Introducing the Internet to the over-60s: developing an email system for older novice computer users

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Abstract

Contemporary technology offers many benefits to older people, but these are often rendered inaccessible through poor software design. As the Internet increasingly becomes a source of information and services it is vital to ensure that older people can access these resources. As part of project funded by the UK government a multi-disciplinary team set out to develop usable software that would help to introduce older people to the Internet. The first step taken was to develop an email system for older people with no experience of Internet use. The project was intended to show that it is possible to design usable technology for this group and to explore some of the issues involved in doing so. Design and technical challenges necessitated various tradeoffs. The system produced demonstrated the success of the design decisions: it was significantly easier to use than, and preferred to, a commercial equivalent by a group of older people with little or no experience of Internet use.

Keywords: design, older people, Internet, email, digital inclusion, usability

Introduction

As early as 1980 specialists warned that if the potential of technology to support older people was to be realised, their needs should be recognised and considered from the beginning of the home computer revolution (Danowski and Sacks, 1980 p.128). The failure of the software industry to heed this warning means that we are now, as Danowski predicted, faced with a situation in which standard computer technology is inappropriate for a large, and growing, proportion of the population. Ironically, this excluded part of the population could benefit tremendously from the technology which it cannot use. As it becomes clear how significant computer technology has become to social, political and financial processes, governments are recognising the significant dangers of technological exclusion and exerting legislative pressure to ensure that 'goods and services' are accessible to people with disabilities (Scottish Executive, 2001; Sloan, 2001). This legislation will have an important effect on older people; over 40% of those the UK Disability Discrimination Act covers are over 65 years old (Young, 2002 p.142). However, legal pressure alone cannot solve the problems of inaccessible software which,

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to a large extent, is attributable to a culture among many mainstream software developers and their clients. Software is commonly developed for typical "able" users, normally young male computer specialists, while the needs of "disabled" users are catered for with 'accessibility options'. Accessibility options allow the developers of the main system to largely ignore the difficulties these users face since they encourage the expectation that these should be solved by additional options. A further problem with this approach is that the dichotomy between 'able' and 'disabled' does not reflect reality: there is, in practice, a continuum of functionality between the two extremes and older people are especially likely to suffer from some minor impairments, but are unlikely to regard themselves as 'disabled' (Newell and Gregor, 1997).

To break away from the 'accessibility options' paradigm and begin providing truly usable and appropriate software for older people it is necessary to develop new kinds of software in new ways (Gregor and Newell, 2001; Newell and Gregor, 2002). The UTOPIA Project (Usable Technology for Older People: Inclusive and Appropriate) was established by Newell and Gregor to examine the issues surrounding older people's use (or non-use) of technology and to alert both academia and industry to the need to design appropriate technology for this group (Eisma et al., 2003). The project is led by the Division of Applied Computing at the University of Dundee and includes the universities of Abertay, Glasgow and Napier.

The Cybrarian Project: Proof of Concept

Researchers from the UTOPIA project were asked to contribute to the Cybrarian Project, a project established by the U.K. Department for Education and Skills (DfES) to address the divide created by the increasingly digital nature of contemporary U.K. society. The project was established "in order to help address a 'digital divide' that is emerging across Britain" and to "facilitate access to the Internet and to learning opportunities for those who currently do not, or cannot use the Internet because of a lack of skills or of confidence or because of physical/ cognitive disabilities" (DfES briefing document, 2003 p.1).

As part of the Cybrarian project, a "Proof of Concept" sub-project was awarded to Fujitsu Consulting, with a development team consisting of a consortium of software development engineers from Fujitsu Consulting, representatives of the DfES, consultant researchers from the UTOPIA Project, and researchers from the University for Industry (UfI).

The Proof of Concept project was to develop an example system which would attract older people to use the Internet, and encourage them to progress to more sophisticated Internet use. The system was to be:

> *"attractive to older users (over 60 years of age) who were uninitiated and unconfident in the use of computers and for whom the internet was an alien territory"*

Older People and Computers

There are many reasons why current computer technology is not used by most older people, these include the inappropriateness of much software design, the various declines

in functionality that people experience as they age, and cultural and social factors. This section lists and discusses these reasons in order to provide a background to the development of the Cybrarian email system.

The DfES estimates that there are as many as 24 million people in the UK who currently do not or cannot use the internet. Of these, 8.8 million adults in Britain do not use the Internet because of lack of confidence or skill, and 4.2 million feel they are "too old" to use the Internet (DfES, 2003 p.2). There is also considerable evidence from other sources that older people distrust modern technology (Jessome and Parks, 2001), and feel uncomfortable with it (Williamson et al., 1997; Gilligan et al., 1998). This distrust and discomfort normally translates into reluctance to use many modern technologies. A survey carried out by Universities of Glasgow and Dundee confirms that the older someone is, the less likely they are to use recently-developed technologies (Goodman et al., 2003).

