Towards Interface Design for Older Users

Dan Hawthorn
UNITEC Institute of Technology,
Auckland, New Zealand
dhawthorn@unitec.ac.nz

ABSTRACT

A rapid increase in the proportion of older people in the population combined with concern that older people will need to be economically self-supporting for longer suggests a strong need to design computer interfaces suited to these older people. This paper briefly reports on the findings from the author's four years of research in this area. It is shown that the general literature on aging can be used to obtain recommendations for successful interface design for older people. However it is also indicated that participation of older users is necessary for turning recommendations in to successful applications. The paper concludes with a look at possibilities for future research in this area.

1. INTRODUCTION

This paper is aimed at providing a brief description of a series of studies on interface design for older users that I am carrying out in association with Waikato University and UNITEC. Until recently there has been almost no research in this area although there has been a vast body of research on aging.

There is still very little research on interface design for older people but there have been a number of related papers on tutorial design for older people learning computing, see Morrell and Echt (1996, 1997) for reviews. Two collections of papers provide a good introductory discussion of performance factors and aging, see Rogers *et al.* (1996) and Fisk and Rogers (1997).

Computer programs and the interfaces that they present the users tend to be designed by relatively young people and aimed at a market of mainly young people. Training groups for older people such as SeniorNet flourish because older people do not find today's interfaces easy or intuitive. This is not simply because older people are meeting computers for the first time. The effects of aging mean that older people (60 plus) differ somewhat from young (sub 40s) computer users in terms of ability to see, manipulate and think about the features that computer interfaces present to them. The need to understand the implications of these differences for interface design is important for several reasons. We live at a time when the proportion of older people in the population is changing in a totally

unprecedented manner. This leads to problems with welfare provisions for retirement so that as people age they will need to stay in the workforce longer. This major demographic change coincides with the spread of computing through business and society. Computer competence will Increasingly be part of participating in the workforce, getting access to social services and engaging in social activity. There are unpleasant consequences if we develop a society where computer competence is mandatory but where through lack of understanding we design programs with interfaces that effectively disenfranchise older people.

The paper will give a brief history of the research so far and then look at the major findings on aging that are relevant to interface design. The results of the two studies of older users done so far will be briefly discussed and the paper will conclude with a look at the useful directions for future research.

2. PROJECT HISTORY

The study started with some personal motivation. I had turned 50 and I was finding that I no longer remembered things as well, ached more and needed reading glasses. Programs that assumed I could read 8 point fonts became an irritation. If I used Help systems to get the details of obscure programming syntax I forgot what I had just read as I Alt-Tabbed from Help to code editor. It is a little humbling to find that ones memory is such that one needs to copy and paste. I am also getting slower to learn new languages. This is worrying in an environment that expects me to work with constant change and complexity until I am 65, if not longer.

In 1997 I began reading about aging with the aim of getting some perspective on what was happening to me. It became obvious that although there was a very large body of research on aging, little had been done to translate this into computer interface design for older people. In particular there was little on older people and computers and a nearly total absence of work relating the needs of older users to my particular interest, interface design. I then started reading with a view to extracting the implications for user interface design from the general literature on aging. This was a two year process and I formally enrolled in a PhD at the start of 1999. The literature survey examining the literature on aging for user interface design implications was published as conference papers and a journal article, Hawthorn (1998a, 1998b, 2000a).

The next phase was to take some issues identified during the literature survey and try a formal experimental study. This study was to look at whether redesigning screens to improve text readability would aid older people in understanding complex information. The study was piloted in the summer of 1999 - 2000. The pilot raised some interesting issues, Hawthorn (2000b) but also suggested that comprehension tasks of the sort used in the study were not particularly relevant to older people's use of computers. I was interested in exploring a model of competition for cognitive resources between the interface and the task so it became important to find a task involving comprehension that was relevant to older users.

While I was doing the literature survey I also looked for ways to become involved with older people as they used computers so as to give myself a less academic perspective. I sat in on introductory computing classes for seniors, the experience was upsetting. The classes were carefully prepared, conscientiously taught and left most of the seniors confused and dismayed. The main issues seemed to be needs for; concrete material to work with rather than theoretical explanations, vastly slowed presentation, the ability to work at their own pace and having simple instructions always available right where the seniors were working. I developed a simple tutorial program to cover Windows basics and then worked with a number of SeniorNet members and interface design classes to refine it over the next year. WinTutor is now being used at a number of NZ SeniorNet branches and is highly regarded. It did not however have a formal theoretical basis for its construction and I had not published a description of the design principles involved. I was asked to do a similar tutorial for teaching file management and this seemed to offer a suitable topic for looking at older peoples' comprehension issues in computer use. FileTutor was developed during 2000.

