Approaches to Web Search and Navigation for Older Computer Novices

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ABSTRACT
A proof of concept web search and navigation system was developed for older people for whom the Internet is seen as an alien territory. A joint industry/academia team deployed User Sensitive Inclusive Design principles, focusing on the usability of the interface for this user group. The search and navigation system that was developed was significantly preferred by the user group to that provided by a standard commercial (Internet Service Provider) system; it scored highly for ease of use and the participants reported increased confidence in their ability to master the Internet. Recorded quantitative measures showed fewer task errors. The outcome of the development was a successful "proof of concept" search and navigation system for older novice computer users together with approaches to design and development for those who wish to design for this user group.

Author Keywords
Human Factors, older people, web browser, web search, usability, accessibility, web portal, interface layering.

ACM Classification Keywords
H.5 Information interfaces and presentation; H.5.2 User Interfaces: *User-centered design*.

INTRODUCTION
While the World Wide Web (web) offers various potential benefits for older adults, take-up remains low compared to other groups [18,26]. The reasons for this 'grey' digital divide exist on a number of levels; many older people who do not use the web do not perceive it as offering information of interest or relevance to their lives [27], and those who do may face accessibility and usability barriers [2,5,8].

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These issues are inter-related, but researchers tend to focus on aspects of one or the other in order to develop well-researched solutions. A concern with the details of web content accessibility, or the browser, or the availability of content of interest to older people, risks neglecting the overall vision which is necessary if we are to address this divide in a person-centred, meaningful and effective way. In this paper we report on Cybrarian, a proof of concept (P-of-C) project taking a wider, more holistic approach to the digital divide. The prototype system that was produced instantiated various approaches to the barriers faced by older people using the web for the first time. Evaluation with older people indicated that the system was strongly preferred to a commercial equivalent and that it performed better on a range of usability measures.

OLDER PEOPLE AND WEB ACCESSIBILITY
"Web accessibility" usually refers to a series of standards, mainly those produced by the W3C, and guidelines for developers. The focus has been on the production of standards-compliant sites which allow users to access the site through assistive technologies such as screen readers. While this approach has done much to enable access for the technically knowledgeable who can use assistive technologies, it is less effective in enabling access for older adults. Although many older adults use the web with no especial difficulty, others may struggle to access it and the barriers they encounter may discourage use or make it impossible without support [24]. One reason for this is that many older adults are inexperienced web users and less likely to be aware of access options or assistive technologies [18,26]. Normal age-related changes in auditory or visual perception, or in manual dexterity, may complicate web use, particularly for poorly designed sites, but are not (and should not be) perceived as "impairments". Accessibility options are developed to cater for specific impairments characteristic of those experienced by younger people. By contrast, if older adults do experience impairments these are more likely to be a range of changes in visual and auditory perception, manual dexterity and cognition [7,9,21] that can inter-react. Functionality will also fluctuate depending on factors such as tiredness, blood-sugar levels and medication, and may do so more for older adults than for younger users [19]. Further, web accessibility standards have been

recognised as failing to provide adequate guidance on design for cognitively impaired people [10] and some older adults may experience cognitive change or, as a result of age-related conditions like stroke, cognitive impairment. Although it is unreasonable to define older adults in terms of age-related changes or impairments, these potential characteristics must be considered if a design is to be inclusive.

Reasons for Non-use of the Web

There are many reasons why older adults do not use the web. Web content presents significant accessibility barriers [5,16,20] and some work has also investigated barriers presented by the user agent [12]. Hanson et al. [20] have summarised how older adults with age-related impairments, especially visual impairments, may find the web very difficult to use. Ellis and Kurniawan [17] and Coyne and Nielsen [11] have demonstrated that the conventional approach to accessibility (standards-compliant websites that offer the *flexibility* to enlarge text size, change colour contrasts, etc.) is inappropriate for older adults, who are unlikely to take advantage of these possibilities.

Ageing is also associated with cognitive change, including a reduction in the efficacy of short term memory, spatial memory and certain forms of reasoning and generalisation of knowledge [7,21]. By contrast, older adults are likely to have significantly more experience and knowledge and a good design will take advantage of this; one problem with current designs is the extent to which they depend on inexperienced users learning a wide range of unfamiliar concepts rather than supporting existing knowledge [3]. Unfamiliar concepts may include: dealing with scrollbars [17]; navigation confusion [22,30]; understanding and identifying hypertext links [8]; and dealing with search engines [2]. For some, these can become impassable barriers [8,24]. There is also the fundamental issue of users not understanding what the Internet is, how it differs from the World Wide Web, and how content is provided.

