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LONG PAPER

A study on the acceptance of website interaction aids by older adults

Silvana Maria Affonso de Lara · Renata Pontin de Mattos Fortes · Cibele Maria Russo · Andre Pimenta Freire

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Abstract The goal of the present work is to investigate the potential acceptance of a set of web interaction aids by older adults, in order to help them overcome difficulties associated with ageing and help them continue using the web as a source of information, communication and services. This paper presents a survey with older adults concerning their perceptions about a set of web interaction aids defined after a field observation study, a study with questionnaires and user tests of web applications. The survey involved 313 participants, of which about 44 % were older adults and elderly users. The results showed that the use of aids to support the interaction of older adults with the web promotes improvements in the interaction of older adults and younger users alike, which supports the argument for enhanced universal usability. Finally, it was possible to diagnose barriers that still remain and which aids had best acceptance by older adults.

Keywords Human–computer interaction · Usability · Accessibility · Older adults

S. M. A. de Lara (✉)
Federal Institute of Education, Science and Technology of São Paulo, São Carlos, Brazil
e-mail: silaffonso@ifsp.edu.br; silvana@icmc.usp.br

R. P. M. Fortes · C. M. Russo
University of São Paulo, São Carlos, Brazil
e-mail: renata@icmc.usp.br

C. M. Russo
e-mail: cibele@icmc.usp.br

A. P. Freire
Federal University of Lavras, Lavras, Brazil
e-mail: apfreire@dcc.ufla.br

1 Introduction

The phenomenon of population ageing has been noted worldwide. This makes it very important that adaptations be made to a variety of services and products to accommodate the needs of older adults who may have changes in their motor, perceptual or cognitive abilities.

In Brazil, where this study was conducted, the results from the 2010 National Census [16] confirmed that the country's population has followed a worldwide trend of ageing. In 1960, Brazilians who were 60 years old or older accounted for 4.7 % of the population. In 2010, they represented more than 10.8 % of the population. It is estimated that this percentage can reach 30 % by 2050 [15].

Population ageing has occurred as a consequence of lower birth rates and improvements in the quality of life of older people. In the particular case of Brazil, the country has experienced an unprecedented growth in the number of elderly people (those above 60 years of age) and older adults (in this work, considered as those in the 40–59 age bracket).

The definition of elderly people and older adults in this work is in accordance with the definition suggested by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium [36]). The definition of WAI was based on the proposal from the Association of American Retired Persons (AARP), defining young adults as those in the 18–39 age bracket, older adults as those in the 40–59 age bracket and elderly as those above 60 years of age.

The growth in the use of the Internet has made the web one of the most important sources of information. The web is a very important medium for online services, such as shopping, banking, government, learning, entertainment, social networking and others. Hence, given the current population ageing, it is very important to consider usability

and accessibility issues to improve the use of websites by older adults and elderly people.

According to Gonçalves et al. [7], age has a strong influence on the use of information and communication technologies (ICTs), with more notable impacts after 45 years of age [25]. In this context, either research studies in the area showed a negative association between age and ability to interact with technological resources [13].

Making websites more accessible to older adults has been a growing concern of researchers in web accessibility. Accessibility is defined by ISO 9241-171 [17] as "the usability of a product, service, environment or facility by people with the widest range of capabilities". In the particular case of web accessibility, this means making websites usable by as wide a range of users as possible, including users with disabilities and older adults.

More specifically, web accessibility aims to make websites more usable to disabled people (including blind, partially sighted, deaf, motor-impaired users) and users who may have difficulties using websites. Although older adults do not necessarily use special assistive technologies as some disabled users do, they could benefit from using supporting mechanisms to aid their interaction with websites. These mechanisms, which are not currently offered by web browsers, could help them by providing adaptations, redundancy or substitution of content according to specific needs they may have.

The lack of experience with technology is one of the reasons why many older adults and elderly users encounter difficulties when using websites. Many users do not know how to perform their daily activities using websites, or are not fully aware of the benefits they may have from using web technologies. Further to those reasons, there are also problems with barriers to access caused by poorly developed websites that can reduce users' productivity and efficiency.

Some people argue that the accessibility of websites to older users may be a generation-related issue. On a different stance, Hanson [10] discusses issues as to whether the difficulties currently encountered by older adults would remain the same 20 years from now. She questions whether the decline of abilities related to ageing, especially those related to learning, would affect technology use when people who are young adults now will become old. Would their experiences and abilities with current technology be sufficient to cope with future technology?

The next generation of older adults will have a richer repertoire of technology abilities than older adults today. This would give them more advantage to deal with the web and with computer applications. The tendency in remaining in the workforce for longer may also mean that those adults will be in touch with technological changes for longer than previous generations [2, 4].

However, it is possible that in a near future, the difficulties of older adults to use future technologies may not be related to difficulties to learn new technology, but with breaking paradigms of technologies they have previously used. Although they might have an advantage from having used currently available technology, they might have difficulties adapting to recently developed technologies. It is possible that 20 years from now, computers may have evolved to a state in which experience with the web as we know it and other applications may not suit older adults. Like the current generation of older adults, the next generation of older adults may encounter technologies that will present barriers to them [10]. The view that accessibility issues for older adults and elderly users should still be relevant for future generations is also shared by other authors, such as Czaja and Sharit [2].

Given the importance of considering the needs of older adults, it is very important to take their needs into consideration when designing websites. Making the web more accessible to older adults and elderly users can greatly improve the way in which they search for information, communicate with family and friends, and also increase the productivity in their work, and make them more independent to accomplish their daily tasks [1].

Although there are technical guidelines that can help build more usable and accessible systems for older adults, it is not enough to build websites that are "technically accessible" [31]. It is very important to provide means for users to be able to use systems compensating for their difficulties without the need for advanced technical abilities.

The aim of the study reported in this paper was to investigate the suitability of a set of interaction aids to help older adults and elderly users with little experience to interact with the web. Ultimately, the main aim of this work was to help designers identify which interaction aids have more acceptance by older adults and elderly users to help inform the design of websites and the development of assistive technology.

The remainder of this paper is organised as follows. Section 2 presents related work. Section 3 presents the method used to develop the present study. Section 4 presents the main results and discussion, and finally, Sect. 5 presents conclusions and future work.

2 Related work

Many studies have targeted issues related to the interaction between elderly users and interactive technologies. It is noticeable that most attention has been devoted to users above 60 years of age, and relatively less has been studied about older adults (those in the 40–59 age bracket). It is

worth highlighting that there is an ambiguity in the definition of older adults/elderly terms, which has caused confusion in the academic community. Our concerns were to reveal the findings of the use of web by both older adults and elderly users.

It has been shown that older adults can have their physical, sensory and cognitive abilities reduced, when compared to young adults [11]. Besides, in the current generation, older adults generally have less experience with technology than younger adults. Those issues make it very important to conduct studies to help understand differences in the use of technology by users in different age groups.

The literature in human–computer Interaction is very rich in research studies that explore the interaction of mainstream users with websites. However, there is still need for investigating specific issues encountered by older adults on websites to make their interaction with the web more satisfactory.

Some research studies have investigated the use of specific online applications by older adults and elderly users. Righi et al. [27] presented a preliminary set of results of a rapid ethnographic study, and they explored the activities and attitudes of elderly (60+) as ICT (Information and Communication Technology) users. Their research has offered some insights into how older people deal with accessibility-related issues, and their main focus was on e-government services. Lines et al. [22, 23] also provided contributions to improving online form design for elderly regarding access to e-government services.