The complete design of an interface used on a tutorial does not lend itself to experimental study. There are simply too many factors involved. I also see piecemeal studies comparing two or three variables

in controlled environments as 1) too removed from actual interface designers and 2) too slow to produce useful software firmly based on experimental findings in the next few years where the immediate need exists. The research design I used tried to escape these problems by recording the results of 3 cycles of usability testing with older users. The result is a good file management tutorial for older users and some interesting insights into the interface design principles behind this. The paper will now proceed to give selected findings from each of the studies mentioned above.

3. LITERATURE REVIEW AND IMPLICATIONS

The first major point was the lack of research on interface design for older users. However in this area there is a very large body of related work available from studies of older people's cognitive and perceptual abilities and psychomotor skills. The problem is that much of this comes from experimental studies under fairly artificial conditions that are designed to address theoretical issues of the mechanisms behind aging rather than to establish older people's performance parameters in the real world. What I attempted to do in the literature survey was to identify relevant cognitive, perceptual and psychomotor differences between older people and the general user population. I then considered the implications that these differences could have for interface design. Morrell and Echt (1996, 1997) have taken a similar approach with regard to instructional design for older people. Note that as used here "older people's abilities" implies that we are looking at average abilities but we should remember that as a group older people vary more widely from the average than any other age group. Old also hides a distinction between the young-old (60 - 74) and the old-old (75 upwards) where a number of studies show significantly poorer performance by the old-old relative to the young-old group.

The points that follow are typical of the findings cited in Hawthorn (1998a, 1998b, 2000a) that have implications for interface design. Older people are slower over almost all activities including learning, there are particular changes in vision such as a reduced visual field and a reduced ability to discriminate between colours, especially in the blue green range. Older people are more risk aversive and their performance may suffer more if they make errors. Older people are less able to perform fine manipulations and it is probable that fewer older users can reliably perform actions such as double clicks. Mouse movements are not only slower but also more jerky, wander off course more and are more likely to overshoot, all of which can have implications for program responses to mouse activity near and over a target. We can also get the situation where older people can read text on screen but have trouble with cursor positioning when editing the text. Older on average are less able to understand complex text passages and less able to make inferences from recently presented material. They have less ability to retain information in short term memory but still show high levels of performance in cued recall.

Learning has been found to take more time in older people and to require more effort. In younger people learning skills there is a progression from conscious performance of the task to automated performance, where the task is done "without thinking" in a way that reduces demand on the individuals' cognitive resources. There are suggestions that older people do not form such automated responses or are at least much slower to do so. This is important because the implication is that computer use may remain intellectually demanding and so compete for cognitive resources with the tasks for which older people are using computers.

4. PILOT STUDY ON TASK COMPLEXITY VERSUS DISPLAY QUALITY

The approach taken in this study was to consider the user's activity in terms of two similtainious tasks, coping with the interface of the application and carrying out the substantive task the application is designed for, writing a letter, sending an email, etc. It has been shown that older people have difficulty carrying out tasks simultaneously, see Korteling (1994). From this starting point it was decided that it would be interesting to look at comprehension of material presented via a computer interface as a general task and to give the same comprehension task to users under different interface conditions. The interface conditions chosen for manipulation involved

text appearance and display style. An interaction effect was expected where difficult comprehension tasks should be more affected by text formats that require effort to read information.

The study was done as a pilot study for a planned larger study. 12 older volunteers each attended three sessions of two and a half hours. They ranged from 66 to 82 years old with a mean age of 76.2. To provide internal replication within the study two different sub-experiments involving different comprehension tasks and display conditions were designed. The same subjects took part in both experiments.

4.1 Task Complexity Versus Display Quality - Experiment 1

It was decided to compare comprehension when the interface used fonts that were easy to read versus fonts that users could read with difficulty. The expectation was that comprehension would drop as the text quality declined (and more effort had to be put into reading).

The underlying task is a “game” in which the participant is given a page with a set of rules stating which of nine common animals can safely be penned together and which would endanger other animals. The rules remained constant. The participant was presented with a text passage on screen describing how eight animals are put into four pens two at a time. The participant then pressed a key on the numeric keypad to record how many animals are safe according to the rules. The format of the text display was varied from good to just readable and the comprehension difficulty was varied by altering the wording of the description of which animals were in which pens.