The barriers that inexperienced older users encounter to web use do not, of course, wholly explain the digital divide. As Selwyn [28] points out, older adults are unlikely to use the internet if they do not perceive its relevance to their lives. While a perception of relevance is an important attractor to use, however, it cannot enable use. Usability and accessibility barriers must still be overcome to enable those who are interested to use the web. Computer use does not inevitably lead to successful Internet use. The progression from word-processing, and other off-line computer use, to the Internet is not trivial [15]. The wide range of different content available online, with different interfaces and presentations, also means that learning to use one site does not necessarily transfer easily to other sites.

The Proof of Concept (P-of-C) Project

A proof of concept (P-of-C) study was established based on an industrial-academic collaboration to address the "grey" digital divide. The project was aimed at addressing the digital divide in part through the provision of appropriate software, by developing systems that were attractive to, and usable by, older adults (age 60+ years) who perceived the Internet as "alien" to them.

Previous Research on Email for Older People

An outcome from previous research on e-mail for older novices [14,1] was a perceived need to focus on a 'radically simple' design strategy. When applied, this strategy had resulted in a system of strictly reduced functionality with a maximum of nine options per page, page-specific help and instructions for the user, and a one-click paradigm where a mouse-click *always* led to a new screen in order to reduce user confusion about selection or double mouse-clicks. Default minimum text and button sizes (point 14 text; 32 and 26 point size targets) were used, and full compliance with the W3C accessibility standards was imposed. Evaluations demonstrated that a system with these characteristics was significantly more usable, and was also more likely to attract users to Internet use, than a comparison system.

A SYSTEM FOR WEB SEARCH AND NAVIGATION

The web is a collection of information that can be presented to the user in many different ways. The question addressed in this proof of concept project was how to present the web to older novice computer users in a way that enabled them to explore and benefit from the web, such that it made sense to them, was not confusing or frightening, and facilitated learning and progression in web usage.

Developing an interface to the web for a special user group such as older novice computer users is fraught with challenges. The diversity of web content means it is not possible to ensure that users see only appropriately designed and usable web pages, indeed such censorship would defeat the purpose of accessing the web in the first place. It is important, however, to ensure that users are not overwhelmed by diverse content from the beginning of the experience. The central design consideration was to ensure that initial experiences of the web were positive: research evidence has demonstrated that such positive introductions reduce user anxiety and increase the likelihood that they will persist in learning a new system rather than being discouraged from the beginning [23]. The system was also intended to facilitate learning and progression among older users.

A User Sensitive Inclusive Design (USID) approach was adopted. This is an approach developed specifically for use with older adults [25], unlike more mainstream User Centered Design approaches, such as Contextual Design, which developed from studies using relatively homogenous groups of users in business settings. USID:

- Challenges the idea of fully representative samples; older people are diverse so it is misleading to over-generalise.
- Uses a pragmatic design philosophy; expert advice is utilised. (The experts in this study had experience of

relevant interviews and focus groups with more than 200 older users.)

- Involves changing the attitudes of designers and developers to appreciate specific difficulties that older users face.

A series of requirements-gathering meetings took place, including members of the design team who had substantial experience of, and expertise in, designing systems for older people. This was followed by an iterative design methodology where prototypes were produced and informally evaluated by the domain experts in the design team. The designers took advantage of results from user evaluations of earlier work on email for older people.

The approach adopted was to provide:

- Three layers of information content;
- A reliable, hierarchic catalogue structure with predictable results;
- A layering of functionality.

Content Layering

As Shneiderman [29] and others have indicated, interface layering represents a useful approach to introducing the novice computer user to available functionality. It is similarly useful for hiding the full complexity of the web from beginners. The system had three levels:

1. A "walled garden" of highly accessible core content, fully controlled by the development team, and repurposed specifically in order to introduce the user to the web.
2. A second layer that was a wider layer of content provided by third parties, but conforming to similar high standards of accessibility and navigable structures.
3. A third layer that consisted of information content from the web in general ("warts and all" content) that did not necessarily conform to accessibility standards.