Hogeboom et al. [14] and Páscoa and Gil [26], for example, highlighted the importance of the participation of older adults and elderly users in social networks as they become older. According to Hogeboom et al. [14], different studies in the literature have contradictory recommendations about the use of social networks, with some asserting that the use of social networks reduces the focus on users' real lives and weakens their "real" social lives, while others assert that the use of the Internet can strengthen users' social lives by improving their social support and connections to other people.

Different theories suggest that participation in social networks affects positively the health and psychological well-being of older users and elderly, helping them reduce their susceptibility to stress-related illnesses. In their study, Páscoa and Gil [26] analysed the contribution of Facebook in what was called "active ageing". The concept of active ageing is understood as the process of optimisation of opportunities for health, participation and safety, in the sense of improving people's quality of life as they become elderly [26]. The main benefits reported in Páscoa and Gil's study from the use of social networks by elderly users were improvements in collaboration, information sharing, contact with family and friends, knowledge acquisition, active participation in society and opportunities for collaborative work.

Other research studies focused on investigating the main difficulties encountered by older adults when using technologies such as PCs, portable media players and mobile phones. The main results of research studies by Chou and Hsiao [3], Kang and Yoon [24] and Gonçalves et al. [7] pointed out difficulties related to: manipulating the keyboard and the mouse, reading focus, incomprehensible error messages, small screens, keys and buttons too close together, involuntary mistakes and problems with colour contrast.

Important research studies have also been conducted to define guidelines and design recommendations for older adults and elderly users [28, 35]. Zaphiris et al. [35] proposed a set of guidelines for older adults and elderly users divided into 11 categories: interactive elements, graphics, navigation, browser characteristics, content exhibition, links, priority to the users' cognitive aspects, text presentation, recognition of orthographic mistakes in search engines, and feedback and support to users. Sales and Cybis [28] also proposed further adaptions that included synchronisation of captions and audio descriptions and the division of large blocks of information into smaller blocks.

The customisation of web interfaces to help older adults and elderly users was the aim of research developed by Hanson [9] and Hawthorn [12]. Their studies investigated means to modify web interfaces according to specific needs of those users, such as: text amplification, interface components in larger sizes and more spaced out to allow for easier mouse clicks, use of buttons instead of links, configuration of line spacing and others.

The provision of contextual interaction support to older adults and elderly users was the aim of research developed by Zajicek [34] and by Grossman and Fitzmaurice [8]. In order to accommodate memory and visual losses, Zajicek [34] developed a voice-based aid to help users build conceptual models of websites, via the *BrookesTalk* web navigator. For each possible state, a spoken output was generated. In each point of the interaction, users were able to choose an option and receive a new message describing the new state of the system. Although the study conducted by Grossman and Fitzmaurice [8] was not directly related to the web, their results could also be applied to websites. Their study investigated the use of online assistance via contextual videos to improve the ability to learn software functionalities. This support, named *ToolClips*, had the goal of extending the traditional tips given in software applications (*Tooltips*) [6], by providing textual and visual assistance according to the current context of the system.

The related research studies presented in this section showed that there is a growing interest in the

investigation of problems encountered by older adults and elderly users when using websites. Different research studies have investigated guidelines to help develop better websites and how to develop interaction aids to improve the access of those users. However, much still needs to be investigated in order to provide empirical evidence of the problems encountered by older adults and elderly users, and which interaction aids are most effective and better accepted by users. The research presented in this paper aims to contribute to further the knowledge in these areas.

3 Method

The investigation performed in this research involved the conduction of an online survey focused on older adults. The survey had the aim to evaluate the acceptance of a set of web interaction aids by older adults. Although the acceptance was not measured in an actual use of the proposed aids, the simulation of the web interaction aids would provide us with an indication of the potential satisfaction and receptivity of them to improve user experience.

The interaction aids were developed based on a field study with older adults, followed by questionnaires and user tests of web applications (an e-commerce web application [18] and another application testing horizontal menus [29, 30]) in the town of São Carlos, in the state of São Paulo, Brazil.

Younger adults were allowed to take part in the study because it would be interesting to compare the perception among the three groups and verify the age influence in the acceptance of web interaction aids although the focus of the study has been the elderly and older adults.

From those studies, a set of design recommendations and guidelines were proposed and described in Lara et al. [19]. A proof-of-concept browser context-sensitive plugin to help older adults and elderly users was developed [20, 21]. The development of those studies formed the basis for the web interaction aids that were investigated in the present study. Further details of the resulting aids are described in Sect. 3.1.

The online survey for the acceptance evaluation was chosen to enable the presentation of demonstrations of the proposed aids for users to check whether they would actually use them.

The aim of the survey was to investigate which aids were best accepted by older adults and elderly users, in order to help inform the design of websites and assistive technologies for older adults, without drastic changes on the interface.

3.1 The web interaction aids investigated

The set of interaction aids evaluated in the present study was based on previous research reported at Lara et al. [19]. The interaction aids were proposed with requirements elicited from empirical studies that investigated the main difficulties encountered by older adults.

The studies involved field observation, questionnaires and user tests of websites. The field observation was conducted by observing an ICT (Information and Communication Technology) course targeted at older adults at a local institution over a period of 4 months.

The next step involved two preliminary surveys to identify the main difficulties encountered in websites by older adults. The sample of the first survey consisted of users above 40 years of age and with substantial experience with the web, totalling 34 respondents. The second survey was conducted with the purpose of investigating how familiar older adults were with interface elements typically found in web pages and tools. An online questionnaire was developed to accomplish such verification, which addressed basic issues, such as URLs, images, menus and links, as well as elements of e-mail and chat tools. A total of 59 respondents participated in the second questionnaire. In both surveys, participants were invited by e-mail, based on lists of institutional contacts from the university where the research was conducted and from other government agencies, selected by the researchers.

Additionally, a study involving user tests of an e-commerce application was performed involving 30 users (including younger adults, older adults and elderly users). The purpose of the tests was to identify the difficulties of these users while performing the e-commerce tasks.

The main problems identified at all the previous study were reported at Lara et al. [19]. They could be summarised and mapped into the following proposed accessibility issues: information visualisation, focus retention of attention, memory of tasks already performed, speed control of interface elements, alternative narratives to relevant information (explanatory texts, format of the fields, documents necessary for application forms, etc.), tab features (what to do and how to do).

Based on those studies, a set of 19 web interaction aids was designed, and a demonstration prototype implementation for each one of these aids showed their basic features. The aids had addressed the proposed accessibility issues previously identified and involved support to: visualise information, retain attention focus, remember tasks already executed, control the speed of execution of interface components, spoken information (explanatory texts, data format, documents necessary to forms, and others) and guide to what to do and how to operate specific system

features. The 19 interaction aids designed in the present study are listed as follows:

- A1: Increase font size;
- A2: Change contrast between foreground and background colours;
- A3: Breadcrumb trail for navigation;
- A4: Help to complete search fields;
- A5: Block banners and advertisements;
- A6: Indication of need to use the scroll bar;
- A7: Summarise content;
- A8: Show content topics;
- A9: Show security information of a link destination;
- A10: Choose colour of visited links;
- A11: Choose colour of links in navigation menus;
- A12: Control the speed of drop-down navigation menus;
- A13: Slow down the speed of video presentations;
- A14: explanation of images;
- A15: Extended guidance on what to do and how to do;
- A16: Break forms into shorter parts;
- A17: Explanation of input fields with reminders of real-life documents;
- A18: Spoken help for data format for input fields;
- A19: Explanation of sequence of actions in a task.