4.2 Task Complexity Versus Display Quality - Experiment 2

There is agreement in the literature that the ability to pay attention to relevant information in the presence of distracting information declines with age. Sub-experiment 2 therefore looked at the effect of distracting animated graphics. Three short articles were presented in Web page formateach using two display conditions. Good - simple display, clear font and a few relevant graphics. Bad - italic font, pictorial background with distracting and irrelevant animated graphics. Text content and layout remained constant.

Task difficulty was manipulated in the quiz questions that followed. Some could be answered directly, some required inference.

4.3 Task Complexity Versus Display Quality - Results

The results were unexpected. Display quality made no difference to time taken or errors in either sub-experiment. Although subjects were able to read material presented in the poor web format the majority of subjects reported that they found the effect unpleasant and would avoid sites like this if they could.

The older users were far more affected by complexity issues than the middle aged people who had been used as informal test subjects when developing the test software. In the pens game subjects were unable to answer accurately in the complex condition unless they counted on their fingers or used some other aid to remembering what they had read. With the web articles, answers for test statements that were explicitly covered in the articles were reasonably accurate. However where inference was required accuracy fell to chance levels.

4.4 Task Complexity Versus Display Quality - Discussion

The key issue highlighted here is redesigning tasks to avoid complexity. Where the pen study provided simple lists or the Web articles gave simple facts relevant to the questions that were asked, then the older people performed relatively well. I had pre-tested the designs with middle aged subjects. Levels of complexity that they found only moderately difficult nearly stumped the older users. This occurred with a group of older users whose career achievements indicate that this had been a decidedly high performing group. Young interface designers are at risk of missing the importance of extremely simple representations of the task. Perhaps young designers are also at risk of not understanding how their view of simple fails to match that of older users.

The details of interface design for older people may be about establishing interfaces that are liked and comfortable within a much wider range of usable

interfaces. The fact that the older users could cope with the more difficult forms of the interface displays did not mean that they liked them. They clearly stated that given a choice they would avoid situations that involved interfaces similar to the difficult ones used. In an environment such as the Web where sites are competing for viewers this becomes crucial. The other point is that the older users described their dislike of the more difficult interface styles in terms of stress, annoyance and strain. I see it as probable that this indicates that performance could fall off, or older users might simply opt out, given prolonged use of these interface styles.

The experimental software itself was specifically designed with easy to read fonts and simple explanations. As such it provides a test of the benefits of simple format for the group studied. All users learnt to use the experimental setups in the pen and Web studies rapidly, in under 25 minutes. There was no evidence of a learning effect in either the Web study or the pen study. The conclusion here is that this older group was very capable when learning a new, simply designed and clearly laid out interface (the experimental software itself).

5. THE FILETUTOR USABILITY STUDY

The main aim was a good file management tutorial. It was hoped that by recording the efforts of participants during usability trials the study would give insights into desirable and undesirable design features. The nature of the experimental paradigm means that it cannot cope with the richness of the considerations underlying real-life interfaces and it is important that accounts of attempts to move from research recommendations to working designs reach the literature. The paper being prepared from the FileTutor research uses a case study approach to record impressions and anecdotal material gained as people interacted with a rich and successful interface design

25 older participants (average age 69.8) came to UNITEC for three 2 hour sessions spaced two days apart. In the first and second sessions participants worked with FileTutor to gain file management skills. After the first session they took a copy of FileTutor home and installed it on their own PCs to allow revision. In the third session the participants did a practical file management exercise using Windows Explorer to evaluate how well skills gained with FileTutor transferred to a real life task. Participants also took part in a focus group discussion and completed a questionnaire.

Level of independence	Error levels	Percent (N = 25)
Completed exercise without prompting	Trivial 0 - 2	48% (12)
Completed exercise with 1 - 2 prompts	Trivial 1 - 4	20% (5)
Completed main parts of exercise with 3 - 5 prompts	Medium	20% (5)
Did not complete exercise		12% (3)

Table 1.

Results from the file management exercise. Numbers of participants completing the exercise at various levels of independence.

5.1 FileTutor Study - Results

Was FileTutor a successful way of conveying complex information to older people? In response to the question “Would you recommend FileTutor to other older people wanting to find out about files and folders?”, using a scale rated from 1 “strongly recommend” to 5 “would not recommend”, twenty-two participants responded with a 1, two responded with a 2 and one with a 3. All but three participants said they had gained a lot from using FileTutor and intended to continue working with it.

In the practical file management exercise using Windows Explorer there was a reasonably high success rate given the limited training time. See Table 1.

