



W1: Workshop on Web and Aging

Organizers

Panayiotis Zaphiris
The Centre for HCI Design
City University, London UK

Sri H. Kurniawan
Department of Computation
UMIST, Manchester UK

R. Darin Ellis
Institute of Gerontology
Wayne State University, USA

25th June 2003

At HCII 2003, Crete, Greece

<http://www.soi.city.ac.uk/~zaphiri/Workshop>



Centre for HCI Design



Department of Computation



Wayne State University

Program

09:00-9:15	<p><i>Registration</i></p> <p><i>Introduction</i> Panayiotis Zaphiris, Sri Kurniawan</p>
9:15 – 10:45	<p>Session 1: Theoretical Foundations <i>Papers</i></p> <p><i>Approaches to Web Access for Older People</i> Sri Hastuti Kurniawan, D. G. Evans, P. Blenkhorn</p> <p><i>The Internet, Senior Citizens and Social Cohension</i> Duncan Timms</p> <p><i>Stimulus-Response Compatibility and Aging: Implications for Web Design</i> Robert W. Proctor and Kim-Phuong L. Vu</p>
10:45-11:00	Coffee Break
11:00-12:00	<p>Session 2: Case Studies and Applications <i>Papers</i></p> <p><i>Aging, cognition and task complexity in the use of an on-line grocery shop</i> Marie Sjölander, Kristina Höök and Lars-Göran Nilsson</p> <p><i>Evidence-Based Web and Ageing Guidelines</i> Shabana Mughal & Panayiotis Zaphiris</p>
12:00-13:00	Open Discussion with focus on research agenda for web and aging

Approaches to Web Access for Older People

S. H. Kurniawan, D. G. Evans & P. Blenkhorn

Department of Computation, UMIST
PO Box 88, Manchester, M60 1QD, United Kingdom
srik@co.umist.ac.uk

Abstract

This paper presents a number of approaches for web access for elderly people including: web page authoring guidelines; modification by a proxy server; access through special purpose browsers; browser interfaces adaptors; and assistive systems. The authors present their position, which is that a combination of well-authored pages together with a browser interface adaptor and, where necessary, appropriate assistive systems may be the best approach.

Problems Addressed

In this paper, we consider the major obstacles to older people accessing the web through as being visual and cognitive declines. Visual decline ranges from a modest decline in vision through more significant degrees of partial sight to complete blindness. Users with a greater degree of visual impairment will normally access a computer system using some form of assistive technology, either a screen magnifier or a screen reader or, indeed, a combined screen reader/magnifier. Problems posed by cognitive decline may include a reduction in a user's ability: to interact with complex systems; to memorize commands and text; and to handle information with complex spatial layouts.

Approaches

Fig. 1 shows a number of approaches through which the problems faced by an older person's access to the web may be addressed.

Server Side

Some accessibility problems can be addressed when the pages are authored by providing web authors and web authoring tool developers accessibility guidelines, e.g., WCAG (W3C, 1999). Increasing number of countries setup a regulation that made it illegal for some institutions to publish websites which do not adhere to accessibility guidelines. Automated checking (e.g., Watchfire Corp, 2002) and evaluation and repair tools to help web authors adhere to certain guidelines are also increasingly available in the market. However, it is unlikely that all web pages will fully comply in the medium term. There are a number of further issues. For example, some guidelines presume the use of an assistive tool to access the information. The most significant example is the "ALT" tag used to annotate pictures, which is probably of most use to blind users accessing information through a screen reader or self-

voicing web browser. Another issue concerns the fact that authoring cannot accommodate all users all of the time. For example, choosing a large font with high contrast text may help older users with modest visual impairments, but may pose problems for some people with dyslexia who require low contrast text. Therefore, there will always be situations where the needs of one group are in direct opposition to another, and both groups cannot be simultaneously satisfied by guidelines or accessibility tools.

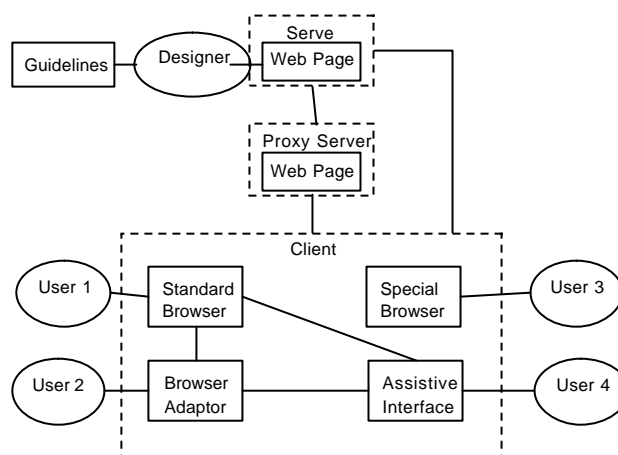


Fig. 1: Approaches to web access

Proxy Sever

A proxy server can be inserted between the server and the client and can be used to reformat web pages to meet a user's requirements before it reaches the client. These approaches are typically based on interpreting and rewriting the HTML. There are some advantages to using this approach. Firstly, some reformatting operations cannot be easily achieved by configuring a standard browser. Secondly, the approach is both machine- and browser-independent. The major disadvantage of using a proxy server appears to be that pages that require a secure connection cannot be operated through an intervening proxy server. This precludes their use for activities such as online shopping, which is the main reason for going online for some older web users.