The reluctance of older people to use modern technologies can be attributed in part to age-related changes in people's functionality. Older people are substantially more likely than younger people to have a major impairment: between the ages of 18 and 49 only 8% of people in Scotland have a limiting, longstanding illness but between the ages of 65 and 74, over a third have such an illness (MacDonald et al., 2001 p.29). In addition, all older people have a range of age-related minor physical, sensory, motor and/ or cognitive impairments, many of which may affect their ability to interact with traditionally designed software (Newell and Gregor, 2000). There is a wealth of research data about the various age-related impairments that have an effect on people's abilities to use technology (see, for example, Carmichael, 1999; Echt, 2002; Young, 2002). One relevant example is visual impairment: as people age, their visual acuity and contrast sensitivity decline, and degradation of ocular motor control means that reading is more difficult, particularly if the characters have unusual shapes and especially if the text is moving. As light scatters more when it enters the eye, people see a lot more visual 'noise'; older people will also find it harder to disregard irrelevant parts of the display. Despite this evidence, however, most currently available software is not sensitive to the particular requirements of older people. The existence of "accessibility options" for older and disabled people (see, for example, http://www.microsoft.com/enable) is not a replacement for accessible design, particularly as these options usually require significant expertise to locate and use (Syme et al., 2003). Accessibility options can lack clarity about the effect that a decision will have, and this promotes insecurity and confusion. One example is that "high contrast" settings include settings with titles like "eggplant" (black on green) and "rainy day" (black on blue), wholly non-descriptive names which do nothing to support the user in determining which of the many available settings would be of most use to them. In addition, it can be difficult to preview accessibility settings: some are implemented immediately, others when the user has clicked 'apply' and closed the dialog box, and a third group are only implemented when the computer has been reset.

Some researchers argue that older people find computer-based technologies especially difficult to learn because older people became adults before computers were widely available and their expectations about the way that machines will behave are grounded in

their use of mechanical technology. These researchers argue that because ICT did not effect older people's "formative years", they are initially less likely to feel relaxed and confident while using it and also, in contrast to younger age groups, many older people do not feel comfortable "learning while doing" in unsupported environments (Rama et al., 2001, p.27). Older people may also regard computer use as irrelevant to their lives. Haddon suggests that this can be partly explained by older people having spent their formative years in periods of austerity and perceiving computers as expensive luxuries (Haddon, 2000). Reluctance to use computers can also be attributed to previous attempts to use existing, inappropriate, software; being influenced by friends and colleagues who have had bad experiences with trying to use software; or exposure to the widely held view that computers are very difficult to learn to use. There is, however, evidence that suggests that when older people do manage to use computers successfully, their attitude towards them becomes more positive (Danowski and Sacks, 1980; Morris, 1992).

Morris emphasizes the importance of positive early experiences in the use of computers. He suggests, in agreement with Rama et al., that older people are particularly likely to feel alienated by modern technology because they grew up without it. As a result, he notes, "one necessary ingredient for successful learning by older adults is a positive initial experience with computers to combat technological alienation" (Morris, 1992 p.75). It is therefore particularly important that the software that people encounter when they begin to use computers is not unnecessarily difficult, with excessive complexity, illegible text or small targets, which are likely to make the experience a negative one.

Email as an attractor to the Internet

While only a small proportion of older people use computers, significantly fewer use the Internet (Booze-Allen and Hamilton, 2000). In 1998, Gilligan estimated that 2% of the over-65 age group used the internet (Gilligan et al., 1998), although the numbers of older people using the internet are increasing, the proportion of the age group 'online' is still very small; recent research suggests that only 6% of the 65+ age group used the Internet (Glasgow Household Survey, 2002).

The numerous reasons why older people do not use the Internet mean any application designed to attract them to using it had to be clearly of value to older people and also be intuitive and usable for novice older computer users. Research carried out among older people who were already Internet users indicated that communication was likely to be effective as an attractor. There are clear social reasons for this: networks of families and friends are increasingly widely spread (Grundy, 1996) and social isolation can be associated with ageing (Russell and Schofield 1999; Andrews et al. 2003). 94% of respondents to a SeniorNet survey used the Internet to stay in touch with family and friends (SeniorNet, November 2002) and the Age Concern 2002 Internet and Older People survey reported that the internet is most often used to "Contact family and friends in the UK" (Age Concern, 2002). Other surveys support the finding that email is the internet application most used by older people (Coyne and Nielsen, p.8; SeniorNet survey, April 2002).

On the basis of this research it was decided to develop an email system as an attractor for those older people who were unconfident in the use of computers, and for whom the internet was an alien territory. This design had to be appropriate both for those with age-related impairments, and also for novice users whose knowledge of system conventions and legacy systems was limited or non-existent.

Interface considerations

A serious problem that novice users face with existing interfaces is that they are overly complicated and contain too many options (Hawthorn, 2002; Dickinson et al., 2003). This complexity results in users becoming confused and lost in a host of alternatives competing for their attention. Such complexity is especially difficult for older users, whose confusion as novice users is often exacerbated by impairments in vision, fine motor control and reduced cognitive functioning, including attention span, and short term memory (Carmichael, 1999). Interfaces with many options crowded into a single screen, with small targets and menu systems, are especially problematic for people with age-related impairments. Morris has reported comments from the over 60s such as: “Having so much information presented at once is mind-boggling.” (Morris, 1992 p.74).

An example of the complexity of commercial email software can be seen from the standard “out of the box” Microsoft Outlook Express interface shown in Figure 1.