In the focus group discussions in the third and last session all participants reported having tried a variety of methods of computer instruction with generally poor results, the partial exception was training specifically for older people provided by SeniorNet branches. The overall response of the participants to FileTutor was that they were meeting a tutorial that was unusually well suited to their needs as older users.

5.2 FileTutor Study - Discussion

The older users who took part in the focus groups saw themselves as a special group. They saw themselves as having different training needs from the general population and stated that it was hard to find training that met those needs. They also very clearly stated that FileTutor and WinTutor were different from the training books and classes they had met and were particularly suitable for older users.

The FileTutor usability information supported what are in many ways standard design recommendations such as simplicity, readability, tight coupling between instruction position, action location and feedback display. There were the expected shifts to allow for age, high contrast levels, larger fonts, slower presentation and more emphasis on individual pacing. The FileTutor study generally supports the suggestions for interface design for older people based on the general literature on aging given in Hawthorn (1998a and b), Morrell and Echt (1996, 1997). What became clear was the importance of usability testing in bridging the gap between the designer’s view of these interface principles and how these principles should be applied in practice in order to create a senior friendly interface.

6. CONCLUSIONS

The work done so far suggests that useful implications for interface design can be taken from the general literature on aging. However it also shows the strong need for involvement of older users in the design process and shows that this is in fact practical to do. With this combination it has been possible to produce programs that are described by older users as standing out in the way that they address their needs. With one of the tutorial programs, WinTutor, the program has also been found to be very suitable to younger users. Studying older users may be a way of increasing the general usability of computer interfaces. Older people may simply be more sensitive to departures from good practice. Including older people in usability studies could become a useful technique for increasing the ability to detect interface problems.

There is also a strong argument for studying older users based on equitable access. Work with WinTutor and FileTutor suggests that training developed in cooperation with older users seems to be able to provide access to computer skills that generally available commercial training does not. Programs and training schemes that older people can cope with are going to become increasingly important as the number of older people grows and as the role of computers in their everyday life increases. Given the strains that are being imposed on welfare systems supporting older users is an urgent issue with implications for all of us.

There is a need to extend the range of attempts to develop senior friendly applications beyond tutorials, how for example do we design on-line versions of census, tax or voting forms that minimize older peoples difficulties? Are there designs that could make automatic teller machines or video controllers more accessible for the older population? Are the current older generation an isolated case or are there still going to be special needs for older users even where the next generation of seniors has more

computer experience? It will be important to consider how well older users adapt to changes in applications and in computing paradigms. In an industry in which "new" is a major economic driver older people who have difficulty adapting could continue to be a disadvantaged group despite previous experience.

The good new is that a variety of research groups are now interested in the area of computer use by older people and publications and communication between groups are set to increase rapidly. But academic studies using experimental methods advance understanding slowly and can have a rather narrow focus. It will continue to be important to create, evaluate and report interfaces for seniors that reach beyond what has been fully supported by research findings and that draw on discussion with the older users themselves. This is one way of ensuring that benefits from more academic research reach the general older population and the population of interface designers.

REFERENCES

Carroll, J. M., (1990) The Nurnberg Funnel: Designing minimalist instruction for practical computer skill. MIT Press, Cambridge MA.

Fisk A.D. and Rogers W.A. (1996) "Handbook of Human Factors and the Older Adult", Academic Press, San Diego.

Hawthorn, D. (1998a). Psychological Ageing and Human Computer Interface Design. In Proceedings, Australasian Computer Human Interface Conference, (p.281-291). Adelaide.

Hawthorn, D. (1998b). Cognitive Ageing and Human Computer Interface Design. In Proceedings, Australasian Computer Human Interface Conference, (p.270-280). Adelaide.

Hawthorn D. (2000a) Possible implications of aging for interface designers, Interacting with Computers, 12, 507-528

Hawthorn D. (2000b) Designing for older users: Display quality versus task complexity In Proceedings, Australasian Computer Human Interface Conference. Sydney.

Korteling, J. E. (1994) "Effects of Aging, Skill Modification and Demand Alteration on multiple task performance", Human Factors 1994, p36(1), 27-43.

Morrell Q.W. and Echt K.V. (1996) Instructional Design for older computer users: The influence of cognitive factors, in Rogers, W. A. and Fisk, A., D. (eds) "Aging and Skilled Perfomance", Lawrence Erlbaum, NJ.

Morrell Q.W. and Echt K.V. (1997) Designing Written instructions for older adults learning to use computers, in Fisk A.D. and Rogers W.A. (eds) "Handbook of Human Factors and the Older