3.2 The questionnaire

The questionnaire, implemented as an online survey on the web, contained 19 multiple-choice questions and 3 open-ended questions. For each question regarding the interaction aids, a visual demonstration was presented, showing how the proposed interaction aid would work. The demonstration could be played as many times as needed so users could understand how it worked.

At the beginning, users accessed the survey URL[1] and were presented with a welcome page. Next, they visualised a form with demographic questions to be answered, including: date of birth, e-mail address (optional), occupation, education, experience with the web and frequency of use.

The questions evaluated the acceptance of different web interaction aids, showing the aid, the question presented to users and images with the demonstrations presenting each aid. Examples of 3 of the 19 questions are shown as follows:

Example 1—Question 5: the aid presented in this question aims to reduce the amount of irrelevant information and to avoid distracting users on web pages, by blocking banners and advertisements.

> **Question 5 (as presented to participants):** It is common that web pages have many advertisements on them. The elimination of banners and advertisements normally makes the content cleaner and easier to read. Which of the following options would best describe the way in which you would use this aid if it was available? (Fig. 1)
>
> **Alternatives:** (a) I would never use this aid/(b) I would use this aid if I felt I needed it/(c) I would use this aid very frequently/(d) I would use another similar resource that produces a similar effect.

Example 2—Question 8: In order to reduce the cognitive load and make it easier for older adults to find information they want more quickly and with more precision, an aid was made available to list the main content topics available on a web page.

> **Question 8 (as presented to participants):** Suppose that you open a web page with a very long text. Say there was an option to visualise the main topics of the page in the form of links to parts of the text. Which of the following options would best describe the way in which you would use this aid if it was available? (Fig. 2)
>
> **Alternatives:** (a) I would never use this aid/(b) I would use this aid if I felt I needed it/(c) I would use this aid very frequently/(d) I would use another similar resource that produces a similar effect.

Example 3—Question 10: the motivation for the aid in question 10 was that, by choosing the colour of visited links, older adults would be able to feel that the interface is more familiar to them. This way, it would be easier to distinguish between visited and unvisited links, reducing the cognitive load and making it easier to recognise which links have already been visited.

> **Question 10 (as presented to participants):** Suppose there was a feature that would allow you to choose the colour of links you've already visited. Which of the following options would best describe the way in which you would use this aid if it was available? (Fig. 3)
>
> **Alternatives:** (a) I would never use this aid/(b) I would use this aid if I felt I needed it/(c) I would use this aid very frequently/(d) I would use another similar resource that produces a similar effect.

The questionnaire also included, at the end, two questions to investigate whether older adults perform more complex transactions on websites, such as on e-commerce and e-banking websites. Finally, they were also invited to

[1] Available online at http://agua.intermidia.icmc.usp.br/questionario, in Portuguese.

Fig. 1 Question 5: Removing banners and advertisements

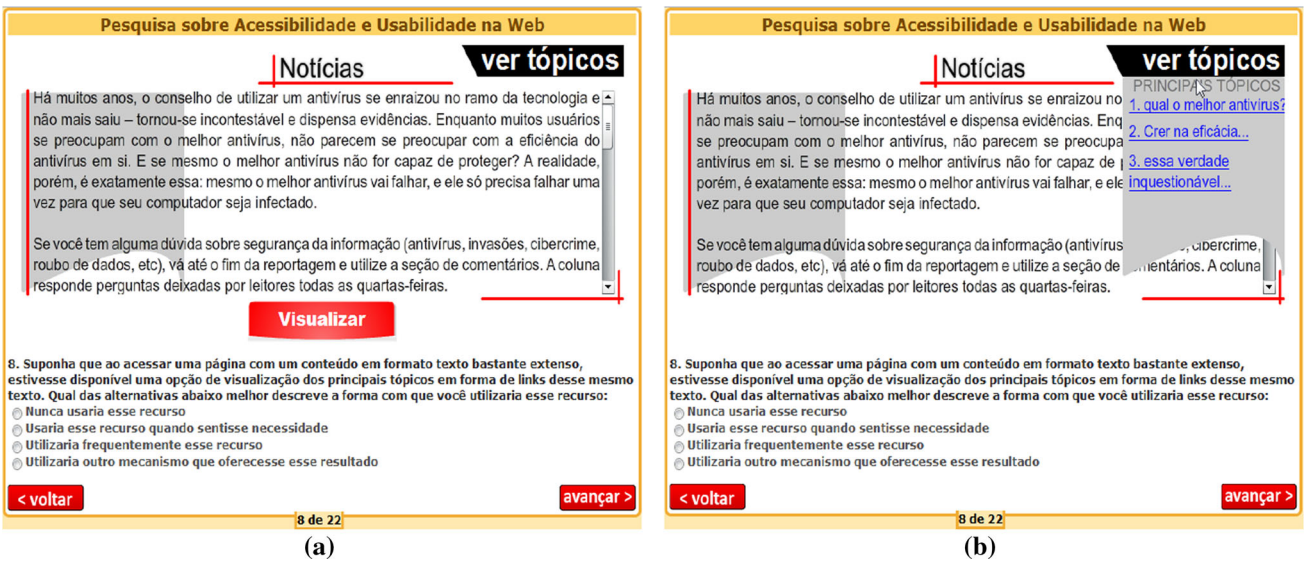

Fig. 2 Question 8: Aid to show content topics

provide comments about improvements they would like to see to make it easier to use such websites.

3.3 Procedure

Participants were invited to take part in the survey about web interaction aids for older adults via e-mail. They were allowed to forward the invitation to anyone who was interested, especially to those above 40 years old. Younger adults were also allowed to take part in the study. This would make it possible to perform comparisons between the perception of older and younger adults.

When accessing the survey, users were presented with a welcome page and then a form with demographic information. Participants were informed that all their information would be kept confidential and that they could abandon the survey any time they wanted.

After filling in the demographic data, participants provided their answers to the questions regarding the aids. For each question, participants were shown a demo of how each interaction aid would work, as described in Sect. 3.2.

The questionnaire was made available online between November/2011 and April/2012.

Fig. 3 Question 10: choose colour of visited links

3.4 Participants

A total of 313 participants took part in the survey. Their ages ranged from 17 to 85 years of age, with average age of 38.28 years. Considering the classification adopted in this work, participants were divided into three groups:

- **Younger adults**–up to 39 years of age
- **Older adults**–between 40 and 59 years of age
- **Elderly**–above 60 years of age

As can be observed in Table 1, 44.5 % of the participants (139) were in the groups of older adults and elderly people, the main target of this research. The values of the mean age and standard deviation (STD) for each age group are also presented.

With regard to the experience with websites, it is possible to observe in Table 2 that younger and older adults had more experience with websites than elderly users.

4 Results and discussion

This section presents the results from the survey with users and their indication of how frequently they would use each proposed interaction aid in websites. Participants were asked to answer how frequently they would use a given interaction aid in relation to the frequency they use the web. The meaning of 'frequently' was explained to them is that the resource would be used in most cases while they use the web pages and 'little' otherwise. Each interaction aid is discussed in detail.

It is worth noting that Tables 3, 4 and 5 present the results regarding aids to increase font size, change colour contrast and breadcrumb trail. Such aids already existed in current web pages and were not first implemented in the present study. The goal of the questions related to these aids was to evaluate how often they were used. In Tables 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, the questionnaire did not include the options "Little" and "Another aid", since they were related to new proposed aids that did not exist up to that moment.