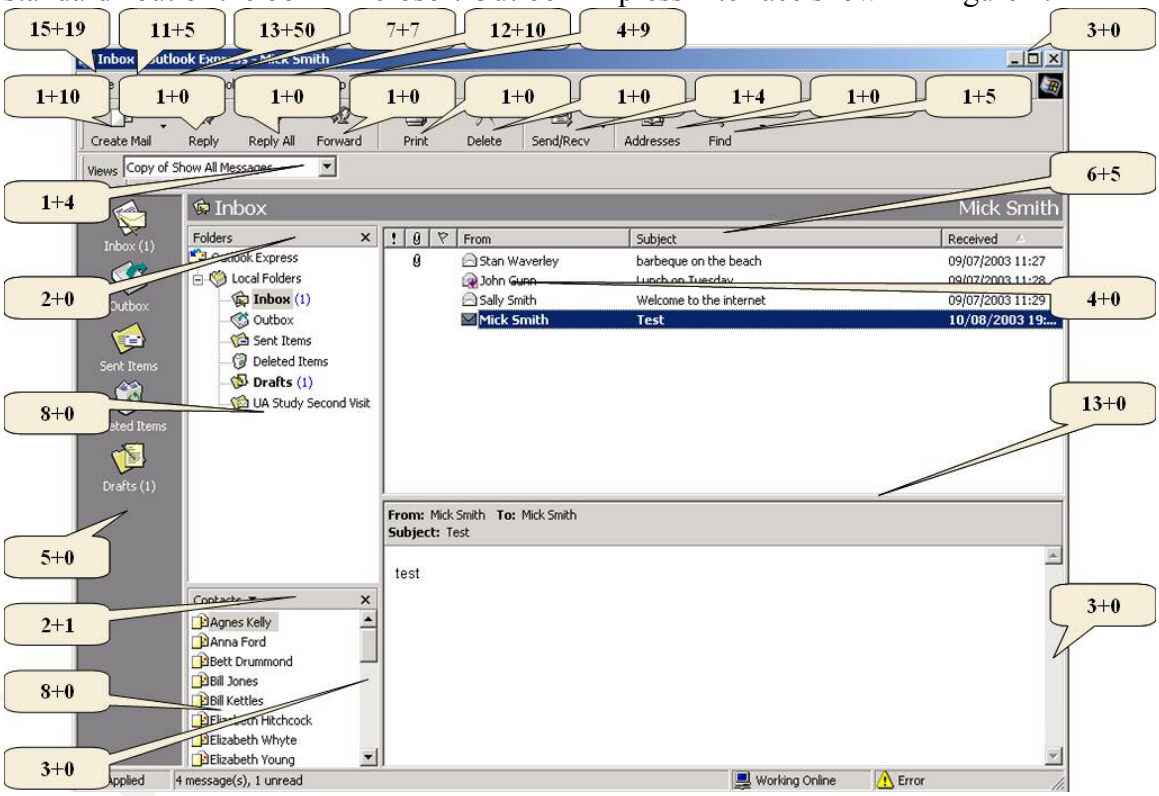


Figure 1: Complexity of Standard Software

Figure 1 shows the tremendous complexity of a standard email system. The labels refer to the number of options available from a menu or button. Thus the File menu label

(15+19) indicates that 15 options are available on the first layer of the menu, and another 19 are available deeper in the menu structure. In total on this interface one hundred and one possible alternatives are offered directly, and a further one hundred and twenty nine alternatives are available indirectly. Once a user becomes familiar with the system, a very large proportion of these alternatives are ignored. However, for people who are unfamiliar with the interface and do not know what they are looking for, the large number of options create serious difficulty.

Display characteristics

Commercially available systems normally have very small targets and text in order to fit all of the many options provided onto the screen. As older people are likely to have some level of visual impairment combined with some reduction in fine motor control, it is likely that they will find larger targets and text much easier to use; in addition, the ability to change text, icon and target size is important. Age-related visual impairments may also make it difficult to read closely-spaced text (in terms of both character and line spacing), certain fonts (especially complicated or decorative fonts) and may make it difficult to distinguish between certain colour combinations, particularly blues and greens (Carmichael, 1999; Echt, 2002).

Commercial software rarely offers a simple, single option for making objects on the screen larger (other than changing the resolution of the monitor, an operation which demands knowledge of display settings and is difficult to reverse). Options for increasing text size, icon size and scroll bar size are variously in application options, toolbar customize options and accessibility options, and finding and changing these settings demands a level of knowledge wholly beyond a novice computer user.

Assumption of background knowledge

Most commercial applications implicitly demand a high level of knowledge from the user. Users are expected to know (or be able to guess) when to double-click, for example, or that clicking on the words along the top of the screen will produce a menu. In email systems, the user is generally expected to know what a “valid” email address should look like, that email addresses do not end in a full stop, or that they have an @ in them somewhere. Although authorities generally argue that systems for older people should not assume familiarity with technology (Mead et al., 2002; Young, 2002), it is very difficult to find commercial software for which this is true.

Some software conventions present other problems, for example, the question of where text will appear on a screen when you start typing. On complicated screens with multiple input boxes, it is not clear to the user why typed text appears where it does, nor how to move between boxes. Visual impairment also makes it difficult to see the cursor, and fine motor control impairments make it difficult to move the focus between lines or boxes.

The Windows system makes it extremely easy for the novice user to make apparently catastrophic errors. By clicking on a window in the background rather than on the one they are working with, the user can “lose” the program window that they are using. The

small object at the bottom of the screen indicating what has happened is not sufficiently obvious to alert them to the possibility of recovering the "lost" object. Users commonly complain that they "lose things" when they are using a computer, and that it is unclear how to recover from what appears to them to be an error; one response to the UTOPIA questionnaire on computer interests illustrates this commonly-felt anxiety:

> "I find sometimes I suddenly lose everything and [find it] difficult to get back. Sometimes I get something I did not want and do not know how I got it."

Burden on memory

Novice computer users find almost all aspects of a system unfamiliar and need to learn the behaviour of numerous onscreen objects like scroll bars, drop down boxes, menu systems and even the misleadingly named "Start" button. This effect is worse for older learners who are likely to learn things more slowly than younger people. As Hawthorn has pointed out, older learners in general take a considerable period to attain "reasonable effectiveness" (Hawthorn, 2002) which includes remembering about, and learning to use, skills that 'advanced' computer users would regard as automatic. Novice older learners cannot call upon the range of skills and background knowledge that most computer users have, and their ability to encode the correct response is degraded by the complexity of the activity.