In level one the user was provided with an initial safe and predictable environment in which content could be explored without risk of getting lost or stuck, or, most importantly, without risk of the user becoming immediately discouraged. In an initial period of usage the user would be introduced to basic concepts of browsing using consistent page layouts, a reliable navigation structure, and on-screen hints and help in using the system.

As far as possible, the familiar features of the page layout and navigation structures were maintained in the second and third layers through a 'framing' technique. Third party content was corralled into a designated area leaving space for the permanent and familiar navigation mechanisms from level one. In layer 2, this was reliably achieved through conformance to standards. In layer 3, this corralling was not totally effective; poorly designed web pages occasionally broke the framing mechanism.

Catalogue Structure with Predictable Results

A hierarchic catalogue structure was developed that enabled users to access types of information content in a highly predictable manner. This hierarchical structure was restricted to three levels to reduce the likelihood of users becoming lost within the hierarchy [30]; it was intended, in part, to introduce participants to the structures and concepts that they would encounter on the Web. The categorisation of content was based on the authors' assessment of what would be most appropriate for the target group, and designed to allow the user to predict the type of information in each category. In content layer 1, the catalogue structure was limited to six top-level categories. In content layer 2, which included third-party content, the catalogue hierarchy was broadened significantly. This required the user to scroll through longer lists of categories and information pages. Dependence on third-party meta-tagging of information meant that it was more difficult to maintain the same degree of predictability as in content layer 1, and in layer 3 the more arbitrary nature of general information content significantly magnified the difficulties of meta-tagging.

Functionality Layering

The first level of functionality allowed access to web content only through the subject catalogue; on the second level, search functionality was introduced as well as the ability to "remember" web pages or to find pages on similar topics. The search facility allowed both a general search and a "search within" facility in which the user could search within specific areas of the subject catalogue. It was thought that some form of dynamic categorisation could help in the presentation of search results, and hence reduce the cognitive load on the user. The search facility was thus enhanced by a clustering engine. This enabled search results to be categorised before being presented to the user, and provided a method for the user to either narrow down the search criteria or select relevant content. A keyword suggestion mechanism was added in which additional search keywords would be suggested to the user to refine the search criteria.

Layout and Presentation

The P-of-C system was designed to comply with W3C standards and to be accessible for older adults; the 'look and feel' from previous research on e-mail and older people was used [14]. Published guidelines on visually accessible design for older people were used to inform the visual design and layout [7,8,11,16,17,20]. Text was sans-serif and a minimum of 14pt [6], targets were a minimum of 28pt and all text was presented with clear contrast between foreground and background. Colours were selected by commercial designers, checked by the research team for accessibility, and evaluated with groups of older people for preferences and clarity. The research team stipulated the use of an off-white background to minimise glare [16], darker text on a pale background, shown to support ease of reading [7] and also ensured that there was no need for participants to distinguish between blues, greens and

purples since the ageing retina can make such distinctions more difficult [16,20]. To cater for more significant or idiosyncratic visual preferences there were also in-built options for users to further enlarge the text, and to change background or foreground colours to suit their own preferences [11]. These options were presented as a wizard which guided the user through the process, making the results of each step explicit as they were carried out [13]. The personalisation choices were implemented using cascading style sheets and once selected were applied to *every* aspect of the user interface. This was a not insignificant challenge as these changes had to apply to all supplied content material as well as core system pages.

Lack of background knowledge about the conventions, language and metaphors used on the web can make the web appear an alien and unsettling environment. Page-specific help was therefore provided throughout the system. Constantly available instructions allowed participants to use their existing knowledge and removed dependency on learning, and retaining, new and unfamiliar concepts. This support was practicable because of the restriction of the number of functions per page. The help was presented in language that did not depend on commonly-used computer metaphors, and on-screen objects such as scroll-bars were explained. In addition, the initial presentation of a subject catalogue was a more familiar and supportive metaphor than search.