Client Side

Browsers. A user may interact directly with a standard browser (User 1 in Fig. 1). In this case web page accessibility is provided: by guidelines that have been followed by the web page author; by reformatted web pages from the proxy server (if used); and by customization of the browsers features. The latter can include configuring the browser for the user's needs and the use of Cascading Style Sheets to change features such as text size and colour. It is likely that User 1 has a modest visual impairment and no cognitive difficulties, although the web page format could have been significantly altered to address problems with spatial layout if a proxy server has been used.

The second choice is to use a custom web browser. This allows: the reformatting of the web page to account for declined spatial ability (generally by linearising web page); enlarging text and possibly diagrams; voicing of the text; and creating a custom interface that can directly address ageing-related decline. An example of such a web browser is BrookesTalk (Zajicek, 2001). Thus, User 3 is presented with a heavily customized interface, which can address cognitive and sensory impairments. The problem with a custom web browser is that it has to keep pace with the rapidly changing technology and has to duplicate the features of standard web browsers. This requires very significant development efforts.

Browser Interface Adaptors. These were originally developed for blind people with the intention of making a standard web browser easier to use when accessed through a screen reader. The systems generally work by interacting with the object model of a commercial web browser to obtain information about the web page and presenting it in a linear format, which includes annotations (for example annotating a link with the text 'Link', which will be subsequently spoken or represented in Braille by the screen reader). Examples of browser interface adaptors include Baum's WebWizard, Frank Audiodata's WebFormator and the authors' Webbie (Blenkhorn & Evans 2002). There is no reason why a browser interface adaptor should stop at simply providing improved access for screen readers. In fact, a full custom interface could be provided so that the user sees an interface that appears to be a custom web browser. For example, IBM's Home Page Reader (IBM, 2003), a custom, self-voicing browser for blind people, is an alternative interface to a commercial web browser. The use of the author's Webbie also supports this idea; it is used by a number of partially sighted people because it provides text enlargement and colour changing on a simple, text-only linear-format page.

This approach has much in common with customized web-browser; indeed User 2's perspective is very similar to that of User 3 with the added advantage that users of a screen reader do not have to learn alternative controls. Moreover, it simplifies the development and maintenance of the software because a standard web browser is used to implement a significant portion of the system. However, like custom web browsers, significant work is required to render scripting

languages such as Java Applets and VB Script appropriately. In addition, some blind users, accessing information through a screen reader, prefer to access standard browsers directly rather than through an alternative interface. However, older users may be more amenable to alternative interfaces to standard systems than the able blind users who do not like this approach.

Assistive Technology. User 4 accesses a conventional or an alternative browser interface through assistive interface. This interface can be a screen reader or a screen magnifier. The choice of whether to use a conventional browser or not depends on how well the user's interface supports web access – some, notably the later versions of Freedom Scientific's Jaws screen reader are very good, others are less good – and whether the user requires the simplification of the browser interface.

Typically, a screen magnifier will be used with a standard browser, but for users who require significant enlargement, a magnifier may be used with a browser interface adaptor, which, by linearising the page may make navigation easier.

Position

Good design guidelines that are widely used can greatly increase the accessibility of web pages. For users with modest impairments, the fact that websites comply with guidelines may be enough. For some users, for example blind users, it is essential that some elements of the guidelines be followed if websites are accessible. However, not every site will follow guidelines and there are issues that guidelines cannot resolve.

For some users websites have to be presented in different forms. The choice is whether the re-presentation is done by a proxy server, the configuration of a standard browser, a custom browser or a browser interface adaptor. In our view, access to web sites is perhaps best obtained through the last of these approaches. From the developer's perspective, technology updates are handled largely by the browser. From the user's perspective, he is presented with a custom interface that may be configured to his needs.

References

- Blenkhorn, P. and Evans D. G. 2002. Augmenting the User Interface of Standard Applications for Improved Screen Reading for Blind People. In *Proceedings of the 18th Annual International Conference of Technology and Persons with Disabilities*. Northridge, CA: Center on Disabilities - California State University, Northridge.
- IBM. 2003. Home Page Reader. At: <http://www-3.ibm.com/able/hpr.html>.
- W3C. 1999. Web Content Accessibility Guidelines 1.0. At: <http://www.w3.org/TR/WCAG10/>.
- Watchfire Corp. 2002. Bobby. At: <http://bobby.watchfire.com/>.
- Zajicek, M. 2001. Supporting older adults at the interface. In *Proceedings of HCI International Conference*, pp. 454-458.