There was a significant difference in the frequency of use indicated by users in different age groups in most aids. In the following five cases, no significant difference in the frequency of use was found: change contrast between foreground and background colour, help to complete search fields, summarise content, show content topics and slow down the speed of video presentations.

Table 1 Participants per age group

Age group	*N*	Percentage	Mean age	STD
Elderly users	18	5.8	67.1875	7.3588
Older adults	121	38.7	49.2231	5.4096
Younger adults	174	55.6	27.3543	5.5446
Total	313	100.00	–	–

4.1 Acceptance of web interaction aids by users in different age groups

4.1.1 Increase font size

The first aid analysed in the study was the use of aids to increase font size in the web browser by users in different age groups. A Chi-square test showed a significant

Table 2 Experience with the web by age group

Age group	Web experience			
	Up to 5 years	5–10 years	Above 10 years	Total
Elderly users	33.3 % (6)	27.8 % (5)	38.9 % (7)	100 % (18)
Older adults	5.0 % (6)	15.7 % (19)	79.3 % (96)	100 % (121)
Younger adults	10.9 % (19)	30.5 % (53)	58.6 % (102)	100 % (174)
Total	9.9 % (31)	24.6 % (77)	65.5 % (205)	100 % (313)

Table 3 Frequency of use of font size increase

Frequency	Never	Little	Every time I need it	Frequently	Another aid
Elderly	27.8 % (5)	11.1 % (2)	50 % (9)	0 % (0)	11.1 % (2)
Older adults	20.7 % (25)	24.8 % (30)	40.5 % (49)	8.3 % (10)	5.8 % (7)
Jovens	29.9 % (52)	31 % (54)	25.3 % (44)	4.6 % (8)	9.2 % (16)

Table 4 Frequency of use of changes in contrast between foreground and background colours

Frequency	Never	Little	Every time I need it	Frequently	Another aid
Elderly users	44.4 % (8)	33.3 % (6)	16.7 % (3)	5.6 % (1)	0 % (0)
Older adults	59.5 % (72)	22.3 % (27)	14.9 % (18)	2.5 % (3)	8 % (1)
Younger adults	67.2 % (117)	13.8 % (24)	12.6 % (22)	2.3 % (4)	4 % (7)

Table 5 Frequency of use of breadcrumb trails for navigation

Frequency	Never	Little	Every time I need it	Frequently	Another aid
Elderly users	38.9 % (7)	27.8 % (5)	27.8 % (5)	5.6 % (1)	0 % (0)
Older adults	19.8 % (24)	20.7 % (25)	35.5 % (43)	23.1 % (28)	8 % (1)
Younger adults	15.5 % (27)	14.9 % (26)	35.6 % (62)	33.9 % (59)	0 % (0)

Table 6 Frequency of use of help to complete search fields

Frequency	Never	Every time I need it	Frequently
Elderly users	0 % (0)	41.2 % (7)	58.8 % (10)
Older adults	7.6 % (9)	49.2 % (58)	43.2 % (51)
Younger adults	11.6 % (20)	52 % (90)	36.4 % (63)

Table 7 Frequency of use of aid to block banners and advertisements

Frequency	Never	Every time I need it	Frequently
Elderly users	0 % (0)	23.5 % (4)	76.5 % (13)
Older adults	4.1 % (5)	22.3 % (27)	73.6 % (89)
Younger adults	7.1 % (12)	35.7 % (60)	57.1 % (96)

Table 8 Frequency of use of indication of scroll bar

Frequency	Never	Every time I need it	Frequently
Elderly users	20 % (3)	40 % (6)	40 % (6)
Older adults	30.3 % (36)	45.4 % (54)	24.4 % (29)
Younger adults	50.6 % (87)	30.2 % (52)	19.2 % (33)

Table 9 Frequency of use of aid to summarise content

Frequency	Never	Every time I need it	Frequently
Elderly users	11.1 % (2)	38.9 % (7)	50 % (9)
Older adults	2.5 % (3)	41.7 % (50)	55.8 % (67)
Younger adults	4.6 % (8)	39.3 % (68)	56.1 % (97)

difference between the age groups ($X^2 = 16.09, N = 313$, $df = 8, p = 0.041$). Table 3 shows the distribution of answers given by each user group. It was possible to observe that none of the user groups had a substantial number of users that use it frequently. However, it was possible to notice that features to increase font size are used when necessary more frequently by elderly users (50 % of users) and older adults (40.5 %) than by younger adults (25.3 %).

Table 10 Frequency of use of aid to show content topics

Frequency	Never	Every time I need it	Frequently
Elderly users	5.9 % (1)	35.3 % (6)	58.8 % (10)
Older adults	2.5 % (3)	31.7 % (38)	65.8 % (79)
Younger adults	4 % (7)	38.2 % (66)	57.8 % (100)

Table 11 Frequency of use of aid to show security information of a link destination

Frequency	Never	Every time I need it	Frequently
Elderly users	23.5 % (4)	52.9 % (9)	23.5 % (4)
Older adults	9.1 % (11)	38.8 % (47)	52.1 % (63)
Younger adults	17.4 % (30)	48.3 % (83)	34.3 % (59)

Table 12 Frequency of use of aid to choose colour of visited links

Frequency	Never	Every time I need it	Frequently
Elderly users	16.7 % (3)	33.3 % (6)	50 % (9)
Older adults	16.1 % (19)	40.7 % (48)	43.2 % (51)
Younger adults	31 % (54)	43.1 % (75)	25.9 % (45)

Table 13 Frequency of use of aid to choose the colour of links in navigation menus

Frequency	Never	Every time I need it	Frequently
Elderly users	5.6 % (1)	55.6 % (10)	38.9 % (7)
Older adults	23.5 % (28)	38.7 % (46)	37.8 % (45)
Younger adults	31.6 % (55)	48.3 % (84)	20.1 % (35)

Table 14 Frequency of use of aid to control the speed of drop-down navigation menus

Frequency	Never	Every time I need it	Frequently
Elderly users	11.1 % (2)	44.4 % (8)	44.4 % (8)
Older adults	19.2 % (23)	48.3 % (58)	32.5 % (39)
Younger adults	27.7 % (48)	52.6 % (91)	19.7 % (34)

Table 15 Frequency of use of aid to slow down the speed of video presentations

Frequency	Never	Every time I need it	Frequently
Elderly users	5.6 % (1)	61.1 % (11)	33.3 % (6)
Older adults	5 % (6)	66.1 % (80)	28.9 % (35)
Younger adults	6.9 % (12)	63.6 % (110)	29.5 % (51)

Table 16 Frequency of use of aid to provide spoken explanations of images

Frequency	Never	Every time I need it	Frequently
Elderly users	0 % (0)	50 % (9)	50 % (9)
Older adults	15.1 % (18)	69.7 % (83)	15.1 % (18)
Younger adults	26.2 % (45)	58.1 % (100)	15.7 % (27)

Table 17 Frequency of use of aid to provide extended guidance on what to do and how to do

Frequency	Never	Every time I need it	Frequently
Elderly users	5.6 % (1)	44.4 % (8)	50 % (9)
Older adults	14 % (17)	63.6 % (77)	22.3 % (27)
Younger adults	24.9 % (43)	59 % (102)	16.2 % (28)

Table 18 Frequency of use of aid to break forms into shorter parts

Frequency	Never	Every time I need it	Frequently
Elderly users	11.8 % (2)	23.5 % (4)	64.7 % (11)
Older adults	10.7 % (13)	52.1 % (63)	37.2 % (45)
Younger adults	28.9 % (50)	37.6 % (65)	33.5 % (58)

Table 19 Frequency of use of explanation of input fields with reminders of real-life documents

Frequency	Never	Every time I need it	Frequently
Elderly users	11.8 % (2)	41.2 % (7)	47.1 % (8)
Older adults	19.8 % (24)	36.4 % (44)	43.8 % (53)
Younger adults	34.7 % (59)	41.2 % (70)	24.1 % (41)

4.1.2 Change contrast between foreground and background colours

Table 4 shows the frequency with which users in different user groups would change the contrast between foreground and background colours on websites. It is possible to observe that a substantial amount of users in all age groups would never use this aid, corresponding to 44.4 % of elderly users, 59.5 % of older adults and 67.2 % of younger adults. A Chi-square test showed no significant difference between the age groups for this aid ($X^2 = 11.36, N = 313, df = 8, p = 0.182$).