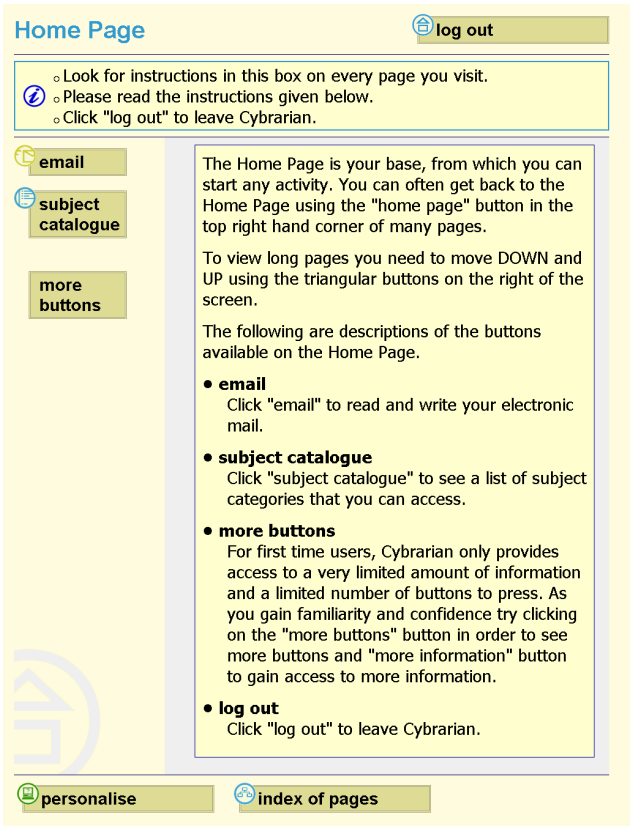

Figure 1: Home Page of the Proof of Concept System.

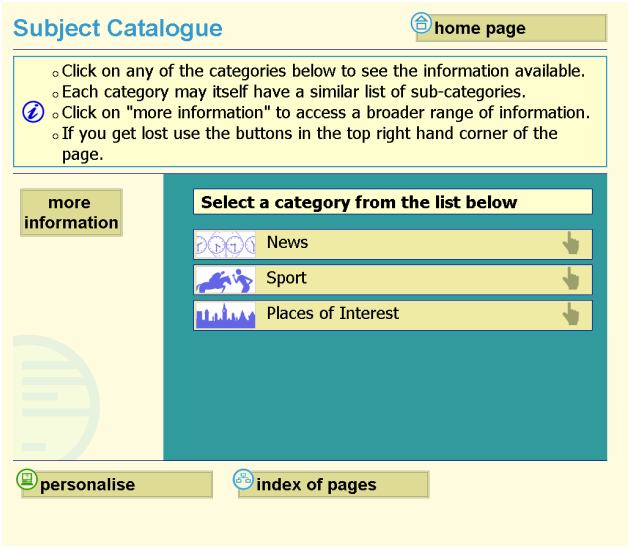

Figure 2: The subject catalogue (Level 1).

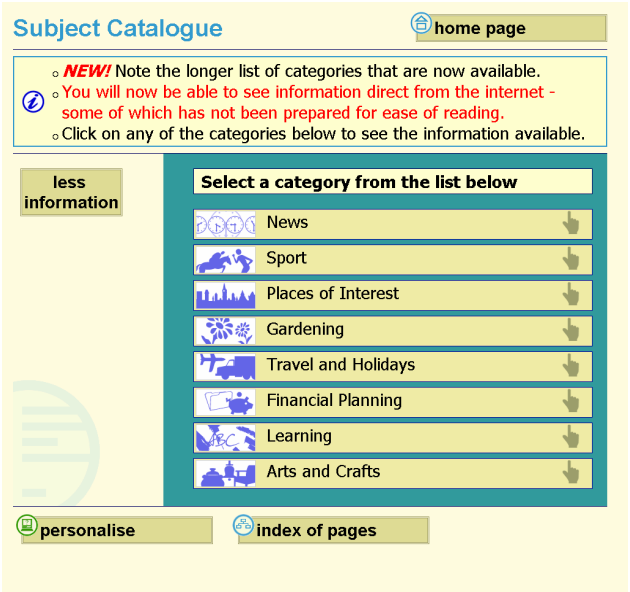

Figure 3: The subject catalogue (Level 2).

The Proof of Concept Project as a Training System

The search and navigation system was designed to provide a secure environment for users to learn about how to interact with the web, while also guiding them through a process that would ultimately result in their using a conventional web browser and web portal. The system thus led the user through a pathway of increasing functionality and content variability to a position where they were capable of accessing the web through more conventional and general interfaces. It was, therefore, vital that the appearance of the system was not confusing or frightening.

The user was initially introduced to the system through a homepage (see Figure 1). This contained a short description of the environment, telling the users where to look if they

needed help, how to get more options if they wanted to explore further, and an explanation of the buttons on the screen. This text appeared in the main viewing area, which is particularly important for older users because of the decline in useful field of view that occurs as people age [4]. Figures 2 and 3 show two levels of the subject catalogue. The first level is that which users initially encounter, with much reduced content; the second level shows added options for the more advanced user. The simple look and feel of the presentation of information is retained throughout.

