

Research-Derived Web Design Guidelines for Older People

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ABSTRACT

This paper presents the development of a set of research-derived ageing-centred Web design guidelines. An initial set of guidelines was first developed through an extensive review of the HCI and ageing literature and through employing a series of classification methods (card sorting and affinity diagrams) were employed as a means for obtaining a revised and more robust set of guidelines. A group of older Web users were then involved in evaluating the usefulness of the guidelines. To provide evaluation context for these users, two websites targeted to older people were used. This study makes several contributions to the field. First, it is perhaps the first manuscript that proposes ageing-friendly guidelines that are for most part backed by published studies. Second, the guidelines proposed in this study have been thoroughly examined through a series of expert and user verifications, which should give users of these guidelines confidence of their validity.

Categories and Subject Descriptors

H5.m. **Information interfaces and presentation** (e.g., HCI):
Miscellaneous

General Terms

Design, Human Factors.

Keywords

Ageing, Web design guidelines, elderly, seniors, HCI.

1. INTRODUCTION

1.1 Older People and the Web

The pervasiveness of the Web appears to be growing in line with the ageing of the population. According to the National Institute of Aging, people over 60 today constitute one of the fastest growing groups of Web users [14]. Meyer and her colleagues [12] also acknowledge the increasing size of the Web and the increasing number of adults over 65 using it. The Web is not exclusively the playground of young persons anymore.

Subsequently there is an increasing call for websites to cater more for older visitors. This is necessary to address the current attitude

that many mature users ‘shying away’ from the Web. Those who are using the Web actually find that the Web offers various benefits, including: socialization; learning new skills; researching special interests; staying informed of current events; personal financial management; developing online companionship; shopping; keeping in touch with family and friends; and assisting people who are homebound or disabled [8].

One of the reasons often cited for the tendency of older people to shy away from the Web is the lack of understanding from Web developers that older people have different needs from their younger counterparts, both in the reasons for which older people use the Web and also in the way older users interact with it (mostly due to ageing-related functional impairments) [8]. Meyer et al. [13] conducted a Special Interest Group (SIG) devoted to issues of ageing and the use of technology and noted that:

The SIG participants reported that even intelligent and educated older people were treated like children in some training classes, because their normal declines in short-term memory meant that they could not remember as many things at once as their younger peers.

Another reason that was also frequently cited is the fact that some older people have never used or been shown how to use the technology and have never had the opportunity to learn [1].

1.2 Ageing-Related Functional Impairments and Their Impacts on Web Interaction

Most papers that discuss functional impairments and the Web concentrate on visual impairment. Whilst visual impairment is the biggest problem in Web interaction (because, in general, the Web adopts a visual interaction paradigm) cognitive and motor impairments also prevent older people from interacting with the Web effectively and efficiently.

Older people often suffer from visual impairments, which can make reading text on a computer monitor an arduous task. Not only is it difficult for such users to read characters that are too small, but also the standard white web page background can prevent such users from seeing the contents of a page even if text size has been optimised [9]. Furthermore, on-screen animations can distract the older user, placing too much strain on their cognitive capabilities [6].

The use of sound as an output device can potentially resolve issues surrounding ageing-related visual impairment. However, many older people are also hard of hearing, thus the benefits of audio output are lost. Moreover, they may be operating the computer in a noisy environment, or one in which sound output would be disruptive such as in a computer centre of an elderly organizations.

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One thing to note about these impairments is that, even though individual functional impairment might not result in a noticeable difference in the user experience, taken together they may have a cumulative effect that makes Web interaction more difficult for older adults. Further, they may result in "knockoff effects," e.g., the cognitive effort required to do sensory processing diminishes the remaining mental resources available for engaging in deeper, interpretive processing of the information.