Designs for older users

Carroll addressed the problem of younger novice users becoming lost in menu options by stripping down the available functionality and making many confusing options inaccessible, and found that this aided the learning process considerably (Carroll and Carrithers, 1984). Using a similar approach with older users, Hawthorn developed SeniorMail, an email system based on Microsoft's Outlook Express, which addressed the problems older novice users have remembering how a system works by having a list of possible actions presented in a simplified menu system. He made this design decision in order to "make it easy for the user to search for the feature that they wanted if they failed to remember where it was located" (Hawthorn, 2002).

There are examples of systems that have enabled visual alterations to be carried out more easily: the SeeWord system, developed at the University of Dundee, avoided these problems by implementing Shneiderman's theory of 'Direct Manipulation' (Shneiderman 1983; 1998). Shneiderman describes direct manipulation as: "rapid incremental reversible operations whose effect on the object of interest is visible immediately" (Shneiderman, 1998, p.205) and the SeeWord system allows users to alter the appearance of text by using on-screen objects which, when manipulated by the user, immediately effect the appearance of the document (Dickinson et al., 2003; Gregor et al., 2003).

There are thus four main areas that cause particular problems for older, novice computer users: overcomplicated interfaces, display characteristics, assumption of background knowledge and burden on memory.

Initial Design Decisions for the Cybrarian Project

The development team recognized from the outset that an email system appropriate for older people who were novice computer users should:

- have a reduced set of functionality presented in a non-cluttered way without menu systems or other items that demanded good motor control to use.
- not expect previous knowledge of computers and the conventions surrounding them (for example, email addresses)
- 'forgive' minor errors or remove the opportunity for them to occur
- tell users where they were in the system and give hints about what they could do at that point.
- support users with visual impairments in two ways:
    - first, the default system appearance should have larger text and targets and higher contrast between foreground and background;
    - second, the user should be able easily to change the visual attributes of the display to enlarge the text or make other alterations.

These requirements can be rephrased as a number of guidelines for the development:

Level of functionality:

- Only essential functionality for a working email system to be included, any advanced functionality being provided by a layered interface
- Each screen to have a very clear primary function
- The number of actions / buttons per screen kept to a minimum (fewer than 10) (Miller, 1956)

Accessibility

- Larger than average clickable targets (32 and 26 pt size recommended)
- Larger than average fonts (14 point as a minimum)
- High contrast choice of colours for text and background
- Accessibility features compatible with the W3C guidelines

User interface paradigms

- Simple and very consistent select and operate paradigms
- Clear conventions for the positions of buttons and information
- No new or poorly established interface paradigms which were unlikely to be understood by the user group
- Avoid scroll bars if possible, and definitely do not use nested scroll bars

Terminology

- Terminology which was understandable by the user group

Personalisation

- Some personalization to allow for people with poor eye sight or dexterity, for example the ability to easily increase text size.

Development

Designs for an email system were produced based on the constraints listed above and from research carried out by the UTOPIA project, including in-depth interviews with older users of email systems, and also on other research projects within the department (Gregor et al. 1999)

The developers faced a number of challenges, including the problem of making the interface as uncluttered as possible while still clearly labeling all the fields, and ensuring that the design took into account issues such as the need for greater than usual foreground/ background contrast on buttons. An early design illustrating some of these problems is shown in Figure 2.

Figure 2: Early screen design

Figure 2 illustrates the way in which complexity crept into designs despite the determination of the development team to keep the interface simple. Although this prototype had very restricted functionality, the screen was still sufficiently cluttered to intimidate novice users. One reason for the clutter was because the user was offered the option to change the arrangement of screen real estate by closing the **where am I?** and **hints and tips** boxes, using the small **close** buttons (which did not follow the same

convention as the other buttons on the screen). This option was thus removed. The eye icons to the right of the messages were intended to represent the user's ability to "view" the message, and the user clicked on the eye icon or the envelope to open a message. However, this too added to screen complexity. The difficulty of technical language creeping into the design is illustrated by this early screen design; users were offered the option to 'log off', in a small bar across the bottom of the screen.

The first prototype was evaluated using heuristic evaluations (Nielsen, 1994) and walkthroughs, and redeveloped in several iterations.

Various changes were made to the design. Much of the complexity was removed and the brackets were removed from the screen titles which were also capitalized, for example: "(message tray)" became "Message tray". The eye icons were also removed and it became possible to open a message by clicking anywhere on the large white button. Small details were altered too: when the design was shown to a small group of older people they not only pointed out that the buttons were unreadable (the contrast was insufficient to make them easily legible), but they also commented that envelopes, not letters, should have stamps.

Figure 3: Workshop design

These later screen designs were presented to a workshop of nine representative older people aged between 65 and 84. The specifics of the workshop are discussed elsewhere; they included plenary discussion sessions and 'break out' groups of 2-3 people who were asked to interact with the paper prototypes as if they were using a touch screen computer system. Results from the workshop fed back into the system design.

Results from the Workshop

The workshop results were invaluable to the system design and highlighted many of the developers' assumptions about computer systems that had been 'invisible' to the developers themselves. The following section examines some of these results and provides some illustration of the issues raised by the workshop participants.
A variety of changes were made based on participants' comments and on the observations of the researchers who facilitated these sessions.

Buttons

There had been an ongoing debate within the development team about the appropriate appearance for buttons and therefore three alternative designs were presented to the workshop participants.

Standard button | Button with text in bold | Button with icon

Figure 4: Three button designs presented to the workshop

The older participants found the non-bold text on the standard button (1) very difficult to read and liked a combination of two of the designs (2&3) but would have preferred different colours; one of the participants commented: "it would be better if it was a white background and black, black text?... much easier to see, *much* easier to see…". Part of the reason for this was that the surrounding screen contained text that was predominantly dark text on a paler background, a contrast which degraded the text's legibility on the buttons.