EVALUATIONS

The system was evaluated to establish its usability and to explore the extent to which it facilitated user learning and progression. The evaluations were designed primarily to address the following questions:

1. Could a novice user complete tasks using the system? This was measured in terms of tasks completed and errors made by the user.
2. Did the system encourage learning and progression; would a user be inclined to attempt new tasks using the system and would they find it straight-forward to learn? This was measured by recording unassisted repetitions and unassisted progressions.

There are many important reasons for using a comparator system within any such evaluation [14]. The plethora of commercially available systems, however, raises the challenge of selecting one that was appropriate for this task, and there is no clear algorithm for making such a choice. After some investigations of alternatives the portal of a major internet service provider (ISP) and its web search facility was chosen. The selection was based on the availability of appropriate content through the portal and the understanding (from discussions with the ISP company) that their portal was aimed at users in their first year of web use. For some tasks, however, alternatives had to be used; for example, on a book-search task, participants were introduced to the site of a major web-based book retailer.

Participants

The evaluation was performed with a group of 11 older people. Older people are much more diverse than traditional young and middle-aged users of technology [7], and the wide-ranging nature of the functionalities of older people are such that it is not possible to recruit a truly "representative sample" as is suggested in traditional user-centred design methodologies. Participants were selected using a User Sensitive Inclusive Design approach [25] focusing on the characteristics important for the study. The important characteristics were that they should be in the older age group, had never used the web, and had either expressed reluctance to do so, or not seen any need to do so. Only older people with some basic experience of computers were recruited to avoid the need for a basic training session; this also ensured that the evaluations focused on the system rather than on fundamentals of computer use.

The participant group consisted of seven women and four men, aged 63-87 (mean age: 72). Participants had a range of minor age-related changes in functionality: one woman had moderate hearing impairment; the two oldest men (87 and 82) had minor manual dexterity impairments; all participants wore reading (6) or bifocal spectacles (5) during the experimental sessions. Five of the participants had personal computers at home, but none of them had used the web. None of the participants experienced any significant impairments: the accessibility of the interface for users with such impairments was evaluated in a separate accessibility audit [14].

Each participant attended two evaluation sessions and used both the experimental and control systems at each visit. A Latin Square experimental design specified the order in which the systems were presented to the users during these visits to avoid order effects. Repeated measures were used over the two sessions.

System Setup and Apparatus

The apparatus used was a PC with 2.4 GHz processor, 512 Mbyte memory, 40 Gbyte disk, CDROM, 1500 LCD monitor, 10/100 Mbps UTP NIC running Windows XP Pro and the Internet Explorer 6 browser. Recording equipment consisted of a digital video camera and a dictaphone.

Visit Structures and Protocol

The session facilitator met the participant and guided them to the study room. A note-taker was introduced to the participant, an informed consent form was discussed and signed, and a short, informal discussion about computer use took place. A traditional usability laboratory approach, with the user and the experimenter separated by two-way mirrors, was not thought appropriate for this user group. As with many older people, the participants had poor confidence in their use of computers and it was ethically important that any study should not increase this lack of confidence. The user, the facilitator and the note-taker were therefore all in one room. The user sat at a desk with the facilitator sitting next to them and the note-taker was situated unobtrusively no more than a metre from the user.

The facilitators worked to a script and a set of instructions. Note-takers, working to detailed instructions, recorded, for example, task completion, together with an indication of any assistance provided by the facilitator, and other details which may not have been captured adequately in the audio and video recordings. They were encouraged to check their records with the session facilitator. A training period and 'dry run' took place to evaluate the procedure. All notes were analysed by the study co-ordinator to check for consistency. Video recordings of the sessions were referred to in cases of uncertainty.

For the initial task the facilitator guided the user and then asked them to repeat the task unaided. The user was asked to complete subsequent tasks as far as possible without aid from the facilitator. Where user distress or requests made

this impossible, facilitators intervened and these interventions were recorded by the note-takers.

Tasks

The evaluation tasks were determined through discussion within the design team. These took into account the characteristics of search and navigation for which web browsers are designed. Care was taken to choose tasks that were likely to be perceived as valuable to the user group (informed by discussions with older people who had some experience of web searching).