Meyer and her colleagues [12] summarised some physical and psychological changes that are responsible for the hesitation of older people using the Web. These include a decline in working memory, which was evidenced from the problems older Web users had remembering which pages they have seen, or how they arrived at the current page. Increased age was associated with increased motor noise and slower movements, which could affect the use of scroll bars or image maps. More positively, however, research has shown cognitive adaptability in older people. In general, older people may respond well to training in complex tasks. Older people were also shown to be able to navigate the Web quite well when the sites are properly designed. The immediate implication is, with proper design and training, older people can use the Web quite effectively.

However, unfortunately a study by Hart [4], which evaluated 25 websites targeted to older audience, found that some websites still failed to adhere to simple guidelines such as providing large and highly contrasted text and as many as 95% of those sites failed to provide backward and forward navigation aids. This might hamper access by older Web users with reduced vision and cognition.

1.3 Web Design Guidelines

The first step in helping Web designers to ensure the usability and accessibility of websites is by providing them with Web design guidelines/heuristics. A web usability guideline has been defined as "any statement ensuring some adequacy of a particular user interface of a website with respect to a particular context of use where a given user population has to fulfil interactive tasks with a given system." [17].

The epitome of Web accessibility guidelines, as most people would agree, is perhaps the World Wide Web Consortium's Web Content Accessibility Guidelines (WCAG) [19]. The current version of WCAG, version 1.0, comprises 14 guidelines and 65 Checkpoints that designers can use to help them design accessible websites, not only for older users but also for users with disabilities in general. Another set of accessibility guidelines that is widely used in the US is Section 508 of the Telecommunication Act [3]. Various other countries also published their own Web accessibility guidelines [20].

There does not seem to be one set of Web usability guidelines that is used as reference worldwide the way WCAG are used for accessibility conformance, although there have been attempts to translate usability guidelines that were intended for user interface (e.g., Nielsen's heuristics) into Web design guidelines.

Review of Web design guidelines revealed that there are two streams of sources of guidelines: academia and industry. There is a lot of theoretical research that resulted in the production of guidelines, as well as sharing of handy tips by practitioners that were then translated into guidelines. Unavoidably, there are many overlaps (i.e., guidelines that aim to highlight the same problem but were phrased differently or have different focus).

2. THE STUDY

2.1 Initial Guideline Development

The purpose of this study are: to gather various published studies that proposed Web design guidelines for older people (both industrial and academic papers) to remove the overlaps, to categorize them in a meaningful way (using the established clustering methods of card sorting and affinity diagram), and to verify the usefulness of those guidelines with the target user group addressed by the guidelines: older Web users.

The study reported in this paper was a result of an extensive literature review (over 100 academic papers were reviewed - the full list of papers is available from the authors) on the areas of HCI and ageing. From the review of the vast literature, a set of 52 guidelines was established and categorized by their impact on ageing-related functional impairments. The guidelines were categorized into ones related to: vision (decline in static acuity, dynamic acuity, contrast sensitivity, colour sensitivity, sensitivity to glare, decrease in visual field, and decrease in processing visual information), psychomotor abilities, attention (declines in selective and divided attention), memory and learning, intelligence and expertise.

Each guideline was backed up with at least one published piece of literature/study. The complete set of the initial 52 guidelines can be obtained from the authors.

2.2 Card Sorting

Card sorting has been described as a quick, inexpensive and reliable categorization method for finding patterns in how users would expect to find content or functionality by sorting cards depicting various concepts into several categories [11]. Therefore, the next step in the study was to perform a card sorting exercise. The exercise was conducted with a group of 40 postgraduate Business Systems Analysis & Design students who are taking a compulsory module in Human Computer Interaction and Design. Participants were provided with a set of 3"x5" index cards containing the initial 52 guidelines, each with a short description. The cards were devised by the researcher, who randomly assigned a number from 1 to 52 along with a senior usability guideline on each card to ensure that related guidelines were not numbered sequentially together.

Participants were asked to group related guidelines, to sort these guidelines into categories and to provide category headings for these groups.

The results from the card sorting session was then inputted into EZSort, a freely downloadable cluster analysis software application from IBM [7]. EZSort produced a tree diagram depicting the 52 guidelines grouped distinctly into 9 different categories.