Table 20 Frequency of use of spoken help for data format for input fields

Frequency	Never	Every time I need it	Frequently
Elderly users	11.8 % (2)	52.9 % (9)	35.3 % (6)
Older adults	23.3 % (28)	52.5 % (63)	24.2 % (29)
Younger adults	39 % (67)	46.5 % (80)	14.5 % (25)

Table 21 Frequency of use of explanation of sequence of actions in a task

Frequency	Never	Every time I need it	Frequently
Elderly users	17.6 % (3)	29.4 % (5)	52.9 % (9)
Older adults	15.1 % (18)	50.4 % (60)	34.5 % (41)
Younger adults	18.5 % (32)	61.3 % (106)	20.2 % (35)

4.1.3 Breadcrumb trail for navigation

The frequency of use of breadcrumb trail to find pages previously visited is shown in Table 5. A Chi-square test showed a significant difference in the frequency of use by users in different age groups ($X^2 = 15.62, N = 313$, $df = 8, p = 0.048$). It can be observed that elderly users are the ones that use this aid the least, with 38.9 % reporting they never use it and 27.8 % using it a little. This result can indicate a lack of knowledge about this aid by elderly users, or that elderly users may tend to start over the navigation in a website from the home page when they need to return to a previous page.

4.1.4 Help to complete search fields

Table 6 shows the results of the acceptance of aids to help complete search fields by the different age groups. A Chi-square test showed no significant different between the three age groups ($X^2 = 5.61, N = 308, df = 4, p = 0.230$).[2] It was interesting to observe that even younger adults had high levels of acceptance of aids to help complete search fields (around 52 % stated that would use if every time they needed it and 36.4 % frequently). This can indicate that filling in search fields may be a difficulty encountered by users of different age groups and that this aid could be useful to many users.

4.1.5 Block banners and advertisements

Table 7 shows the results of the acceptance of features to block banners and advertisements on web pages. A Chi-square test showed a significant difference between the three age groups ($X^2 = 9.94, N = 306, df = 4, p = 0.041$).[3] Although this aid had a high acceptance by younger adults (about 57 % of the users), more than 70 % of older adults and elderly users stated that they would use it frequently.

4.1.6 Indication of need to use the scroll bar

Table 8 shows the results of the acceptance of aids to indicate that the scroll bar needs to be used to see more content. A Chi-square test showed a significant difference between the three age groups ($X^2 = 16.33, N = 306$, $df = 4, p = 0.003$).[4] This aid had the highest rejection rate by younger adults, with 50 % of them reporting they would never use it, while 40 % of elderly users reported they would use it frequently.

4.1.7 Summarise content

Table 9 shows the results of the acceptance of aids to summarise content on web pages. A Chi-square test showed no significant difference between the three age groups ($X^2 = 3.176, N = 311, df = 4, p = 0.529$).[5] This aid had high acceptance rates by all user groups, with more than 50 % of users in all age groups reporting they would use it frequently and around 40 % of users reporting they would use every time they needed it.

4.1.8 Show content topics

Table 10 shows the results of the acceptance of aids to show the main topics of the content in a web page. A Chi-square test showed no significant difference between the three age groups ($X^2 = 2.356, N = 310, df = 4, p = 0.671$).[6] This aid had high acceptance rates by all user groups, with around 60 % of users in all age groups reporting they would use it frequently.

4.1.9 Show security information of a link destination

Table 11 shows the results of the acceptance of aids to show information about the security of a link destination. A Chi-square test showed a significant difference between the three age groups ($X^2 = 12.897, N = 310, df = 4, p = 0.012$).[7] Older adults were the users who had the highest concern about knowing the security of a link destination, with more than 50 % of them reporting they would use an aid to show security-related information about links frequently.

[2] Five participants opted not to respond to question 4.

[3] Seven participants opted not to respond to question 5.

[4] Seven participants opted not to respond to question 6.

[5] Two participants opted not to respond to question 7.

[6] Three participants opted not to respond to question 8.

[7] Three participants opted not to respond to question 9.

This may indicate that users in this age group may perform more transactions that involve risks, such as banking or shopping.

4.1.10 Choose colour of visited links

Table 12 shows the results of the acceptance of aids to choose the colour of visited links. A Chi-square test showed a significant difference between the three age groups ($X^2 = 15.013, N = 310, df = 4, p = 0.005$).[8] Older adults and elderly users reported they would use such feature more frequently than younger adults.

4.1.11 Choose colour of links in navigation menus

Table 13 shows the results of the acceptance of aids to choose the colour of links in navigation menus. A Chi-square test showed a significant difference between the three age groups ($X^2 = 15.013, N = 310, df = 4, p = 0.004$).[9] Older adults and elderly users reported they would use such feature more frequently than younger adults.

4.1.12 Control the speed of drop-down navigation menus

Table 14 shows the results of the acceptance of aids to control the speed in which drop-down navigation menus are shown. A Chi-square test showed a significant difference between the three age groups ($X^2 = 10.832, N = 311, df = 4, p = 0.029$).[10] Older adults and elderly users reported they would use such feature more frequently than younger adults. However, although indicated more often by older adults and elderly users, it is worth noting that more than 50 % of younger adults also reported they would use it when they needed it.

4.1.13 Slow down the speed of video presentations

Table 15 shows the results of the acceptance of aids to slow down the speed of video presentations. A Chi-square test showed no significant difference between the three age groups ($X^2 = 0.673, N = 312, df = 4, p = 0.955$).[11] More than 60 % of users in all age groups reported that they would use this aid every time they needed.

4.1.14 Spoken explanation of images

Table 16 shows the results of the acceptance of aids providing spoken explanation of images. A Chi-square test showed a significant difference between the three age groups ($X^2 = 21.66, N = 309, df = 4, p < 0.001$).[12] All elderly users in the study reported they would use it frequently or use it every time they needed it. Few older and younger adults reported they would use it frequently. However, many of them reported they would use it every time they needed it.

4.1.15 Extended guidance on what to do and how to do

Table 17 shows the results of the acceptance of aids providing extended guidance on what to do and how to do tasks on websites. A Chi-square test showed a significant difference between the three age groups ($X^2 = 16.592, N = 312, df = 4, p = 0.002$).[13] Most elderly users reported they would use this aid frequently (50 %) or use it every time they needed it (44.4 %). Older and younger adults had similar percentages of users who reported they would use this aid every time they needed it. In field observations of elderly users, it was observed that elderly users were those who got lost the most when faced with a task they were unfamiliar with. They were also the users who needed the most to request help in person to explain to them where to go and what to do, as they did not know how to look for information in help sections of websites and systems.