Tasks were selected to reflect, as naturally as possible, genuine tasks that might be carried out on the web. Tasks were not identical between the systems since each user used both systems, but tasks were equivalent. The language in which tasks were described was non-technical, thus users were asked to "find their way" to stories, rather than to "navigate" to them. Users were asked to 'think aloud' as they carried out the tasks.

Second visit tasks were initially similar to the tasks carried out in the first visit. In later stages of the evaluation, Visit 2 tasks involved branching out to wider use of external web content, for example the National Rail enquiries website or a similar site called Journey Planner.

RESULTS

The analyses examined two independent variables: System {P-of-C System vs. ISP} and Visit {Visit 1 vs. Visit 2}.

Tasks completed

A strong indication of the ease of use is the number of tasks carried out autonomously by the user, and these are shown in Table 2 (for all users).

T-tests showed that, while users of the P-of-C search and navigation system completed significantly more tasks unaided in the first visit than did users of the control system [$t(11)=5.641$, $p<0.001$], there was no difference in task completion between systems in the second visit [$t(11)=1.472$, $p=0.169$]. More tasks were carried out using the P-of-C system in the first visit than in the second [$t(9)=4.234$, $p=.03$]. There was no difference for the control system [$t=0.567$, $p=.586$].

Thus, during Visit 1 the P-of-C system supported more autonomous use, but Visit 2 did not show any difference in autonomous use between the two systems. This may have reflected the increased sophistication of the web tasks in the second visit, together with the need for users to access more non-core content and use of facilities and functionality outside the P-of-C system.

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	P-of-C System	ISP Portal
1	Find your way to today's news from "The Scotsman" and look at a couple of articles.	Find your way to today's news and look at a couple of articles.
2	Find your way to today's sports headlines from "The Scotsman" and look at a couple of articles.	Find your way to today's sports headlines and look at a couple of articles.
3	Find your way to more news from "The Scotsman" and look at a story about *	Find your way to news stories about politics and look at an article about *
4	Find your way to a Place To Visit called Angus Folk Museum.	Find your way to a place to visit in Dundee.
5	Find your way to information about Angus Folk Museum – what are its opening hours, facilities, how to get there and that sort of thing?	Find your way to information about this place.
6	Look around the other Places To Visit and choose one that interests you.	From the <****> Web Site Directory search for one of the places we noticed earlier.
7	Find your way to information about the place you have chosen.	Find your way to information about the place you have chosen.
8	Search more news to find out about *	Search the News area and find out about *
9	Look at one of the stories in BBC News.	Take a look at a story from another news source.
10	Find your way to Places of Interest again. (Can you see any changes from when we looked at it before?)	Return to <****>. Is there any more information that might help plan a day out?
11	Find out what facilities are available at *, what are its opening hours and how do you get there?	Return to <****>. Say you wanted to go to Glamis Castle – what are its opening hours and how would you get there?

Table 1. Visit 1 Tasks.

** The facilitator checked that day's news before the session began in order to find relevant news items about which questions could be asked. (<****> = name of the ISP.)*

	Visit 1		Visit 2	
Task	P-of-C	Control	P-of-C	Control
1	10	7	10	7
2	10	9	8	5
3	8	4	7	4
4	11	4	3	3
5	11	7	6	9
6	11	4	9	8
7	11	3	5	5
8	5	2	1	1
9	10	1	5	3
10	7	5	-	-
11	5	1	-	-
Mean	8.33	3.92	4.5	3.75

Table 2. Number of users who completed a task without facilitator intervention (max score in each cell = 11).

	Visit 1		Visit 2	
User	P-of-C	Control	P-of-C	Control
1	1	1	8	14
2	1	8	1	4
3	0	0	2	2
4	0	5	1	0
5	0	0	0	2
6	0	4	0	1
7	0	2	0	8
8	0	1	3	1
9	1	3	0	4
10	0	1	1	2
11	0	2	0	3
Mean	0.27	2.45	1.45	3.73

Table 3. Minor errors by user, visit and system.

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Errors

Errors were classified as either minor errors or serious errors. Minor errors, such as choosing an incorrect option while attempting to complete a task, are taken as an indication of how well the participant understood the interface as well as how clearly they understood the purpose of the options available to them and the ways in which to carry out the tasks. Serious errors involve a more critical mistake that would typically have caused the task to fail.