Language

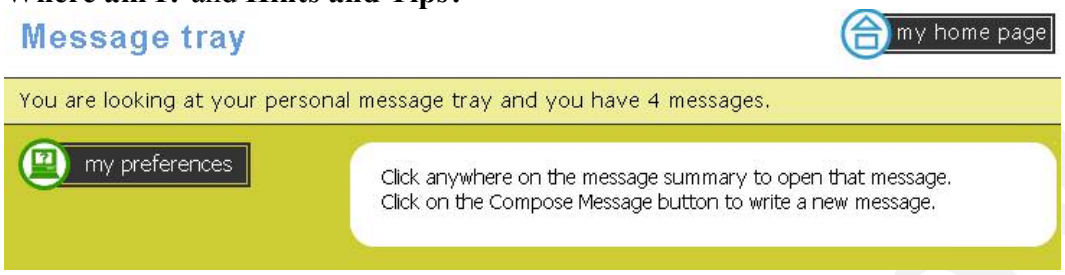
The workshop was particularly valuable in demonstrating that many of the developers' assumptions about language and computer systems were not shared with the user group. The terminology used throughout the prototype system was regarded as far too complicated by the workshop participants. Formal words like "compose" ("what's wrong with *write*?") and "recipient" were seen as unsuitable.

Confirmation message changes

The screen which confirmed that a user's message had been sent looked like a received email addressed to the user and this caused considerable confusion to the participants. It was not clear to them that the confirmation message was a message from the system as opposed to a message from the person they had just emailed. The participants were also confused by receiving a message from the system as if it were a person.

Hints

The prototype presented to the workshop had two sections at the top of the screen: **Where am I?** and **Hints and Tips?**



Participants very much appreciated the hints section, but felt that it would be more useful to provide explicit instructions on how to do things instead of hints, and to attract attention to this section so that users knew to read it. They repeatedly emphasized how useful such instructions would be.

Final Prototype

The design team continued the iterative process of development. Several workshops at different stages of the development process would have been of great benefit but the strict time constraints of the project made this impossible.

The final prototype was an email system which conformed to as many of the initial design constraints as had been found to be technically feasible within the development period. Developing a system without the complexity inherent in most current computer software, however, necessitated a number of difficult design decisions.

Restricted Functionality

The Cybrarian email system allowed the user access to a restricted range of functionality, permitting them to:

1. read emails
2. send emails
3. reply to emails
4. delete emails
5. forward emails

Points 1-4 were based on discussions with older email users. The ability to “forward” emails was added this facility might prove useful to people, but is unlikely to be requested by inexperienced users of email systems.

The restricted functionality ensured that each screen could have a single primary purpose. There was only ever one text entry box on a page, meaning that the user never had to move between multiple input boxes on a single screen, avoiding the numerous errors that

such screens cause. A single text entry point on each page also provided a strong hint to the user about where text would appear when they started typing.

Figures 4, 5 and 6 show how the system design guided the user through the process of (in this example) sending an email.

Figure 5: The user is directed to choose a person to send their email to

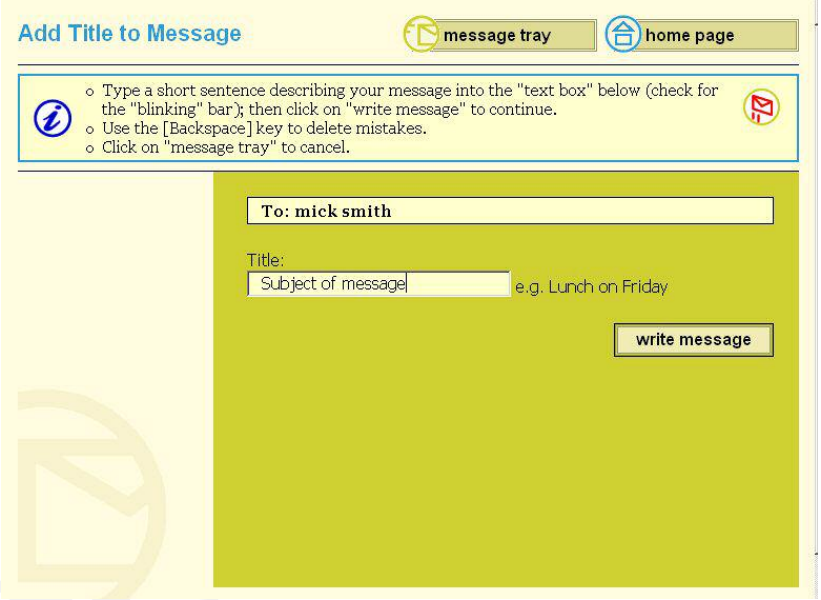


Figure 6: The user is asked to add a title (subject)

Figure 7: the user is offered a screen to compose their message on

The step-by-step procedure broke tasks down into individual actions and allowed each page to be relatively uncluttered and to have a clear purpose. There were no dynamically changing components on the screen (for example: moving text, images which alter as the mouse moves over them) because older people can find changing images confusing or off-putting, particularly since such objects often change too quickly for older computer users to either see them clearly or click on them confidently.

All interaction was either text entry or a single mouse click on a button or object. The implications of this decision were wide ranging. For example, there could be no facility for users to 'select' and 'operate' on an object, for example: select a message on the message tray and then delete it. To retain the single-click decision operations had to take place on dedicated screens, for example: a message had to be opened, taking the user to the Read Message screen, before it could be deleted, printed, replied to or forwarded.