2.3 Focus Group

Building on the results from the card sorting exercise, a focus group was conducted with five HCI experts. The focus group technique was chosen because it is a quick, cheap and useful method and can rapidly bring a wide variety of views to the surface and even a consensus [10].

The key aims of the focus group were to:

- Gain an understanding of the chosen user groups' views on the 9 categories/groupings that had been devised from the card sorting exercise;
- Gain an insight into how users perceived the relationship between similar related guidelines;
- Consider whether related guidelines could be merged together to develop a smaller concise set of senior friendly usability guidelines;
- Provide clear category headings to the final groups of guidelines arranged by the participants.

The affinity diagramming technique was used within the focus group, in which the 52 guidelines from the card sorting session were printed onto yellow post-it notes and stuck onto the wall into the nine groups produced by EZSort. Affinity diagramming is a categorization method, similar to card sorting, where users sort various concepts into several groupings and categories [5]. This technique has been described as a powerful method to understand and group information [2] and is used by teams of users who are asked to organize large amounts of data according to their natural relationships between each other [10].

The focus group members were then asked to review the guidelines within each category and were given the freedom to move or remove any guidelines from their initial position. This was an iterative process which consisted of guidelines being removed from groupings and being added to either other groups or being added to new guideline categories.

Once the group had collectively agreed on the sorting categories for the 52 guidelines, they were then asked to consider whether there were any guidelines which they thought were very similar and could therefore be merged together to produce a smaller condensed set. As a final task the focus group agreed on category headings for each grouping of guidelines. Throughout the focus group, the researcher acted as a note taker, capturing the key decisions and considerations being made by the participants.

2.4 Final Guidelines

The result of the focus group discussions was a new smaller set of 38 guidelines which were grouped under 11 distinct category headings.

H1. Target Design

- H1.1. Provide larger targets
- H1.2. There should be clear confirmation of target capture, which should be visible to older adults who should not be expected to detect small changes
- H1.3. Older adult should not be expected to double click

H2. Use of Graphics

- H2.1. Graphics should be relevant and not for decoration. No animation should be present
- H2.2. Images should have alt tags
- H2.3. Icons should be simple and meaningful

H3. Navigation

- H3.1. Extra and bolder navigation cues should be provided
- H3.2. Clear navigation should be provided
- H3.3. Provide location of the current page
- H3.4. Avoid pull down menus
- H3.5. Do not use a deep hierarchy and group information into meaningful categories

H4. Browser Window Features

- H4.1. Avoid scroll bars

- H4.2. Provide only one open window e.g., pop-up/ animated advertisements or multiple overlapping windows should be avoided

H5. Content Layout Design

- H5.1. Language should be simple and clear
- H5.2. Avoid irrelevant information on the screen
- H5.3. Important information should be highlighted
- H5.4. Information should be concentrated mainly in the centre
- H5.5. Screen layout, navigation and terminology used should be simple, clear and consistent

H6. Links

- H6.1. There should be differentiation between visited and unvisited links
- H6.2. Links should be clearly named and no link with the same name should go to a different page
- H6.3. Links should be in a bulleted list and not tightly clustered

H7. User Cognitive Design

- H7.1. Provide ample time to read information
- H7.2. Reduce the demand on working memory by supporting recognition rather than recall and provide fewer choices to the user

H8. Use of Colour and Background

- H8.1. Colours should be used conservatively
- H8.2. Blue and green tones should be avoided
- H8.3. Background screens should not be pure white or change rapidly in brightness between screens. Also, a high contrast between the foreground and background should exist, for example, coloured text on coloured backgrounds should be avoided.
- H8.4. Content should not all be in colour alone (colour here is denoted by all colours other than black and white)

H9. Text Design

- H9.1. Avoid moving text
- H9.2. Text should be left justified and text lines should be short in length
- H9.3. There should be spacing between the lines
- H9.4. Main body of the text should be in sentence case and not all capital letters
- H9.5. Text should have clear large headings
- H9.6. Use sans serif type font i.e., Helvetica, Arial of 12-14 point size. Avoid other fancy font types.