The Internet, Senior Citizens and Social Cohesion.

Duncan Timms

Faculty of Human Sciences, University of Stirling

Discussions and policies on the relation between ICTs and social cohesion in knowledge-based societies have focussed on the role of ICTs in providing access to employment. The concentration has been on people of working age or younger. This concentration ignores the large and growing part of the population who are not in the workforce as a result of age. There is a pressing need for an investigation of the potential of ICTs for encouraging social inclusion - e-inclusion - among older adults or "senior citizens" and on the promise of the Internet for encouraging inter-generational relations. With the spread of ICTs across Europe and the adoption of the e-Europe Action Plan by the European Commission the next five years are critical in ensuring that all members of the population are included.

Two contrasting views are extant among social scientists concerning the impact of ICTs on social cohesion. On the one hand, dystopians consider that the application of communications and information technologies to an ever widening range of social, cultural and economic activities (e-commerce, e-learning, *etc*) is providing another dimension for social exclusion. To lack access, for whatever reason, is to be excluded from the knowledge society. Age has been presented as one of the dimensions along which differentiation can occur, with elderly people being disadvantaged by reason of economics and cultural factors and, in some cases, disability. From this perspective the spread of ICTs may lead to a widening of generational differences rather than to the development of a more inclusive society.

Technological utopians, on the other hand, consider that the development of ICTs provides the basis for new forms of social inclusion, enabling people to participate in society regardless of temporal, spatial and other physical constraints, including those associated with personal characteristics such as age. From this perspective, the extension of the Internet and other forms of computer-mediated communication (CMC) provides scope for a rise in social capital, "connections among individuals - social networks and the norms of reciprocity and trustworthiness that arise from them" (Putnam, 2000, p.19).

The focus of the proposed research is the extent to which the spread of ICTs, especially those which enable connection to the Internet, can be associated with a

growth in network relations and trust among senior citizens and can contribute to new forms of relationship between young and old members of the population. In order to disentangle temporal effects which may be implicated in the "Internet paradox", a longitudinal approach will be used, following participants over a period of three or more years.

A series of demographic reports (e.g. the Report *People in Europe* prepared by the Commission) point to the significant increase in the number and proportion of people aged over 60 years of age in Europe during the next decade. At the same time, a recent *NIACE* Report (NIACE, 2002) points out that participation in learning declines sharply with age, falling off dramatically among those of retirement age. In a Knowledge Society, the role of ICTs will be vital in extending learning and other participatory activities to the old as well as the young.

Evidence on the use of the Internet by older people is sparse, but suggests that while those in relatively affluent situations are well-connected, those characterised by deprivation are doubly disadvantaged compared to younger groups of the population. Aldridge (2000) notes that "Income is one of the biggest factors, it divides who can and cannot have access". She goes on to say that "The technology is also very complicated, which has a deterrent effect" and that "A barrier to many older people is fear, fear that the equipment will fail the user, and fear that the user will fail themselves. Public points of access such as high street Internet cafes, libraries, kiosks at stations *etc* offer a chance to sample the technology for those who are still unsure of it." One of the areas in which research is needed is the difference in impact of home use and use from a public access point. The effect is likely to be complicated, being mediated not only by economics, but also by differences in self-efficacy associated with differential biographies.

There has been little study of the actual use which connected senior citizens make of the Internet or other ICTs or of any differences in such use between those connecting from home and those using public points of access. The proposed research will address these questions through a combination of online and offline surveys and focus groups. Attention will also be paid to the work of peer group non-profit organisations such as

SeniorNet (SeniorNet 2003) in Sweden and its sister organisations in Belgium, Finland, Denmark and the Netherlands, which have a well-developed programme for developing the online presence of senior citizens (defined in Sweden as those aged 55 years and over). Local branches of SeniorNet, e.g. in Malmö and Bromma, have pioneered projects which are designed to involve groups of senior citizens working with school pupils in the development of local web pages and other activities.

A distinguishing characteristic of the Internet is its ability to support online or virtual communities. Although there have been some voices suggesting that online participation detracts from participation in local communities, the majority view is that online communities can be complementary to those based on physical presence (see Ferlander and Timms 2000). Haythornthwaite *et al* (1998, p. 213) note that “Virtual communities extend the possibilities for community; just as CMC extends possibilities for interaction.” The proposed research will investigate the extent to which the use of ICTs, specifically the Internet, can contribute to the creation of social capital among older members of the population and their potential for creating links between older and younger generations.

An on-line community, like one grounded off-line, is held together by the feelings of togetherness and connectedness that confer a sense of belonging (Foster, 1997). Such feelings do not ‘just happen’. In a speech delivered as part of the *BBC Online Community Day* (17 June 1999), Rheingold pointed out:

“In order to succeed, a virtual community has to have an affinity – the answer to the question ‘what would draw these people together?’”