4.1.16 Break forms into shorter parts

Table 18 shows the results of the acceptance of aids to break long forms into shorter parts. A Chi-square test showed a significant difference between the three age groups ($X^2 = 15.86, N = 301, df = 4, p < 0.001$).[14] About 65 % of elderly users reported they would use this feature frequently, compared to about 35 % of users in other age groups. About 52 % of older adults reported they would use it every time they needed it, and about 30 % of younger adults reported they would never use this aid. The results from the survey confirm previous observations in a field study with users. Many elderly users and older adults encountered problems when they had to fill out a very long form and, when pressing the submit button, received a message informing that the session had expired.

[8] Three participants opted not to respond to question 10.

[9] Three participants opted not to respond to question 11.

[10] Two participants opted not to respond to question 12.

[11] One participant opted not to respond to question 13.

[12] Four participants opted not to respond to question 14.

[13] One participant opted not to respond to question 15.

[14] Twelve participants opted not to respond to question 16.

4.1.17 *Explanation of input fields with reminders of real-life documents*

Table 19 shows the results of the acceptance of explanation of input fields with reminders of real-life documents. A Chi-square test showed a significant difference between the three age groups ($X^2 = 17.058, N = 308, df = 4, p = 0.002$).[15] This aid was better accepted by older adults and elderly users, and it was rejected by about 35 % of younger adults.

4.1.18 *Spoken help for data format for input fields*

Table 20 shows the results of the acceptance of spoken help for data format for input fields. A Chi-square test showed a significant difference between the three age groups ($X^2 = 13.981, N = 309, df = 4, p = 0.007$).[16] This aid was better accepted by older adults and elderly users, and it was rejected by about 39 % of younger adults.

4.1.19 *Explanation of sequence of actions in a task*

Table 21 shows the results of the acceptance of aids explaining the sequence of actions in a task. A Chi-square test showed a significant difference between the three age groups ($X^2 = 13.57, N = 309, df = 4, p = 0.009$).[17] More than 50 % of elderly users reported they would use such feature frequently, while about 50 % of older adults and 61 % of younger adults reported they would use it only when they felt they needed it.

4.2 Acceptance of web interaction aids by levels of experience with websites

Separate analyses were also performed to investigate the acceptance of the proposed interaction aids by users with different levels of experience with websites. In these analyses, it was observed whether users would somehow use each aid (either frequently or only when they needed it) or would not use each aid. Users were grouped according to three levels of experience, according to how long they had used the web: up to 5 years, between 5 and 10 years and above 10 years.

A set of 19 Chi-square tests were performed for each interaction aid comparing whether users with different levels of experience with the web would use it or not. None of the tests found any significant difference in the acceptance of the different interaction aids by users considering their levels of experience with the web as the independent variable.

4.3 Acceptance of web interaction aids by frequency of use of websites

Separate analyses were also performed to investigate the acceptance of the proposed interaction aids by users with different frequencies of use of websites. In these analyses, it was observed whether users would somehow use each aid (either frequently or only when they needed it) or would not use each aid. Users were grouped according to whether they used the web little (at least once a week or once a month) or frequently.

Chi-square tests found significant differences between the acceptance of two interaction aids when comparing users who have different frequencies of use of the web. However, a Fisher exact test confirmed a significant difference in only one of them.

Table 22 shows the percentage of users who use the web with different frequencies that accepted the aid to indicate scroll bars. A significant difference was found between the acceptance of this aid by frequent and non-frequent users ($X^2 = 5.562, N = 306, df = 1, p = 0.018$). This result was expected, given that people who use the web less frequently might be more likely to not recognise when they need to use the scroll bar.

4.4 Acceptance of web interaction aids in general by different age groups

Another set of analyses was performed to investigate whether there were differences between the acceptance of web interaction aids in general according to the ages of the users.

A set of Mann–Whitney tests for the acceptance of each interaction aid (reject/ would use) found significant differences in the ages of users who accepted or not the following interaction aids: indication of scroll bars ($U = 9479.5$, $n_1 = 180$, $n_2 = 126$, $p < 0.01$), choose colour of visited links ($U = 10645.0$, $n_1 = 234$, $n_2 = 76$, $p = 0.015$), choose colour of links in navigation menus ($U = 11130.5$, $n_1 = 227$, $n_2 = 84, p = 0.039$), spoken explanations of images ($U = 9576.0$, $n_1 = 245$, $n_2 = 63$, $p < 0.01$), extended explanations of functionalities ($U = 9284.5$, $n_1 = 251$, $n_2 = 61, p = 0.014$), break long forms into shorter parts ($U = 10210.0$, $n_1 = 246$, $n_2 = 65$, $p < 0.01$), explanation of input fields with reminders of real-life documents ($U = 12079.0$, $n_1 = 223$, $n_2 = 85$, $p < 0.01$) and help with requirements of data format for input fields ($U = 12760.5$, $n_1 = 212$, $n_2 = 97, p < 0.01$).

[15] Five participants opted not to respond to question 17.

[16] Four participants opted not to respond to question 18.

[17] Four participants opted not to respond to question 19.

Table 22 Frequency of use of websites and acceptance of indication of scroll bars

Frequency	Reject	Would use	Total
Little	8.3 % (1)	91.7 % (11)	100 % (12)
Frequently	42.5 % (125)	57.5 % (169)	100 % (294)
Total	41.2 % (126)	58.8 % (180)	100 % (306)

In general, users that tended to indicate they would use interaction aids had a median age of 41 (including all aids).

4.5 Interaction aids most accepted and rejected by users of different age groups

Table 23 presents a list of the three web interaction aids that were most accepted and rejected by each of the three age groups studied in this research. Blocking banners and advertisements and highlighting the content topics were the most accepted by all three age groups.

Elderly users had best acceptance of the aids to help complete search fields and break long forms into shorter parts, while older and younger adults prioritised the aid to summarise text.

The three highest rejection rates do not indicate that the aid was totally rejected by users in that age group, but that they had the highest percentage of rejection.

4.6 Use of e-commerce and e-banking by different age groups

The final questions of the survey also investigated whether users would use e-commerce and e-banking services. The results presented in Table 24 show that elderly users are still reluctant to perform tasks that involve financial transactions on websites, when compared to older and younger adults. Chi-square tests showed significant differences between the use of e-commerce services ($X^2 = 9.676$, N = 313, df = 2, $p < 0.01$) and e-banking services ($X^2 = 7.064$, N = 313, df = 2, $p = 0.029$) between the different age groups.

Users were asked to comment on suggestions to improve e-commerce and e-banking services, in order to make them easier to use for them. Some of the main comments about improvements to e-commerce from elderly users are listed below:

- "I would like to have words that are easy to understand and have security";
- "I would like forms to be easier to fill out and to reduce the bureaucracy";
- "websites should show demo videos and certification [of products] by official entities".

For older adults, some of the main comments to improve e-commerce were:

- "I would like to have a notification by e-mail of all the steps that I carried out, as some times I would like to have a guide of what I did, even if I did not complete my purchase";
- "I would like a voice message indicating whether the steps I've carried out were correct and giving instructions about what to do";
- "from the second purchase, the website should present to the user which options he/she used in the previous purchase, such as payment options or suggestions to perform the second purchase".