H10. Search Engine

- H10.1. Search engines should cater for spelling errors

H11. User Feedback & Support

- H11.1. Provide a site map
- H11.2. An online help tutorial should be provided
- H11.3. Support user control and freedom
- H11.4. Error messages should be simple and easy to follow

2.5 Heuristic Evaluation

The validity of the new set of guidelines was tested by conducting heuristic evaluations using both sets of guidelines (the initial 52 and the second set of 38) on two different websites. A heuristic evaluation is defined as a "usability inspection method, which analyses user interfaces for usability" [15]. The main purpose of using the heuristic evaluation was to identify any usability problems that may exist in the new set of guidelines.

The key aims for employing the heuristic evaluations was firstly to test the meaning and understanding of the new set of guidelines which had consolidated and rephrased some of the guidelines to produce a smaller concise set of 38 guidelines and to identify any

guidelines which appeared ambiguous to users. The second aim was to compare the consistency of the responses being provided by participants in their evaluations when reviewing the same websites using the same set of guidelines, which would determine the reliability and robustness of the guidelines. Finally the third aim of conducting the heuristic evaluation was to determine whether a smaller set of guidelines would be more practical and useful to a web designer to use because it is quicker to assess a web site using a smaller set of guidelines than a longer set.

Six participants were recruited for this exercise (researchers and research students in the domain of HCI, unfortunately all are of young age – under 40 years old). The two websites chosen for review were www.elderhostel.org/welcome/home.asp and www.nslc.org whose screenshots are depicted in Figures 1 and 2.

These two websites were used in other evaluation studies on the usability of websites for older people (e.g., SURL) and are very different in layout, colour use, navigation, and various other aspects covered by the guidelines.

The sequence of websites and guidelines the participants reviewed were balanced. The participants were asked to work through the heuristic evaluation sheets provided and to evaluate the website in light of whether the site met a guideline or not by selecting ‘Yes’, ‘No’ or ‘NA’ on the heuristic evaluation sheets and providing any comments they had.

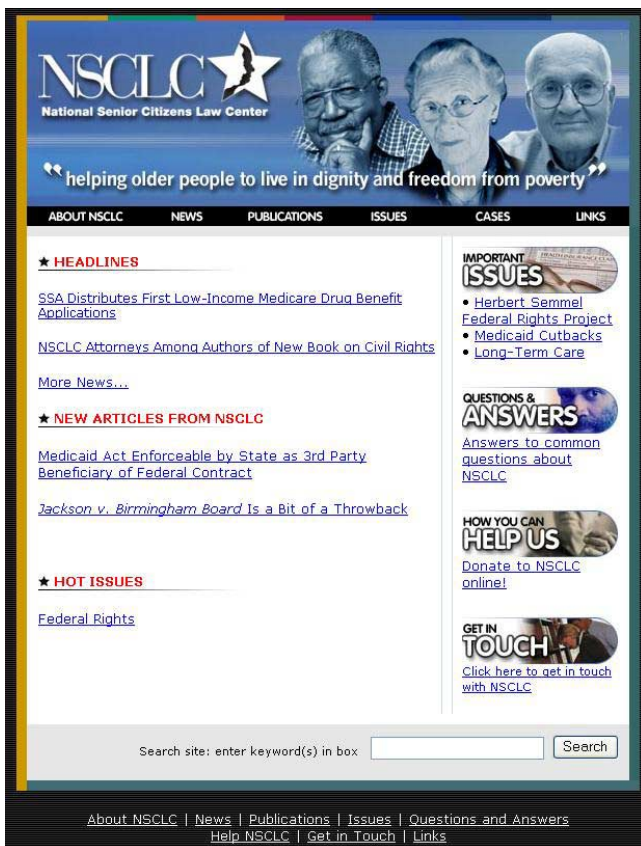


Figure 1. Screenshot of www.nslc.org

The evaluation results show that in rating the NSCLC website, participants rated the website very consistently using both guidelines, with a small variance in the total points being provided using both sets of guidelines and 71% of the new guidelines and

67% of the original guidelines consistently being answered by participants in exactly the same way. A comparison of the responses of the 9 new merged guidelines on the new set of guidelines with the separate 23 unmerged equivalent guidelines on the original set found that 7 out of the 9 merged guidelines were answered unanimously by participants compared to only 12 out of 23 equivalent unmerged guidelines being answered in exactly the same way.