Visual Alterations

All the default text had a minimum size 14 font and the minimum target size was 32 pt, both significantly larger than those on standard interfaces. This increased text and target size was helpful for those with visual and motor control impairments. There was a reasonably high contrast between foreground and background. All text was presented in relatively short lines and not right justified.

Rather than relying on the 'accessibility options' provided by Windows, the developers allowed users to easily 'personalise' elements such as the size of text, the typeface and the text spacing. These options were available from every page through a 'personalise' button which took the user to a wizard, which guided them through the process. Allowing users to personalise the system with a variety of text sizes, spacing etc. produced difficulties for both the designers and the developers. The text on any button needed to be scalable and all screens had to look coherent and attractive for all text sizes; the

designers therefore considered a range of possible text settings to ensure that those with visual impairments who needed larger text would be able to use an attractive system. Allowing users to personalise the text raised issues of text wrapping which could have had the effect of making the text harder to read and, when this was controlled for, it was also necessary to carefully avoid triggering additional scrollbars.

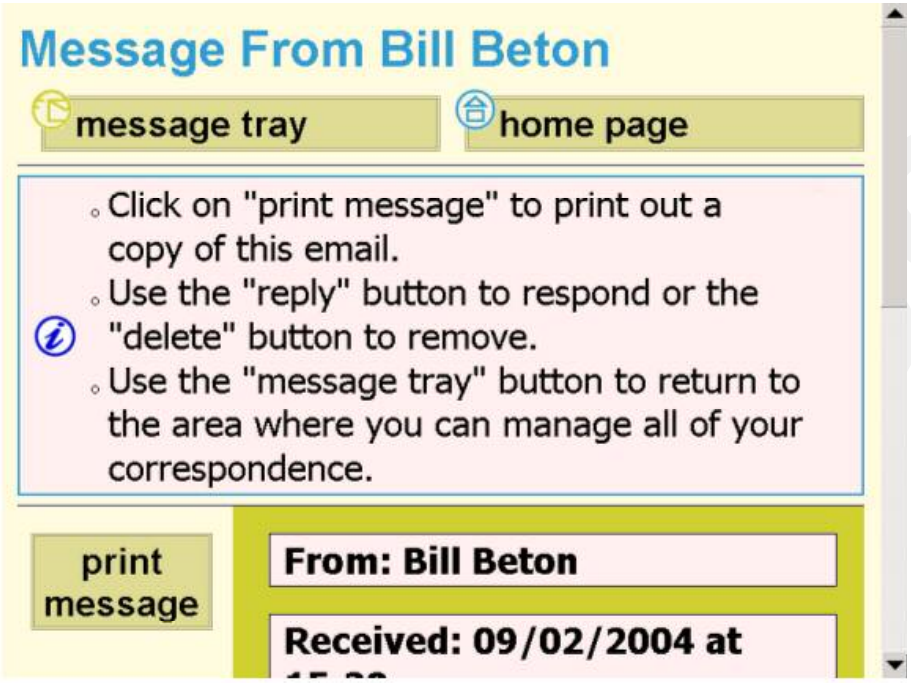


Figure 8: The "read message" screen with large text and with default text

Forgiving System

As Morris and others have noted, this group of users lacks confidence with modern technology and it is important to make early experiences with computers positive to encourage confidence. When novice users make errors they can be very discouraged, especially if it is unclear to them what went wrong and they are unsure how to avoid the error in future. All screens were therefore kiosk-style, that is, they covered the whole screen. This removed the problems associated with confusion between windows and a computer running the Cybrarian email system appeared as a dedicated emailing tool.

When an error was made, the system made it explicit to users how to go back and undo an action that they had made by mistake. For example, when users were entering a surname into the address book they were told in the instructions "Click 'back' to go back to change the first name" and the 'back' button was clearly visible (see Figure 9).

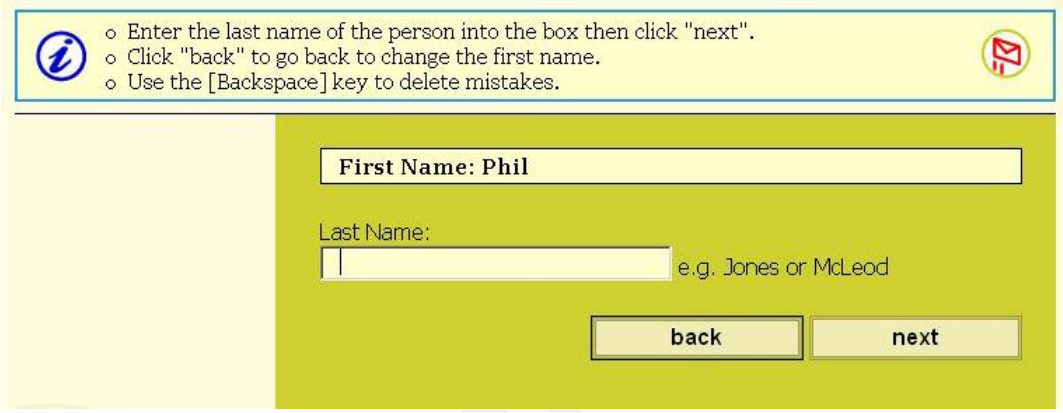


Figure 9: Entering a surname into the address book

As email addresses commonly create problems for this user group, the system tried to identify common errors in email addresses and provide instructions about what was wrong and how to correct it. For example, it would suggest that email addresses with full stops at the end of them were incorrect and ask the user to remove the full stop.

Another aspect of the system being both forgiving and sensitive to the needs of older users was the decision to make the whole target (like received messages or entries in the address book) capable of being clicked (see Figure 10), this decision had been vindicated at the workshop where the participants made different choices about where to click on the message they wanted to open. The outlining made it clear to users that the whole of the received message summary was a button and could be clicked.