Participants made more minor errors using the control system than they did using the P-of-C system. These differences were significant for both visit 1 [$t(11)=3.184$, $p=.01$] and visit 2 [$t(11)=2.538$, $p=.029$].

These results imply that participants had a better understanding of the P-of-C interface and a clearer idea of the purpose of the controls. Very few serious errors were made, and there was no difference between the systems or the visits in terms of serious errors.

Unassisted Repetitions

For the purposes of this study, learning was defined as "the process of acquiring a new skill or knowledge through instruction, example or activity". This was measured by *unassisted repetitions* which occurred when the user, having had an activity demonstrated or having carried one out themselves, repeated the activity without any assistance from the facilitator. Minor examples of these unassisted repetitions included a user remembering to click "Subject Catalogue" to begin looking for information. Such minor unassisted repetitions were common for both systems, and there were no differences between P-of-C and the control system.

Significant unassisted repetitions were recorded if the participant used a sequence of commands or functions to complete a whole task, or a substantial portion of a task, without help. Navigating through a number of levels of the subject catalogue to reach a specific target would constitute a significant unassisted repetition. Such repetitions indicated that users could proceed not only through individual steps, but through sequences, representing a considerably more important step towards autonomy.

More significant repetitions occurred when participants were using the P-of-C system than when they were using the control system; this occurred for both visit 1 [t(11)=2.858, p=.017] and visit 2 [t(11)=2.485, p=.032].

This result implies that participants learned to use the P-of-C system more quickly and more effectively than they learned to use the control system. In addition learning of coherent sequences of steps was demonstrated more often with the P-of-C system than with the control system.

Unassisted Progression

Progression indicated the extent to which participants were becoming familiar with the system and learning to use it. It was defined as "the ability to transfer learned skills or knowledge to another more complex or different task". Instances of progression were recorded when users showed the ability or willingness to tackle a different or more complicated task without help and without prompting from the facilitator. Progression was recorded whether or not it led to a successful conclusion as the measure was concerned with user confidence and attitude as well as ability. Minor unassisted progressions were recorded when the user independently decided on a way to accomplish a task, e.g. "it must be under the subject catalogue somewhere". T-tests on the data indicated that while there was a possible trend towards more minor progressions for P-of-C users during the first visit [t(11)=1.869, p=.091], on the second visit there was no difference between systems.

Significant unassisted progressions were when the user explored something that they found interesting, without being prompted to do so. A significant difference existed between the first and second visit: there were fewer progressions in the second visit than in the first for both the P-of-C system [t(11)=2.227, p=.05] and ISP [t(11)=3.318, p=.008], but there was no significant differences between systems. These differences are likely to reflect the difficulty of the tasks during the second visit, which may have influenced participants' confidence.

Participant Preferences

Participants were asked to rate each system for (a) ease of use, (b) pleasantness and (c) ease of remembering. Ratings were recorded on a seven-point Likert-type scale (where 1 was strongly positive and 7 strongly negative). The scale was explained to the participant by the facilitator and displayed while they rated the system. Ratings were obtained immediately after a system had been used, resulting in two ratings per visit, and four ratings in total for each system.

The P-of-C system was rated more positively over all the measures. Wilcoxon signed-rank tests showed that this was especially pronounced for the first visit (n=11), where preference for the P-of-C over the control system was clearly expressed on ease of use (T=1, p=.019), pleasantness (T=0, p=.007) and ease of remembering (T=0, p=.01). On the second visit (n=10) only ease of remembering showed a statistically significant preference for the P-of-C system (T=0, p=.026). The difference between the two systems was reduced in the second visit: ease of use (T=1, p=.088) and pleasantness (T=2, p=.086) showed only a possible trend towards preference for the P-of-C system.

Participant Comments

Participant comments on both systems gave insights into the subjectively-expressed preferences of the users. Several participants noted that the control system had a lot of information on the screen and that this distracted them from the information they were seeking. The ISP portal was described as having "Too many distractions – far too sophisticated – all that info. is unnecessary – still very difficult to handle" (user 1, visit 1); "Overpowering – too much information" (user 2, visit 1); "Very busy screen", "Bit sort of eye-boggling", "Harder to see what you are looking for" (user 5, visit 1).

Users commented again on the complexity of the ISP interface during the second visit: "It's [ISP] such a busy screen so as you say I was looking down here and I missed the thing I was looking for!" (user 5, visit 2) and "But I still find there is so much information on the [ISP] screen I don't know where to look and often I miss the things I really need" (user 8, visit 2).