Figure 2. Screenshot of www.elderhostel.org/welcome/home.asp

Looking at the heuristic evaluation results of the Elderhostel website, the results show that participants using the new set of guidelines again provided very similar compliance points with a variance of only 2 points between the lowest and highest ratings being provided. Additionally the 3 participants using the new set of guidelines had answered 71% of the guidelines in exactly the same way. The heuristic evaluation results using the original set, however show different ratings were provided to the Elderhostel website by the 3 participants in this evaluation, with the lowest compliance points of 18 being awarded by one participant and the highest compliance points of 37 being awarded by another, which provides a variance of 19 points. Additionally, only 40% of the guidelines were responded to in the same way by participants using the original set of guidelines. Comparing the responses of the new merged guidelines with the separate unmerged equivalent guidelines again also found that 8 out of 9 merged guidelines were answered in exactly the same way by participants compared to only 8 out of 23 equivalent unmerged guidelines being answered unanimously by participants using the original set.

In summary, the new set of guidelines is more robust than the original unmerged set of guidelines. A post-evaluation questionnaire also indicated that the new set of guidelines was perceived as more informative and more logically structured than the original set.

2.6 User Evaluation of the Guidelines

The next step of study was to involve sixteen older Web users (mean age = 59.2 years, 6 males and 10 females, their average Internet experience was 3.4 years) in a controlled experiment to evaluate the usefulness of this new set of guidelines. To provide a context for evaluation, the two websites used in the heuristic

evaluation were presented to each participant. Each participant was asked to rate the two websites on their conformance to each guideline. This was done to stimulate the participants to think about each guideline in more depth. Whenever a user was not clear of what a guideline meant, an experimenter was at hand to explain it. The whole session was videotaped for later observation.

After the participants finished rating the two websites, each was then asked to rate the usefulness of each guideline from '1' (useless) to '5' (very useful) and to provide some justification for their ratings. Due to the scope of this paper, the ratings of the two websites are not reported. Instead, the average of the usefulness rating for each guideline and the justification the participants provided are summarised in Table 1. The comments from these participants were transcribed by four experienced transcribers in real-time. The transcribers later resolved the notes in a group discussion, assisted with videotape replays when necessary.

Table 1: Guidelines' usefulness ratings and their justification

Guidelines	Mean	Justification
H1.1.	4.75	Important for those with motor and visual impairments.
H1.2.	4.25	Important for those with motor and visual impairments. Very useful as users need to know whether their actions were successful.
H1.3.	4.875	Important for those with motor impairments – difficult to keep the mouse still enough to double click, although following hyperlinks, the common activity in Web browsing usually does not require double-clicking.
H2.1.	4	Important for those with cognitive impairments. Older users often get annoyed with animation. Animation also distracts users.
H2.2.	3	Essential for users with visual impairment relying on non-visual browsers (<i>note: only very few users understand what this guideline means</i>).
H2.3.	3.75	Icons are generally not used in web design. No point in having complex icons in a web page as those with visual impairment will not be able to see the detail and work out its meaning.
H3.1.	3.75	Helps users know where they are (<i>note: it was observed that the participants were confused on the difference between guidelines H31.1, H3.2 and H3.3.</i>).
H3.2.	4	Helps users move smoothly through the pages of the web site. Users would get frustrated if they couldn't find what they are looking for and they would probably just not bother using the website.
H3.3.	4	It is important for users to know their current location in the web site.
H3.4.	4.25	Important for those with motor, visual and cognitive impairments. Older users are more likely to have hand problems that make manoeuvring a mouse difficult. Disagree, pull-down menus save space.