Age, by itself, is unlikely to provide such a focus. One of the research goals is to map other factors which will help in the (re-)creation of community among senior citizens and the extension of this across generational and other social barriers. A specific focus of the proposed research, combining interests of psychologists, sociologists and educational researchers, will be on the promise of the Internet for supporting the development of learning communities, spanning geographical and generational barriers. In order to assess this potential a series of elearning activities will be undertaken in which diverse groups of citizens collaborate online in the production and dissemination of “community portraits”. This approach has already been piloted in a project concerned with the continuing professional development of health and welfare workers in

geographically marginal areas of the EC (Timms 1999); it is proposed to greatly extend the approach to incorporate lay members of communities selected from across the EU. The approach is firmly based on pedagogical and sociological models that stress the social processes involved in the construction of knowledge and the extent to which community identity is negotiated between local and external actors. Engagement of community participants in the research process will be an essential component of the proposal and will provide a unique example of trans-national action research.

References

- Aldridge, E. 2000. *PAT15 Workshop: Age and ICTs*. <http://www.pat15.org.uk/research/age.pdf>
- Ferlander, S. and Timms, D., 2000. *Social Cohesion & Online Community*. Brussels: EC SCHEMA Project. <http://www.stir.ac.uk/schema/deliverables/d6.3.pdf>
- Haythornthwaite, C, Wellman, B. & Garton, L. 1998 “Work and community via computer-mediated communication”. In Gackenbach, J. ed. *Psychology and the Internet*. San Diego: Academic Press.
- Foster, D. 1997 Community & identity in the electronic village. In Porter, D. ed. *Internet Culture*. London: Routledge.
- NIACE 2002. *Older people and learning – some key statistics*. NIACE Briefing Sheet 32, September 2002. http://www.niace.org.uk/information/Briefing_sheets/Older_Learners_Stats.htm
- Putnam, R. 2000. *Bowling Alone – The Collapse and Revival of American Community*. New York: Simon & Schuster
- Rheingold, H. 1999. *Community Development in the Cybersociety of the Future*. <http://www.partnerships.org.uk/bol/howard.htm>
- SeniorNet.se 2003. *SeniorNet Sweden – a Network Community of Seniors 55+ in Sweden*. http://www.seniornet.se/browse.jsp?id=01_03&cikkid=424
- Timms, E. 1999. “Communities and welfare practice: learning through sharing”. *New Technology in the Human Services*, 11 (4): 11-17. <http://www.chst.soton.ac.uk/nths/etimms.htm>

Stimulus-Response Compatibility and Aging: Implications for Web Design

Robert W. Proctor and Kim-Phuong L. Vu

Department of Psychological Sciences, Purdue University
703 Third Street
West Lafayette, IN 47907-2004 USA
proctor@psych.purdue.edu and kvu@psych.purdue.edu

Abstract

Response selection is a major component of human information processing that affects response time and accuracy in many situations. A significant contributor to response-selection efficiency is stimulus-response compatibility. When interfaces have highly compatible relations between the displayed information and the required actions, performance is better than when they do not. Older adults typically are slower at response selection than are younger adults and often show larger costs of incompatibility. The present position paper discusses the importance of designing Web interfaces in a manner consistent with how older adults represent tasks and select responses. It also reviews the effects of aging on several variables known to affect stimulus-response compatibility and describes implications for design guidelines.

Authors' Background

This position paper is based on research projects conducted by the authors. Much of our work has examined basic theoretical issues in stimulus-response compatibility and their implications for interface design. Our most recent efforts, which focus on the influences of age on response-selection processes, are supported by the National Institute of Aging (No. 1R03AG21741-01). In addition, we have been examining human factors issues in Web design, having written a chapter on this topic for the *Handbook of the Internet*. We currently are editing the *Handbook of Human Factors in Web Design* which includes topics of designing for the elderly, and for universal access.

Introduction

The population of older adults is reaching an all time high. The Web provides a means for elderly adults to communicate with others, purchase goods, and search for information, without requiring them to leave their homes. It is thus important to design Web sites and computer interfaces in a manner that facilitates access by older adults, as well as other group of users. An important part of accessibility is ensuring that the interface is consistent with the perceptual and motor capabilities of the users. For example, because vision in older adults, text needs to be in larger fonts and of higher contrast with the background.

More important, the information architecture and interface need to be compatible with the cognitive processes of the users (Proctor, Vu, Salvendy, et al., 2002). That is, if a Web site is not designed in a manner that is consistent with the user's knowledge and expectancies, the user may become frustrated and leave the site. If older adults encounter too many frustrating experiences, they may avoid using the Web altogether.

Aging and Response-Selection

Considerable basic research on human information processing has been conducted that is relevant to human-computer interaction (HCI) in general and Web design in particular (Proctor & Vu, 2003b). Factors that influence speed and accuracy of responding have been the focus of many investigations because, in everyday life, both younger and older adults must respond quickly and accurately to a variety of stimuli that arrive through the senses.