Figure 10: Large clickable buttons in message tray

Instructions

The Cybrarian system provided instructions throughout the system in everyday language to make it clear to the user what could be done on each page. The instructions also made their location in the system explicit to the user (see Figure 11).

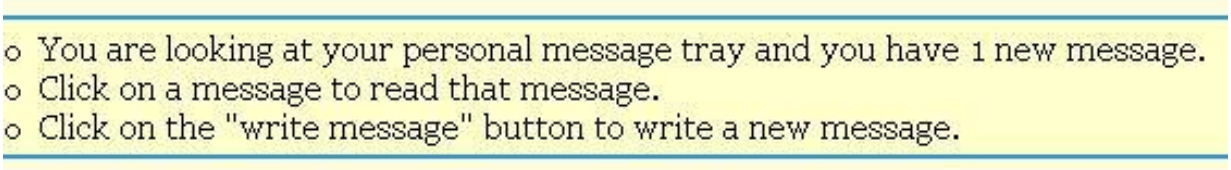


Figure 11: Instructions to users on the Message Tray screen

Instructions were particular to each page and concentrated on the actions the user was most likely to want to try when they *first* used the system, for example, read a message, write a message, reply to a message.

The developers did not assume that the user had any background knowledge of how to use an email system, and ensured that all the terms used were 'real English' rather than the jargon associated with computers. The instruction panel at the top of the screen gave basic instructions about how to use the system for those who were unfamiliar with email programs.

The simplicity of each screen meant that the Cybrarian email system had more screens than most commercial systems. The user progressed through a guided pathway rather than being offered all the possible functionality from one central screen.

The provision of this level of simplicity for the user represented a development process that was itself far from simple. Many assumptions about interface design move the complexity onto the user and the really difficult achievement is to produce a system where the user sees as little of the system's complexity as possible. The necessity of removing the complexity associated with motor control and physical movement meant

that many more screens were needed which meant that an easy and intuitive navigation structure was vital.

Finally, the developers tried to remove as much of the burden on memory as possible by producing a simple system in which only a limited range of functionality was available, instructions were always at the top of the screen to remind the user what they could do on the page, and all functionality available on that page was immediately visible to the user: none was hidden in menus.

There are many steps between the recognition of the general reasons why older people do not use the Internet and the development of a system which they find usable. The only way in which the success of the decisions made along the way can be judged is through evaluation with a representative group of older users. Although the email system was developed with input from target users it was also, as discussed above, based on a large number of small design decisions. These numerous decisions could not all be fully tested with users within the constraints of the project. The evaluations were intended to indicate whether or not this design process, and the decisions made, had been successful.

Evaluations

The Cybrarian system was evaluated in a controlled environment over a two week period with 15 older people (58-87). Each user attended twice and on each occasion performed a series of email tasks in two sessions of an hour and a half each with the experimental system and a commercially-produced comparative system. The order in which people used the experimental and control system was controlled to avoid order effects.

Outlook Express, a system commonly provided by Internet Service Providers, was chosen as the control system. The evaluations indicated that Cybrarian was easier to use, that people using it needed significantly less help and made significantly fewer errors and hesitations than those using the comparison system and that they described it as easier, more comfortable and easier to remember than the comparison system.

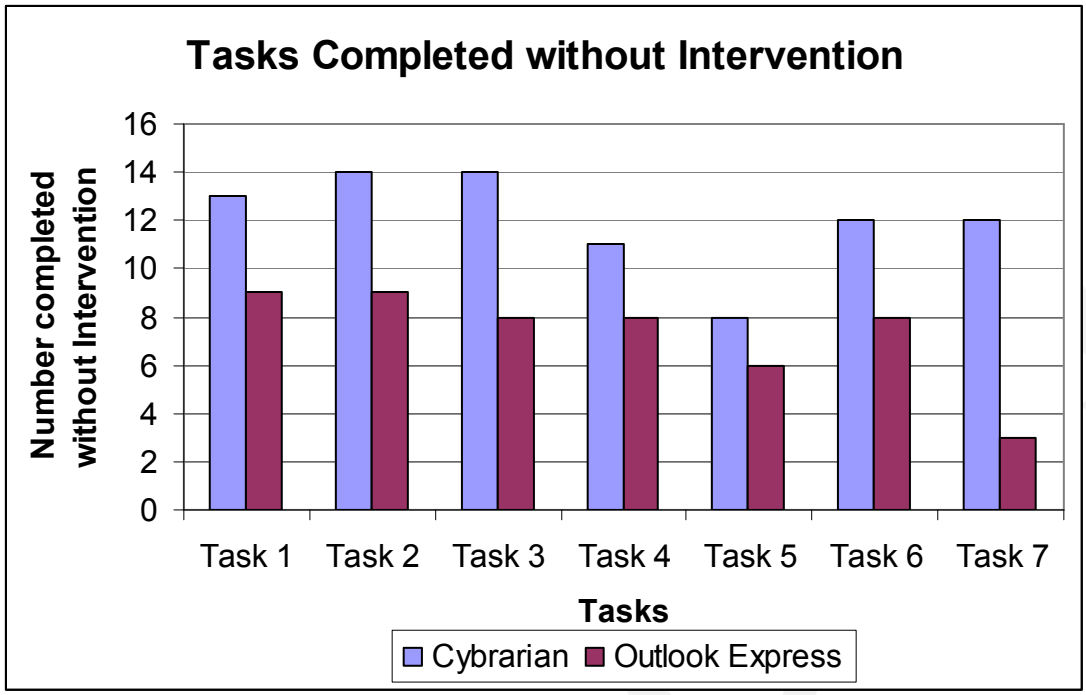


Figure 12: Task Completed without Intervention (visit 2)

Figure 12 shows the number of tasks that participants managed to complete without help from a facilitator during the participants' second visit, when they had already used both systems. Participants were able to use the Cybrarian system more autonomously than they could use the comparison system. A Mann-Whitney test carried out on these results indicate that they are significant ($p<0.01$).