Guidelines	Mean	Justification
H3.5.	4.25	Improves content clarity and minimize density of the web site. Helps users find relevant information quickly
H4.1.	3.375	Horizontal scrollbars are easier to avoid, however vertical scrollbars are generally displayed in browser. Older users are more likely to have hand problems that make manoeuvring a mouse to the scrollbar difficult. The information that has to be accessed after scrolling is likely to be missed.
H4.2.	4	Multiple windows may cause confusion. Minimise distraction
H5.1.	4.25	Increased readability. Important as older users would have problem understanding complex language.
H5.2.	4.5	Reduced page density and increased comprehension. It is always important to keep a page simple.
H5.3.	4.25	Reduce browsing time by highlighting important information. Helps draw attention to it.
H5.4.	4.375	That particular area of the screen places emphasis on information. Important as otherwise users may not notice the information.
H5.5.	3.875	This guideline is too general. Important as once users know their way around a page, they should not have to start working it out all over again just because a different layout template is used.
H6.1.	4.625	Important for those with cognitive (particularly memory) impairments. Helps users not to remember which links they had visited.
H6.2.	4.25	Reduces confusion.
H6.3.	4.25	Enhanced readability and legibility. Makes links stand out.
H7.1.	4.75	Helps users have enough time to understand information presented. Very important as older users read more slowly [than younger users]
H7.2.	3.5	Important for those with cognitive (memory) impairments.
H8.1.	3.75	Important for those with visual impairments. Too many colours would require constant refocusing.
H8.2.	3.5	Important for elderly users only when these two colours are used in close proximity. These two are difficult to see as text colours.
H8.3.	4	Enhanced readability and legibility. Negative contrast is preferred.
H8.4.	3.125	Important for those with visual impairments.
H9.1.	4.625	Reduces confusion. Older users are more likely to have problems reading moving text.

Guidelines	Mean	Justification
H9.2.	4	Increases readability. Older users are used to reading left justified text so it is easier to read left justified text.
H9.3.	4.125	Not consistent with standard design principle. Improves readability.
H9.4.	4.25	Consistent with standard format. Improves readability.
H9.5.	4.25	Important for those with visual and cognitive impairments. Improves readability.
H9.6.	4.25	Increased readability, important for people with visual impairments.
H10.1.	3.75	Users who misspell words should be provided with the right spelling, instead of their search showing no result. Older users have problems spelling long words. Worsened eyesight might also cause more spelling mistakes as the users cannot easily see what they are typing.
H11.1.	3.125	Gives users a clear and accurate overview of the site. (<i>note: some users never saw or use a sitemap so didn't know what it was good for</i>)
H11.2.	3.625	Gives users detailed instructions about how to use the site. It would only be useful when it is user-friendly (most of them are not). It could be used to teach users how to use a site as many older users have limited experience with Web browsing.
H11.3	4	It is good to give users control of how desired information should be presented, e.g., changing font size. Important as user needs to feel in control.
H11.4	3.625	The error message must be clear so that users do not repeat the same errors. It is useless to have error messages that are only useful for a computer expert as most of the time the expert is not there with the user.

After the participants finished rating the usefulness of those guidelines, they were given an opportunity to propose their own guidelines. Only few participants responded to this. Some also proposed guidelines that were already covered by the existing set. The participants were asked for clarifications when their statements were unclear. The guidelines proposed include:

- Enable users to change font size as some users have worse sight than others do.
- Information should not be duplicated in the same page – it is a waste of space.
- Page should remain the same each time it is revisited (*note: the participant referred to advanced pages whose image changes every time the page is refreshed or revisited*).
- Include multilingual facility for non-English speakers (*note: this was suggested by a participant whose first language is not English*).