A major determinant of differences in performance with different display-control relations is the efficiency of response-selection processes, that is, those processes that mediate perception and action (Proctor & Vu, 2003a). The decrease in speed and accuracy of performance with age, can be attributed, for the most part, to slowing of response-selection processes. For example, in a recent research article, Meiran and Gotler (2001) concluded, "Modelling results indicate that the most pronounced effect of old age was in what can be broadly defined as the duration of the response selection" (p. 165). Consequently, it is particularly important for older adults that designs of Web interfaces promote efficient response selection.

The most widely studied phenomena attributed to response-selection processes are stimulus-response compatibility (SRC) effects. SRC effects have been studied extensively since their introduction by Fitts and Seeger in 1953. Most designers are aware of the basic fact that performance with spatial displays and response sets is best when the two are arranged and mapped in a corresponding manner. However, there has been 50 years of research on SRC, and compatibility effects have been the focus of particularly intense research activity over the past 20 years (Proctor & Vu, 2003a). Consequently, much more is now known

about the mechanisms that underlie SRC effects and mediate perception and action. Unfortunately, little of this knowledge has been incorporated into current design guidelines, and people who are unfamiliar with the SRC literature are unable to accurately predict performance for many situations (Vu & Proctor, 2003).

Maintaining compatibility is especially important for the elderly because, in many situations, the cost of incompatibility is larger for them (Proctor, Vu, & Pick, submitted). A good example is the design of the butterfly ballot used by some counties in Florida for the 2000 U.S. presidential election. For this ballot, the presidential candidates' names appeared in left and right columns and were mapped to punch holes in a single, centered column. The names were mapped to punch holes in an alternating fashion, such that the first candidate in the left column was mapped to the first punch hole, the second candidate in the left column to the third punch hole, and so on. Thus, for all candidates except the first, the relative location of the punch hole did not correspond with that of the name in the column. This violation of a principle of spatial compatibility confused many older voters, who claimed that they inadvertently voted for the wrong candidate.

As illustrated by this example, it is important to determine what specific aspects of incompatibility are problematic for older adults and the extent to which incompatibility affects their performance more than it does that of younger adults. Although there has been sporadic interest in the topic of aging and response-selection in general, and aging and SRC in particular, the number of research articles devoted to the topic is still limited, leaving many issues unresolved. We will summarize the current findings of this literature, their implications for human factors and Web design, and recommend topics for which further research is needed.

Within choice-reaction tasks, the cost of an incompatible mapping relative to a compatible one is greater for older adults than for younger adults. For two-choice tasks, the cost of incompatibility is 1.5 - 2.0 times larger for older adults. The absolute cost of incompatibility for older adults relative to younger adults increases as the number of S-R alternatives increases, but the ratio remains in the region of 1.5 - 2.0. As the task becomes more complex, the cost of incompatibility increases disproportionately more for older adults than younger adults.

SRC effects also occur when spatial location information is irrelevant to the task. In such cases, older adults show larger spatial correspondence effects than younger adults when the irrelevant information is in the same sensory modality as the relevant information, but not when it is in a different modality. However, the cost of incompatibility or noncorrespondence can be minimized by providing advance information that reduces the complexity of the task

or by providing extensive training on the task. These findings support the following guidelines:

- Incompatibility should be minimized when designing for the elderly, particularly when the stimulus-response transformations are complex.
- Minimize noncorrespondence of irrelevant stimulus location information and responses, particularly when the relevant task involves a discrimination of any type within the same modality.
- For complex tasks, advance information that simplifies the task should be provided.

In summary, the topic of aging and SRC has important implications for designing Web interfaces with which the elderly must interact. Despite the importance of this topic, there has not been a concerted effort devoted to it, leaving many issues remain to be resolved and explored. These issues include, but are not limited to, how performance of younger and older adults differs for tasks that require manual vs. vocal response input, the role of practice in improving performance, and what S-R transformations can be learned and transferred to other tasks. There are many opportunities for researchers to advance the current state of knowledge on aging and SRC, with the goal of improving design guidelines for the elderly population.

References

- Meiran, N. & Gotler, A. 2001. Modelling cognitive control in task switching and ageing. *European Journal of Cognitive Psychology*, 13, 165-186.
- Proctor, R. W., Vu, K.-P. L., Salvendy, G., and 19 other authors. 2002. Content preparation and management for web design: Eliciting, structuring, searching, and displaying information. *International Journal of Human-Computer Interaction*, 14, 25-92.
- Proctor, R. W., & Vu, K.-P. L. 2003a. Action selection. In A. F. Healy & R. W. Proctor, eds., *Experimental psychology* (pp. 293-316), Volume 4 of the *Handbook of Psychology*. New York: Wiley.
- Proctor, R. W., & Vu, K.-P. L. 2003b. Human information processing: An overview for human-computer interaction. In J. A. Jacko and A. Sears eds. *The Human-computer interaction handbook* (pp. 35-51). Mahwah, NJ: Erlbaum.
- Proctor, R. W., & Vu, K.-P. L. in press. Human factors and ergonomics for the internet. In H. Bidgoli ed. *The Internet encyclopedia*. New York: Wiley.
- Proctor, R. W., Vu, K.-P. L., & Pick, D.F. submitted. Aging and response selection in spatial choice tasks. *Human Factors*.
- Vu, K.-P. L., & Proctor, R. W. 2003. Naïve and experienced judgments of stimulus-response compatibility: Implications for interface design. *Ergonomics*, 46, 169-187.