As Morris anticipated, a positive initial experience with the software encouraged users to continue using computers (Morris, 1992 p.75). Users reported that they felt more inclined to explore other things that computers could do, especially the Internet, after they had used Cybrarian. One participant commented: "using Cybrarian would encourage me to use a computer far more. Using OE only may well have put me off".

However, as would be expected after such a rapid development process, the results of these trials also showed that there were aspects of the Cybrarian system that could be improved.

Address book

The importance of the navigation structure being clear and intuitive, since it was unusually deep in terms of having many separate screens, was illustrated by problems with the procedure for writing an email, which were recognised at an early stage of the trials. The developers had conceived of the address book page as the dedicated part of the system which would be used to edit and add "contacts". If a user wanted to write a message to someone they needed to click on the "write message" button on the message try screen, and not on the "address book" button which was underneath it.

Figure 13: Message Tray - it was necessary to click on "write message" to write a message, and not on "address book"

Not only was the idea of "contacts" an essentially technical one, it rapidly became clear that the natural flow of actions led the user to select a name from the address book and then send a message to that person. This was probably influenced by users' familiarity with paper address books. The problem was solved by adding a "send message to" button to the option screen in the address book.

Figure 14: The address book screen - there was no facility to send a message from this screen, the only options were to click on a person to edit their details or to add a new person to your address book

Language

It became clear that many participants had difficulty with the concept and the terminology of "forwarding" a message. Similarly, the word "edit" caused confusion and was described as "computer language". The two terms had been deliberately included to support participants in learning the kind of language they would encounter in standard email systems but the use of these words proved confusing. These examples highlight the reality that seemingly unimportant matters make a substantial difference to older people's ability to use an email system for the first time.

Screen similarity

The appearance of the system's screens met with positive comments, and the participants clearly felt secure in the Cybrarian system, but it was clear that participants had difficulty distinguishing between certain screens where the only difference was of detail (for example: the title of the screen, which was at the top left-hand side). In future development it would be advisable to investigate inclusion of obvious cues about screen change, perhaps including (but not confined to) colour differences between different screens.

Scroll bars

The trials confirmed the researchers' views that scroll bars are not only physically difficult to use (their use involves clicking on a relatively small target), difficult to notice (because they are at the very edge of the screen), but also conceptually novice computer users find it hard to understand the way they work: many users thought that by pressing the upward pointing arrow, they were "scrolling up" and did not understand when the document moved *down*. Multiple scrollbars created major problems, which the developers tried very hard to avoid, but the personalise options meant that it was very difficult to avoid triggering the Windows scrollbars. Alternatives to scroll bars are an important area to explore in developing systems for older novice computer users.

Evaluation conclusions

The Cybrarian system received very positive responses from evaluators, and there was persuasive evidence that it was easier and more comfortable for them to use. Nonetheless some problems remained, as described above. Although the some represented oversights on the part of the developers, others, most obviously the scroll bars, reflected the constraints of the environment. To adequately address problems like these, the development time for a genuinely new kind of system needs to be longer, to allow more extended user testing and more user involvement in the iterations of the design.

Conclusions

The email system developed demanded far less from the user than commercial interfaces but development of a system with reduced functionality and such a simple interface was far from simple itself. Various design tradeoffs had to be made to retain the simplicity and this involved difficult design decisions for the development team.

The efficacy of involving representative users stemmed not only from their direct input to the development process, but also from the powerful effect that observing them had on the developers. The time frame of the project constrained the amount of user involvement that was possible and it would have been better to involve more of them and have more iterations of the prototype.

The positive early experience associated with the use of the Cybrarian system led participants to be more confident about computer use generally, but especially about Internet use. Such confidence is essential for successful future learning. Among the user group there was evidence of increased confidence and enthusiasm for the system. To have taken a group of older people with little knowledge of computers and a perception of the Internet as 'alien' and received such positive responses to the experimental system, and demonstrations of successful use, indicates that it is possible to develop appropriate systems for many of the people who are currently unlikely to use the Internet.

Many of the characteristics of the current Cybrarian system are also appropriate for other non-users. A system that demands no prior knowledge and provides instructions and supportive feedback is useful for a wide range of the people who do not currently use computers. The Glasgow Household Survey found that almost 30% of non-computer users of all ages said "I don't know how to use it" and a similar proportion said "I don't know anything about it" (Glasgow Household Survey, 2002), indicating that non-users of all ages are likely to be helped by a system that makes no assumptions about their knowledge. As well as being helpful for novice users, the Cybrarian system is also likely to be useful for those with mild cognitive or motor control impairments, while the existing interface and the easy availability of options to change the visual parameters make it useful also for those with visual impairments, including, in some cases, people with dyslexia (Wilkins, 1995; Keates, 2000).

The real challenge of producing the Cybrarian email system was to hide the complexity of the functionality. Companies selling commercial software normally emphasise the new functionality that it offers, and measure success in terms of the new options being offered. One of the most difficult processes during the development of the system was recognising when our preconceptions about what was 'necessary' for an email system allowed complexity to creep into the interface designs. There is no doubt that contemporary computers are powerful enough to hide most of their excessive complexity from the user, but it is equally true that this involves a paradigm shift in managers', designers' and developers' understanding of what a good computer system is, and a recognition that a market exists for simple interfaces.

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