- Search facility should be placed in a noticeable place as some users prefer to search than to browse.
- Inform users of the most appropriate screen resolution. Provide multiple presentations for various screen resolutions, e.g., for large and small monitors.
- Do not use spacing too liberally – it is a waste of space (*note: the participant referred to the blank space in www.nslc.org. This suggested guideline is interesting as it contradicts H9.3.*)
- Provide a printer-friendly version.

3. DISCUSSIONS

The paper sets out to develop a set of guidelines that can help Web designers ensure accessibility and usability of Web pages for older people. This was achieved through an extensive literature review, to produce an initial set of guidelines that were fully backed by published manuscripts. The initial set of guidelines produced was very detailed and comprehensive, covering all important areas of ageing-related functional impairments that might hamper Web interaction. A card sorting exercise was then performed to categorize the guidelines into meaningful structure, resulting in 9 categories.

The paper then tests whether this initially large number of guidelines (52 in this case), could be shrunk without affecting the comprehensiveness of the set. This was done because studies found that too many guidelines might actually prevent adherence by Web designers. Scapin and colleagues [17] also supported this view by stating if the guidelines are potentially too long, general and not too specific, then a lot of time may be expended by the users of the guidelines in trying to interpret them according to the context of the user interface, with the designer not knowing when and how they can be used. Zajicek [18] emphasized this view by stating that this vast amount of research is often difficult to access by new designers of systems for older people because it requires the designer to first wade through the vast amounts of detail before they can understand how the knowledge applies to their domain.

A focus group exercise with affinity diagramming shrunk the set into 38 guidelines and 11 categories. The next major task was to then verify that the new set of guidelines were at the very least as comprehensive and informative as the original set. The heuristics evaluation performed conformed that the smaller set of guidelines are more robust and perceived most positively by the experts.

Robertson [16] has asserted that it is important to ensure that guidelines, which have been created, are organized, useful and meaningful for the users of the product. We had gone a long way into ensuring this, by first performing a series of expert validations using established methods, followed by user rating of usefulness with the user group targeted by the guidelines.

Observing the usefulness rating exercise performed by the older Web users, the rating averages show that in general our participants rated the guidelines quite positively. There was only one guideline that was rated a '1' by one participant. There are two interpretations of this tendency: either the guidelines were considered useful by our participants, or there was hesitation to mark down the guidelines presented. By asking the participants the justification for each rating, we can reasonably confidently say that we exclude the latter case.

It was observed that our older participants were not familiar with some terminology, and some had not been exposed to some of the features proposed in the guidelines. However, when an explanation was provided, the participants could supply a

reasonable justification for its usefulness rating. There were also cases where our older participants were not aware of the difference between several guidelines. And finally there was one odd case where a participant suggested a guideline that contradicts the existing guideline (although upon elaboration, the participant further explained that white space is good but not when used excessively). These three cases might not have a severe implication as these guidelines were intended for use by Web designers. However, if a user-centred design method is to be adopted, the occurrence of these three cases might pose a problem, as older participants might not fully understand the implication of a certain guideline or disagree with the given guidelines. This also highlights the importance of ensuring that guideline users understood what the guidelines refer to and that the target user group addressed by the guidelines had been consulted.

4. CONCLUSION

The study described in this paper has achieved to develop a manageable and robust set of guidelines for designing and evaluating ageing-friendly websites. The guidelines were backed by published manuscripts and had been exposed to several stages of expert and user validations, which should provide some assurance of their validity to their respective users.

There are inevitably some limitations of the present study. The first follow-up study is to hand-in this set of guidelines to Web designers to ensure their understanding and to seek suggestions on how to phrase the guidelines in the way that would be more easily comprehensible by Web designers. A comparison study of evaluations using the proposed guidelines and other existing guidelines with a range of websites targeted for older people would further confirm the usefulness of this set of guidelines. Another possible extension to this study is to compare websites designed with and without adherence to the proposed guidelines to investigate the effect of implementing this set of guidelines on the accessibility and usability of websites for older users.