Aging, cognition and task complexity in the use of an on-line grocery shop

Marie Sjölander, Kristina Höök

Swedish Institute of Computer Science
Box 1263, SE-164 29 Kista, marie@sics.se, kia@sics.se

Lars-Göran Nilsson

Department of Psychology, Stockholm University, SE-106 91
Stockholm, lgn@psychology.su.se

ABSTRACT

This study examined navigation and search in an on-line grocery store, and how solving those tasks was related to subjects' age, spatial ability, working memory, computer- and Internet experience. Task complexity was also included in the design of the experiment. In the study 48 subjects participated, there was one group of elderly and one group of younger subjects. The results showed that the elderly subjects needed more time to complete the tasks. Both age groups spent more time to find the items in the complex task, but there were also age differences for the complex task, where the elderly subjects spent more time with the complex task. It turned out that age, spatial visualisation ability and working memory had the strongest impact on performance for the complex task. For the easy task, on the other hand, Internet experience had the strongest impact on performance.

INTRODUCTION

Elderly people perform a variety of computerised tasks slower, they reach poorer final levels of performance (Kubeck, et al, 1999), and they have less computer experience than young adults (Mead, et al, 2000). Beside the age differences in experience, a number of age-related aspects affect our use of computers, for example psychomotor skills, perception, and cognition. Context and different levels of task complexity might also affect performance on computerised tasks. In cognitive tasks in general, performance of older adults is affected more than that of young adults by increases in task complexity (Gick, et al, 1988; Salthouse, 1992). The same results have been found for computer related tasks, with no or little age differences on easy tasks, but when the task becomes more complex the elderly users perform worse (Kubeck, et al 1999). This study examined aging, cognition and task complexity in the use of a hierarchical on-line grocery store that can be found on the Internet today.

METHOD

Age, gender, prior experience, spatial ability, working memory and list order were the independent variables of the study. Task complexity was included in the design of the experiment, as a variation within subjects.

Subjects

There were 48 subjects, 24 young adults (age 20-30), and 24 old adults (age 60-77). Half in each group were men and half women. The elderly subjects were recruited from an Internet course for elderly people. The younger subjects were reached

through bulletin boards, both at the university and in other places.

The web service used in this study

The object of study in this experiment was a commercially available on-line food store named ExpressFood. It was a hypertext-based store, organised in a hierarchical fashion: on the top level the users face the main groupings of goods. After choosing one of these categories users either arrive at specific products or at subcategories. Finally at the lowest level, the consumers can select what specific brand of the product they want and how many items/weight of the product they are going to purchase.

Tasks and procedure

After practise, the subjects performed two shopping tasks, they purchased items from both one easy and one complex shopping list. The easy list consisted of six everyday items, such as milk and bread. It was obvious where to find these items. The other list that was more of a weekly shopping list consisted of ten items. These items were harder to find because they were less common products, and it was not obvious to which category they belonged. After completing the shopping lists, the subjects performed a 'find-again' task of two products that they had searched for while shopping from the lists. One of the products was from the easy list and the other from the complex list. In a questionnaire the subjects were asked to state age, gender, educational level, and computer/Internet experience. All subjects performed tests measuring spatial rotation and spatial visualisation, abilities that might be related to performance in hypermedia navigation. 24 subjects also performed a working memory test.

RESULTS

Time spent, for the shopping tasks, was assessed by using the measurement time per item actually found. For this measurement, time between items and time spent on items not found were excluded. Other measurements were also used in the study, however they will not be reported here. For a more detailed description of the study and the results, see Sjölander et al, 2003. All analyses of variance are using Bonferroni correction.

Age, gender and task complexity

A 4-way ANOVA with age, gender, type of list (easy, complex) and list order (started with easy list, started with complex list) showed a significant main effect of age, $F(1,40)=16.53$, $p<.05$,

where the elderly subjects needed more time to complete the tasks. There was also a significant main effect of list type, $F(1,40)=29.12$, $p<.05$, where the subjects spent more time per item with the items in the more complex list. None of the other main effects and no interactions were significant in this analysis. Analyses of variance were also performed with age, list type and prior experience, and with age, list type and spatial ability. In these analyses there were no significant main effects or interactions, beside the ones already reported above (main effect of age and main effect of list type). However, there were tendencies towards interaction between age and list type, where the elderly subjects spent more time, than the younger, with the complex task. In these analyses there were also tendencies toward interaction between age, computer experience and list type, where elderly subjects with little computer experience needed more time to complete the complex tasks than the young subjects with little experience.