For younger adults, some of the main comments to improve e-commerce were:

- "there could be a central database to store all my data (name, address, credit card, etc) so I don't need to fill out this information every time I use a new e-commerce website";
- "there could be a step-by-step guide to help finalise my purchase. It could be some sort of avatar that would give an overview of what I need to do when I click on an input field. There could be an option to give an audio explanation or to read it on the screen (with a story board, for example)";
- "there could be some mechanism that would do a contextual search according to my history of visits to other e-commerce sites. It could show other products I was looking for before visiting that website";

From the main comments from users about e-commerce websites, it was possible to observe that the most important aspects considered by elderly users were the ease of use and security of websites (such as authenticity and privacy). Older adults highlighted aspects to reducing memory and cognitive load, given that their suggestions were related to guides, summaries and directions in order to be able to be sure their actions were correct and having the possibility to remember them later on. Younger adults reported they wanted more agility in the process of completing information in forms and contextual help and examples to make the purchasing process quicker.

With regards to e-banking services, the main suggestions given by elderly users were the following:

- "I find this explanation via voice with tips about the service you are using very useful. In some cases, the path to the service you want to use can be very confusing";

Table 23 Interaction aids with highest acceptance and rejection rates by user group

Interaction aids most accepted	Interaction aids most rejected
Elderly users	
Block banners and ads—76.5 %	Link security—23.5 %
Break long forms—64.7 %	Indication of scroll bars—20 %
Help to complete search/Content topics—58.8 %	Sequence of actions—17.6 %
Older adults	
Block banners and ads—73.6 %	Indication of scroll bars—30.3 %
Content topics—65.8 %	Colour of visited links—23.5 %
Summarise text—55.8 %	Spoken help to data formats—23.3 %
Younger adults	
Content topics—57.8 %	Indication of scroll bars—50.6 %
Block banners and ads—57.1 %	Spoken help to data formats—39 %
Summarise text—56.1 %	Real-life documents in forms—34.7 %

Table 24 Use of e-commerce and e-banking by different age groups

Service	Age group	Yes	No	*p* value
(e-commerce)	Elderly	55.6 % (10)	44.4 % (8)	<0.01
	Older adults	81.8 % (99)	18.2 % (22)	
	Younger adults	85.1 % (148)	14.9 % (26)	
(e-banking)	Elderly	44.4 % (8)	55.6 % (10)	0.029
	Older adults	69.4 % (84)	30.6 % (37)	
	Younger adults	74.1 % (129)	25.9 % (45)	

- "I would like to be able to use one single pin number to access all my bank accounts - including savings and current account. This way I could do all my banking transactions without having to access each account separately".

For older adults, the main suggestions to improve e-banking services were:

- "I would like to receive some kind of more evident alert to confirm when a transaction is being completed. Maybe something like changing the colours, of something highlighting that it is a critical point in the transaction";
- "my main problem is to remember my pin number, why not use my fingerprints?";
- "I would like to have a resource with a set of the operations I do most frequently, so I can access them with one click only";
- "I'd like to know what my last actions were, as I don't use the service frequently and I often forget the steps of the process";
- "I'd like to have a report sent by e-mail to me informing all operations done in my bank account online one a week or once a month".

Finally, the main suggestions given by younger adults for e-banking websites were:

- "a biometric reader that could certify who I am on the website";
- "a reminder of the last operations, so I can do them again";
- "I'd like to have a list of the operations I perform most frequently";
- "I think e-banking websites should have more detailed explanations (be it by text or voice) of any available resource or action that needs to be done".

For e-banking, the main difficulties encountered by users, independent of age group, were related to memory and excessive cognitive load. The difficulties were mainly related to remembering pin numbers and the steps to perform operations on websites, as well as feeling insecure about whether actions were completed correctly or not.

4.7 Web interaction aids most accepted by older adults and elderly users

From the analyses performed in this paper by means of the survey presented, it was possible to identify which web interaction aids were preferred by older adults and elderly users. A list of the main interaction aids prioritised by elderly users according to the input provided by them is presented below:

1. Remove banners and advertisements;
2. Break long forms into shorter parts;
3. Extended guidance on what to do and how to do;
4. Choose the colour of visited links, Spoken explanation of images and Explanation of sequence of actions in a task;
5. Explanation of input fields with reminders of real-life documents;
6. Indication of scroll bars;
7. Choose colour of links in navigation menus;
8. Spoken help for data format in input fields;
9. Slow down the speed of video presentations;
10. Show security information of a link destination.

For older adults, the main interaction aids considered as most relevant are listed as following, according to their priority:

1. Remove banners and advertisements;
2. Show security information of a link destination;
3. Explanation of input fields with reminders of real-life documents;
4. Choose the colour of visited links;
5. Choose colour of links in navigation menus;
6. Break long forms into shorter parts;
7. Explanation of sequence of actions in a task;
8. Slow down the speed of video presentations;
9. Indication of scroll bars;
10. Spoken help for data format in input fields;
11. Explanation of sequence of actions in a task;
12. Spoken explanation of images.

The analyses performed in this paper were important to further the knowledge into what types of aids older adults would like to have to use websites. The research has also shown differences they would have when compared to elderly users and younger adults.

The study had a limitation in that the interaction aids were not used in real-life tasks. Another limitation was that participants may have had a bias to answer positively when presented with a piece of technology that could help them perform their tasks. However, the results of this study remain much valuable to provide leads to knowing which interaction aids are more promising to help older adults improve their web interaction, based on field observations of difficulties encountered by older users performing real tasks. The use of the aid themselves to help in scenarios with real tasks will be the focus of further investigation.

5 Conclusions

This paper presented a study on the acceptance of a set of web interaction aids to help improve the accessibility and usability of websites for older adults. Research into improvements on the usability of websites by older adults is very relevant, particularly as life expectancy continues to grow. It is very important to better comprehend the ageing process and its consequences to elaborate better recommendations to improve the interaction of older adults with the web.

An important contribution of the present work was to provide empirical evidence from the perception of older adults of the types of aids they would like to have on websites. The set of aids proposed were based on field observations and on previous related work in the area.

The research performed showed that older adults have specific needs that have to be taken into account to allow them to use the web satisfactorily. It is important to consider the heterogeneity of those users and the ways in which they use the web, in order to avoid that technology becomes a barrier to them.

In the technical sphere, the lack of use of good practices when designing web pages can pose many barriers for users. However, most importantly, the lack of knowledge about how real users interact with websites and difficulties they may have can create barriers that may seriously discourage them to use websites, especially as their difficulties can become more serious as they age.

From the observation of older adults using websites, a set of interaction aids was proposed and the acceptance of those aids by older adults was evaluated by means of an online survey. The results from this survey were very important in the sense that they provide important behaviours, opinions and expectations of older adults in relation to their use of websites.

The results from this study revealed that many older adults have a strong dependence on in-person support of family members or friends to help them use websites. Based on this, it was very important to acknowledge how important it is to create specialised aids to help those users use the web effectively. The analysis of the survey showed that older adults have different expectations of the types of aids they would like to have when compared to elderly users and younger adults.

Although this work has not explored all possible types of problems encountered by older adults when using websites, it provides a very important initial contribution to help develop better websites for those users. As future work, the authors intend to continue to investigate what are the problems encountered by older adults by means of tests of websites by those users. They also intend to continue the development of interaction aids and assistive technology and evaluate their effectiveness with extensive evaluation by older adults.