5. REFERENCES

- [1] Christopher, P. Older Adults - Special considerations for special people, 1999. Available at: <http://www.gsu.edu/~mstsw/courses/it7000/papers/newpage31.htm>.
- [2] Gaffney, G. What is Affinity Diagramming?, 1999. Available at: <http://www.infodesign.com.au/ftp/AffinityDiagramming.pdf>.
- [3] General Services Administration. Section 508, 1998. Available at: <http://www.section508.gov/>.
- [4] Hart, T. Evaluation of Websites for Older Adults: How "Senior Friendly" are they? Available at: http://psychology.wichita.edu/surl/usabilitynews/61/older_adults.htm.
- [5] Hom, J. The Usability Methods Toolbox Handbook, 1998. Available at: <http://jthom.best.vwh.net/usability/usable.htm>.
- [6] Hwang F., Keates S., Langdon P., Clarkson P.J., Robinson P, 2001. Perception and haptics: Towards more accessible computers for motion-impaired users, in *Proceedings of Workshop on Perceptual User Interfaces (PUI'001)* (Orlando, USA, Nov 2001). Available at: <http://www.cs.ucsb.edu/conferences/PUI/PUIWorkshop/PUI-2001/a26.pdf>.
- [7] IBM. EZSort. Available at: http://www-3.ibm.com/ibm/easy/eou_ext.nsf/Publish/410
- [8] Kolodinsky, J., Cranwell M., Rowe, E. Bridging the Generation Gap across the Digital Divide: Teens Teaching Internet Skills to Senior Citizens. *Journal of Extension* 40, 3, 2002. Available at: <http://www.joe.org/joe/2002june/rb2.html>
- [9] Lopes, J.B. Designing user interfaces for severely handicapped persons. *Proceedings of the 2001 EC/NSF workshop on Universal accessibility of ubiquitous computing: providing for the elderly*, (Alcácer do Sal, Portugal, May 2001). ACM Press, 100-106.
- [10] Maguire, M.C. User-Centred Requirements Handbook, Version 3.3, 1998. Available at: <http://www.ejeisa.com/nectar/respect/5.3/44.htm>
- [11] Maurer, D., Warfel, T. Card sorting: a definitive guide. Available at: http://www.boxesandarrows.com/archives/card_sorting_a_definitive_guide.php
- [12] Meyer, B., Sit, R.A., Spaulding, V.A., Mead, S.E., Walker, N. Age Group Differences in World Wide Web Navigation, in *Extended Abstracts of the Proceedings of the SIGCHI conference on Human factors in computing systems (CHI '97)* (Atlanta, GA, USA, March 1997), ACM Press, New York, NY, 1997, 295-296.
- [13] Meyer, B., Mead, S.E., Rogers, W.A., Schneider-Hufschmidt, M. Making technology accessible for older users, in *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI '98)* (Los Angeles, CA, USA, April 1998), ACM Press, New York, NY, 1998, 373.
- [14] National Institute on Aging. Making Your Web Site Senior Friendly: A Checklist, 2002. Available at <http://www.nlm.nih.gov/pubs/checklist.pdf>.
- [15] Nielsen, J. Ten Usability Heuristics, 1994. Available at: http://www.useit.com/papers/heuristic/heuristic_list.htm
- [16] Robertson, J. Information design using card sorting. Available at: <http://www.steptwo.com.au/papers/cardsorting>.
- [17] Scapin, D., Leulier, C., Vanderdonckt, J., Mariage, C., Bastien, C., Farence, C., Palanque, P., Bastide, R. A Framework for Organising Web Usability Guidelines. Available at: <http://www.tri.sbc.com/hfweb/scapin/Scapin.html>.
- [18] Zajicek, M. Successful and available: interface design exemplars for older users. *Interacting with Computers* 16, 2004, 411-430.
- [19] W3C. Web Content Accessibility Guidelines 1.0., 1999. Available at: <http://www.w3.org/TR/WCAG10/>.
- [20] W3C. Policies Relating to Web Accessibility, 2003. Available at: <http://www.w3.org/WAI/Policy/>.