Search task

Time spent on a search task (second time subjects searched for an earlier found item) was used as dependent measurement in four analyses of covariance. Age was a factor in all analyses combined with computer experience, Internet experience, spatial visualisation and mental rotation in each separate ANCOVA. Time spent finding the item the first time was used as covariate. With the easy search task no main effects or interactions were significant. With the complex search task there was a significant main effect of age in all analyses (analysis with computer experience $F(1,39)=9.52$, $p<.05$, with Internet experience $F(1,39)=11.02$, $p<.05$, with spatial visualisation ability $F(1,39)=15.68$, $p<.05$, and with mental rotation ability $F(1,39)=11.65$, $p<.05$).

Cognition, prior experience and time spent

To be able to examine whether the age differences in time spent could be explained by the decline in any of the spatial ability measurements (spatial visualisation and mental rotation), working memory or by prior experience, regression analyses (stepwise) were performed. Two regression analyses (one for the easy task and one for the complex task) were performed. The results showed that Internet experience was the only variable that had a significant impact on time spent for the easy task. For the complex task, age, spatial visualisation and working memory had a significant impact on time spent.

DISCUSSION AND IMPLICATIONS FOR DESIGN

The results from the present study showed that the elderly users needed more time to perform the tasks, which is in line with earlier studies (Kubeck, et al, 1999). The results from the

present study, also shows that elderly people have more problems with more complex computer related tasks. Complex tasks place higher demands on cognitive resources than easy tasks, and in complex tasks self-initiated processing is needed. This kind of processing is more difficult for elderly people. Another explanation to the age-related difference in performance of complex tasks is that complex cognitive tasks place greater demands on working memory (Salthouse, 1992). The results from the regression analyses in the present study also showed that, when the task was easy, Internet experience had the strongest impact on performance, but on the other hand when the task was complex age, spatial visualisation and working memory had the strongest impact on time spent. Earlier studies have found that elderly users with no or little computer experience have more difficulties than young users with no or little experience (Kelly & Charness, 1995; Mead, et al, 2000) In the present study the elderly subjects with less computer experience needed more time to complete the complex tasks than the young subjects with less experience.

A number of design issues, arising from the work with the present study. The information space should be made smaller or at least less complex and the design should aid users to divide a complex task into smaller subgoals. Further, the interface should provide memory cues and a visualisation of where the user are within the environment. It should also provide alternative ways to navigate the information space. For a more detailed description of the implications for design, see Sjölander et al, 2003.

REFERENCES

- Gick, M.L., Craik, F.I.M., & Morris, R.G. (1988). Task complexity and age differences in working memory. *Memory and Cognition*, 16 (4), 353-361.
- Kelly, C.L. & Charness, N. (1995). Issues in training older adults to use computers. *Behaviour and Information Technology*, 14 (2), 107-120.
- Kubeck, J.E., Miller-Albrecht, S.A. & Murphy, M.D. (1999). Finding information on the World Wide Web: Exploring older adults' exploration. *Educational Gerontology*, 25, 167-183.
- Mead, S.E., Sit, R.A., Rogers, W.A., Jamieson, B.A., & Rousseau, G.K. (2000). Influences of general computer experience and age on library database search performance. *Behaviour and Information Technology*, 19 (2), 107-123.
- Salthouse, T.A. (1992). Why Do Adult Age Differences Increase With Task Complexity? *Developmental Psychology*, 28 (5), 905-918.
- Sjölander, M., Höök, K., and Nilsson, L-G (2003). The Effect of Age-Related Cognitive Differences, Task Complexity and Prior Internet Experience in the Use of an On-line Grocery Shop. *Spatial Cognition and Computation*, 3(1), 61-84. Lawrence Erlbaum Associates, Inc.

Evidence-Based Web and Ageing Guidelines

Mughal, S. & Zaphiris, P.

Centre for HCI Design
City University, London, EC1V 0HB, United Kingdom
zaphiri@soi.city.ac.uk

Abstract

This paper presents a set of evidence-based guidelines for designing websites for the elderly. Extensive literature review was conducted, guidelines were developed and supported by literature, and finally the guidelines were used to evaluate ten websites that have as their primary target audience the elderly.

Problems Addressed

There is a lot of past research on the topics of aging and human computer interaction by the elderly but no central collection of this information is presented in an organised way. Through this study, a structured classification of usability guidelines was created to address the area of human-computer interaction for the elderly.

When information is researched about web design, such as the best way to convey information on a website, the best way to structure the information, how to attract the visitors' attention and so on, it is common to find that these issues are addressed with a so called typical audience in mind: the more frequent users of the world wide web. One can go so far as to say that the frequent users of the World Wide Web are seen as the young generation by default.

The World Wide Web is a profitable business that capitalises on its main asset: information. People visit websites for information retrieval. The purpose is defeated if people visit a website only to be unable to obtain the required information. Sometimes the information is actually there but hidden.