The P-of-C system was commented upon positively for the simplicity of its interface: "Not so much information hitting you on the screen" (user 10, visit 1) and the limitation of the possible options, "[I] liked the limited options and ability to get back to where we come from" (user 7, visit 1).

The P-of-C was also praised for ease of use, especially during the first visit: "I am sure that (the P-of-C) was easier to use. It was more idiot proof! It was less likely to lead me down irrelevant routes" (user 6, visit 1); "[(the P-of-C) is] an awful lot easier just because there's not so much to look at" (user 4, visit 1). By contrast, "[the ISP] was totally bemusing! I found it very complex and very difficult." (user 8, visit 1).

Users commented positively on aspects of the P-of-C system: "This is very easy to remember because, if you forgot, the prompts gave you easy help. I liked this very much" (user 7, visit 1); "Clearer, big print, not so busy, less information but relevant, I don't mean less overall but not being bombarded with useless information." (user 2, visit 1); "[the P-of-C] was not complicated and it was direct – it was not cluttered by confusing information" (user 3, visit 1) and "[I] preferred the P-of-C system. Doesn't have so many sophistications and complications; you were able to find what you want instead of having to fight through the adverts" (user 11, visit 2).

DISCUSSION

The results presented indicate a clear distinction between the two systems: basic web tasks (carried out during the first visit) were more likely to be carried out autonomously, fewer errors were made, and more evidence of user learning

was demonstrated when participants used the proof of concept system.

This difference between systems was especially pronounced during the first visit; subjective data also indicated a strong preference for the experimental system after the first visit. Although important differences remain between the systems during the second visit, for example in terms of user errors and repetitions, the distinction between the systems is less clear.

This outcome is predictable: the initial visit reflects a first introduction to the web, and the carrying out of basic web tasks. It is at this stage that a specialised system with training and support is most advantageous. The experimentally-driven quick progression, in the second visit, from basic supported tasks to more sophisticated use of the wider web transferred much of the users' effort from the basic web interface to the interfaces of specific websites where the specialised system could not support them so effectively. In non-experimental, and unsupported, environments it is likely that the first phase would last much longer, increasing the usefulness of such a dedicated interface to this user group.

CONCLUSION

The search and navigation system was devised as a proof of concept to demonstrate that appropriate software could provide a more positive initial experience of the web and encourage learning and progression, which were indications, it was argued, of potential for autonomous use of the web. An evaluation by a small group of older people showed the experimental system to be a usable and accessible web browsing system for older people who had some computer experience but no web experience, and which could be used with little training. It performed better on a range of performance measures and was initially strongly preferred to the control system - a popular commercially available web portal. It was also easier to learn to use than the control system. There were no clear results between the systems for the "progression" measures, which suggested that users would be interested in exploring whichever system they are introduced to (although arguably the *ability* to explore is contingent on the system used).

The introduction of two new measures, repetitions and progressions, constitutes a contribution to research in this area. Learning and progression are vital elements in determining how successfully older users are adopting new technologies. Measuring user learning and progression is of particular importance for this group of users. Previous studies have demonstrated that some older adults never attain autonomy using standard computer systems and, when external support is withdrawn, these participants have to stop using computers [e.g. 24].

Conventional accessibility, focused on the removal of fundamental accessibility barriers, is not sufficient to truly enable access to the web for this group of users. The proof of concept system was designed to reduce the need for additional accessibility options, and was successfully used by older people with the kinds of minor sensory and motor control changes that are associated with growing older.

There are important issues of anxiety and confusion in introducing older adults to the web using traditional search and navigation systems. In addition, the tremendous complexity that the content represents means that containing and disguising that complexity are non-trivial, but important, steps in allowing wider access to the web. The evaluations demonstrated the conceptual difficulties that the web presents to inexperienced users. As web tasks became more sophisticated, and dependence on the proof of concept system less certain, users encountered external content that was poorly designed for novices and depended on an understanding of, for example, drop-down lists and radio buttons. The proof of concept system was a first attempt at producing a system targeted at this group of users, and exploring the usefulness of approaches such as content and functionality layering, a supportive interface and a consistent "frame" around web content. Both qualitative reports from the users and quantitative data indicate that these approaches are useful elements of design for providing a way for older computer novices who are anxious about their own ability to use the web.

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