited but it is growing larger year by year. Cognitive impairment can be an additional barrier for the use of electronic services. However, the small sample size is a limitation of the present size and future research should enlighten further this crucial issue. Technology assisted applications can offer new opportunities in this population.

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