Website designers have many techniques at their disposal to attract attention to content on websites. Use of colour, images, and animation are just some of the techniques that can be used. This seems logical and plausible. But the issue is that websites should be accessible by all people. This includes not only the young generation but also those with disabilities and the elderly.

One can find guidelines that can be followed to make the experience of information retrieval on websites user-friendly, but these appear as generic. It is feasible to use these generic guidelines to make websites more accessible for the elderly but they need to be more specific and be traceable to the needs of the elderly. It is important to

realise that the elderly are and will continue to be a large audience that are regular users of technology.

The main themes that come to light are the fact that the population of older people appears to be increasing, Czaja (1997). And also, according to Hawthorn (2000) computing is now ubiquitous. Thus it is important to address this issue and ensure that this particular audience is catered for as well with regards to interface design.

Key Objectives

The main aim of this project was to review the areas of aging and Human computer interaction by the elderly. It can be broken down into the following sub-objectives:

- ? Review literature on the areas of Human computer interaction and aging.
- ? Have a central repository of the findings from the review.
- ? Establish usability criteria of websites that are used by the elderly.
- ? Evaluate a selection of websites designed specifically for the elderly, using the criteria established.

To meet the objectives outlined for this evaluation project, an extensive literature review on the areas of aging and human computer interaction specific for the elderly was carried out by reviewing over 100 papers on this topic.

From the review of the vast literature, a set of usability guidelines was established. These usability guidelines are specific for the use of websites by the elderly.

Finally, an evaluation was conducted on existing websites. The websites evaluated are those that have specifically been created with the elderly in mind. The established usability guidelines were used in order to carry out the heuristic evaluation.

Results-Discussion

The objective here was to establish usability criteria that should be met in order to make websites usable by the elderly. Evidence-based guidelines were used and these were applied to the relevant areas of decline that can occur in aging. There were 102 guidelines established in total with 52 being unique. The guidelines were created to address the following areas:

Vision

1. Decline in static acuity
2. Decline in dynamic acuity
3. Decline in contrast sensitivity
4. Reduction in colour sensitivity
5. Sensitivity to glare
6. Decrease in Visual Field
7. Decrease in processing of visual information

Psychomotor abilities

8. Decrease in psychomotor abilities with increase in age

Attention

9. Decline in selective attention
10. Decline in divided attention

Memory and Learning

11. Decline in memory and learning

Intelligence and Expertise

12. Decline in intellectual abilities

Each of the areas had guidelines established that could be used for designing websites for the elderly.

These guidelines were then used to evaluate ten websites that target as their primary user population the elderly.

The results showed that all the websites met over half of the guidelines. It was also demonstrated that the mean number of websites that violated the guidelines for static acuity were 3; for dynamic acuity the mean was 4; contrast sensitivity had a mean of 1; colour sensitivity was 3.5; glare sensitivity was 5; visual field was 3.5; processing visual information was 2; psychomotor skills was 3; attention was 1 and memory and learning had a mean number 1.5 websites that violated the guidelines specific to this area. The overall mean number of websites that violated guidelines was 3.01. For more details see Figure 1.

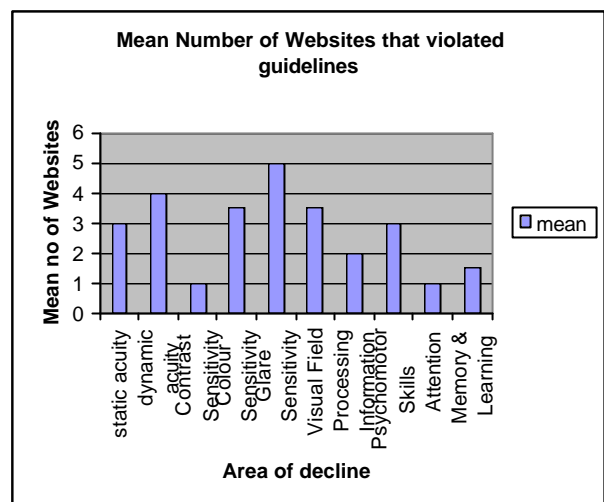


Figure 1: Mean Number of websites that violated guidelines.

As the guidelines addressed the different areas of decline, it was found that the guidelines that were most frequently violated by the websites were those to do with Vision and Psychomotor ability. This is very informative as vision is the channel that is the beginning to the processing of visual information.

Conclusions

The established guidelines provide a starting point for future studies in establishing a more manageable set of guidelines. Techniques like card-sorting are being investigated as a mechanism for grouping the different guidelines and removing any duplicates.

References

- Czaja, S.J. (1997). Using Technologies to Aid the Performance of Home Tasks. Chapter 13, In Handbook of Human Factors and The Older Adults. Academic Press
- Hawthorn, D, (2000) Possible implications of aging for interface designers. Interacting with Computers 12, Elsevier Science B.V, p 507-528.