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References

1. Burdick, D.C.: The aging imperative: designing for an aging population. In: Proceedings of the mini-conference of the South Jersey human factors and ergonomics society: human factors in complex sociotechnical systems, pp. 131–135 (2005)
2. Czaja, S.J., Sharit, J.: Preparing organizations and older workers for current and future employment: training and retraining issues. In: Czaja, S., Sharit, J. (eds.) Aging and Work: Issues and Implications in a Changing Landscape, pp. 259–278. The Johns Hopkins University Press, Baltimore (2009)
3. Chou, J.R., Hsiao, S.W.: A usability study on human-computer interface for middle-aged learners. Comput Human Behav **23**, 2040–2063 (2007)
4. Convertino, G., Farooq, U., Rosson, M.B., Carroll, J.M., Meyer, B.J.F.: Supporting intergenerational groups in computer-supported cooperative work (CSCW). Behav Inform Technol **26**, 275285 (2007)
5. Di Blas, N., Paolini, P., Speroni, M.: Usable accessibility to the Web for blind users. In: Proceedings of 8th ERCIM workshop: user interfaces for all, pp. 28–29 (2004)
6. Farkas, D.K.: The role of balloon help. SIGDOC Asterisk J. Comput. Doc. **17**, 3–19 (1993)
7. Gonçalves, V.P., Neris, V.P.A., Ueyama, J.: Interaction of elderly users with mobile phones: flexibility to support diversity. In: Proceedings of the 10th Brazilian symposium on human factors in computing systems and the 5th latin American conference on human-computer interaction, pp. 343–352 (2011)
8. Grossman, T., Fitzmaurice, G.W.: ToolClips: an investigation of contextual video assistance for functionality understanding, pp. 1515–1524 (2010)
9. Hanson, V.L.: The user experience: designs and adaptations. In: Proceedings of the 2004 international cross-disciplinary workshop on web accessibility (W4A), pp. 1–11 (2004)
10. Hanson, V.L.: Technology skill and age: what will be the same 20 years from now. Universal Access Inform Soc **10**(4), 443–452 (2011)
11. Hawthorn, D.: Possible implications of aging for interface designers. Interact. Comput. **12**, 507–528 (2000)
12. Hawthorn, D.: How universal is good design for older users? In: Proceedings of the 2003 conference on Universal usability, pp. 38–45 (2003)
13. Hellman R.:, Universal design and mobile devices. In: Proceedings of the 4th international conference on universal access in human computer interaction: coping with diversity, pp. 147–156 (2007)
14. Hogeboom, D.L., McDermott, R.J., Perrin, K.M., Osman, H., Bell-Ellison, B.A.: Internet use and social networking among middle aged and older adults. Educ. Gerontol. **36**, 93–111 (2010)
15. Brazilian Institute of Geography and Statistics(IBGE): Synthesis of social indicators 2008: an analysis of the life conditions of the Brazilian population
16. Brazilian Institute of Geography and Statistics (IBGE): National Census 2010: General Results (2010)
17. International Standards Organization: ISO 9241–171: Ergonomics of human-system interaction. Part 171: Guidance on software accessibility (2008)
18. Lara, S.M.A., Pietronero, W., Fortes, R.P.M.: Accessibility for older adults and elderly users in e-commerce. In: XVI Brazilian symposium on multimedia and the web–WebMedia 2010, Belo Horizonte, MG: SBC (2010)
19. Lara, S.M.A., Watanabe, W.M., Santos, E.P.B., Fortes, R.P.M.: Improving WCAG for elderly web accessibility. In: Proceedings of the 28th ACM international conference on design of communication, vol. 1, pp. 175–182 (2010)
20. Lara, S.M.A., Oliveira, D., Fortes, R.P.M.: Accessibility context sensitive to middle-aged adults and elderly in web systems. In: Proceedings of the 29th ACM international conference on design of communication (ACM SIGDOC'11), pp. 33–36. ACM, Pisa (2011)
21. Lara, S.M.A., Oliveira, D., Fortes, R.P.M.: Context-sensitive accessibility for older adults in web systems. In: Proceedings of the X Brazilian symposium on human factors in computing systems. orto de Galinhas, PE: SBC, pp. 353–357 (2011)
22. Lines, L., Ikechi, O., Hone, K.S., Elliman, T.: Online form design for older adults: introducing web-automated personalization. Presented at HCI, the web and the older population workshop, British HCI 2006 Queen Mary, University of London, London, UK (2006)
23. Lines, L., Patel, Y., Hone, K.S: Online form design: Older adults access to housing and welfare services. In: Proceedings of HCI and the older population workshop, workshop proceedings, HCI 2004, September 7–11, Leeds UK pp. 2122 (2004)
24. Kang, N.E., Yoon, W.C.: Age- and experience-related user behavior differences in the use of complicated electronic devices. Int. J. Hum. Comput. Stud. **66**, 425–437 (2008)
25. Minister of Industry, Learning a Living: First results of the adult literacy and life skills survey, Canada and Organisation for Economic Cooperation and Development (OECD) (2005)
26. Páscoa, G., Gil, H.: Facebook and elderly users: the importance of social networks for life-long learning. In: Proceedings of the 7th Iberian conference on systems and information technology, pp. 544–549 (2012)
27. Righi, V., Sayago, S., Blat, J.: Towards understanding e-government with older people and designing an inclusive platform with them: preliminary results of a rapid ethnographical study. Int. J. Public Inform. Syst. **3**, 131–142 (2011)
28. Sales. M.B., Cybis, W.A.: Development of a checklist for the evaluation of the web accessibility for the aged users. In: Proceedings of the latin American conference on human-computer interaction, pp. 125–133 (2003)
29. Santos, E.P.B., Lara, S.M.A., Castro, M., Fortes, R.P.M.: Horizontal drop-down menus: a case study with priority for older adults (in Portuguese). In: CLEI 2011, 2011, Quito, Equador. Proceedings of the Centro Latino Americano de Estudios en Informtica (CLEI 2011), vol. 1, pp. 1–10 (2011)
30. Santos, E.P.B., Lara, S.M.A., Watanabe, W.M., Castro, M., Fortes, R.P.M.: Usability evaluation of horizontal navigation bar with drop-down menus by middle aged adults. In: The 29th ACM international conference on design of communication (ACM SIGDOC'11), Pisa, Italy: ACM, pp. 145–150 (2011)
31. Sloan, D.: Two cultures? The disconnect between the web standards movement and research-based web design guidelines for older people. Gerontechnology **5**, 106–112 (2006)
32. Small, J., Schallau, P., Brown, K., Appleyard, R.: Web accessibility for people with cognitive disabilities, CHI '05 extended abstracts on human factors in computing systems, pp. 1793–1796 (2005)
33. Thatcher, J. & Waddell, C.: Constructing accessible web sites, Glasshaus (2002)
34. Zajicek, M.: Interface design for older adults. In: Proceedings of the 2001 EC/NSF workshop on Universal accessibility of ubiquitous computing, pp. 60–65 (2001)
35. Zaphiris, P., Ghiawadwala, M., Mughal, S.: Age-centered research-based web design guidelines. In: CHI '05 extended abstracts on Human factors in computing systems, pp. 1897–1900 (2005)
36. W3C, Web accessibility for older users: a literature review. W3C working draft. Available online at http://www.w3.org/TR/wai-age-literature/ (2008). Accessed 18 Nov 2012
37. W3C, Web Content Accessibility Guidelines 1.0. Available online at http://www.w3c.org/TR/WCAG10 (1999). Access 18 Nov 2012