



Strategic Promotion of Ageing Research Capacity

Age-related Differences in Browsing the Web

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Age-related Differences in Browsing the Web

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Older people browse the internet in a different way to younger people. This creates significant challenges for those who wish to design web sites which appeal and can be used effectively by people of all ages. This study investigated how older and younger adult web users browse web pages. It found that older people experience more difficulties in using computers and browsing the web than younger people. In particular, older people read on-screen information as quickly as younger people, but move the mouse more slowly, and when progressing through a hierarchy of screens follow a different decision-making process. These age-related differences have important implications for web design.

Key Findings

- The findings from this research showed that older people were less confident and experienced more difficulties navigating the web than younger people. The difficulties older adults experienced included finding information, and developing a sense of where they were and where they were going.
- In the trials conducted as part of this study, older people took longer to complete browsing tasks compared to younger people. This was not due to differences in the ability to read on-screen information (which on average was similar to that of younger people), but to moving the mouse more slowly and taking longer to decide where to click than the younger participants.
- Older users were found to be more likely to read all of the information on a screen before committing themselves to move to the next screen by clicking. As a consequence, they made fewer clicks when working through a hierarchy towards a target, and fewer errors.
- Younger users were more likely to read less of the on-screen information on a web page and to work with a certain amount of trial and error, hence making more clicks and more errors. Nevertheless they were faster than the older users in reaching the target.
- The impact of these different scanning strategies is most marked when there is a deep hierarchy of web pages. For shallow hierarchies the differences were quite small.
- The main implications of the findings are that for ease of use, speed and retaining a sense of position on the web, websites designed with shallow hierarchies may be more easily handled by older people.
- The study showed that very modern eye-tracking technology can generate rich and accurate data on eye movement and browsing strategies, which in turn has the potential to reveal important information about underlying thought processes which influence cognition and decision making.

Introduction

The Issues

Older adults want to use computers but they often have more difficulty than younger adults. More and more older people are using computers and the internet for information retrieval (especially on health-related issues), communication with family members, and for keeping up with daily news. In the UK, 'silver surfers' represent 12% of internet users, and there is a higher level of computer ownership among the 60-64 age group (50%) than among the 18 to 30 age group (46%).

Little is known about how older people use the web, particularly their ability to navigate complex sites. Even less is known about how to support older people in information retrieval tasks through better web design. Yet it is thought that age-related changes in cognitive, motor and perceptual abilities do influence the speed and accuracy with which older adults browse online information systems. The largest impact seems to be with tasks that require the most cognitive processing (that is using short term memory) and with visual information; and the least is thought to be where prior knowledge is an important aspect of the task. There are also age-related declines in the ability to make fast movements, such as with typing and mouse manipulation, with cursor control and when tracking and capturing a target with a mouse.

Eye Tracking

Eye tracking equipment helps identify where on the computer screen a computer user looks. Eye tracking equipment have been intrusive in the past requiring the participant to wear a helmet or restrict their movement while interacting with the computer.

The eye tracker used in this study gives both flexibility in terms of installation but also provides a non-intrusive configuration that makes the equipment transparent to the user. The device is placed below the PC monitor and through a series of calibration sessions accurately monitors user's eye gaze. The hardware comes with specialised software which enables the experimenter to record and analyse eye-gaze data.

Background

The way in which information is categorised, labelled and presented, and how navigation is facilitated, determines not only whether users will and can find what they need, but also affects user satisfaction. A term often used to describe the process of structuring and organising information is **information architecture**. Intuitive information architecture helps the user get a better sense of orientation within the website. It also helps the user to be more efficient and accurate.

One of the most common ways of presenting information is through hierarchical structures, where by clicking on a target on one page another page is revealed. Previous research, however, has shown that novice users are more likely to "get lost" in a hierarchical structure than more experienced searchers. Also, older people are less likely than younger people to complete tasks where there are long path lengths (three moves or more through a hierarchy). But they are just as likely as younger people to complete tasks where there is a short optimal path length (two moves or fewer). Some research has shown that older people use less efficient search strategies and have more problems remembering which pages they have visited (and what was on those pages) compared to younger adults.

Studying navigation can be done by breaking down the browsing task into three key factors: reading, mouse movement and decision making. People read the options/links they encounter on the web, make a decision about which one to click, and then move their mouse to that link and click. Mouse movement and reading speed differences are relatively easy to measure, but decision time is much more difficult. This study sought to measure decision time through using eye-tracking technology.

The Study

The Aims of the Study

The key aim was to investigate differences in how older and younger people browse websites through studying the three main tasks of: reading, mouse movement and decision making.

The Study

The study investigated how 22 older internet users (aged between 58 and 87) and 22 younger users (aged 19-27) performed three exercises: mouse movement, online reading, and browsing. All lived independently in the community. They had no visual or cognitive impairment or functional limitations that could have directly interfered with their performance.

Younger participants had undergone more years of formal education compared to the older users, and reported that they were more confident in using computers. There were also differences between the younger and older group concerning website navigation. Older people reported more problems. These ranged from finding information on the web, to returning to a page that they once visited, to determining where they could go, and visualising where they were on the web.

Both groups gave a similar level of importance to using the web for finding information. The most significant differences were in the ratings for using the web for entertainment and time wasting, in both cases these were more important to older people. Also the older group rated 'other' uses of the web as less important than the younger group.

Mouse Movement Tasks

The first experiment consisted of a series of mouse movement tasks. In each task the location and distance between the start and end buttons was randomly varied and the time taken to click on the target, the target width and the initial distance of the target from the starting point were measured.

Online Reading Tasks

Participants were asked to read three different on-screen passages, one after the other. The passages, each between 160 and 165 words, contained information about three different topics – the construction of a pipeline, the female workforce in the early twentieth century, and bacteria. They were asked to read the passage to themselves as fast but also as carefully as possible. The time to perform each task, and the mouse movements, were recorded using an eye tracker and specialised computer software.

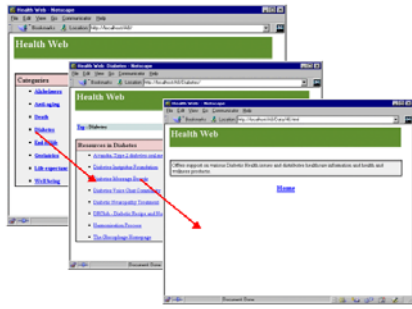
Browsing Practice

The participants then browsed the website "dmoz" (<http://www.dmoz.org>) to look for information on three non-health related topics (a recipe, a football team and a music band). The purpose of this task was: to provide a practice browsing session; and to observe whether participants had sufficient browsing experience to participate in the main study.

Browsing Tasks

A set of web pages, consisting of 64 **end nodes**, (the possible end points or destinations of a search), of health-related information were designed and presented to participants using a standard web browser. The test stimuli were taken from a health section in the dmoz directory. To investigate the effect of depth of hierarchy, the pages were arranged in depths of 2, 3 and 6. In addition, the participants were asked to perform a series of tasks on a number of live UK government websites.

The websites were presented in three configurations. The first offered participants the choice of two options per webpage and had a depth of 6 pages to the end point. The second website design offered four choices per page and therefore had a depth of three clicks to the endpoint. The third presented eight options per page and required only two clicks to reach the end point. The browsing experiment consisted of 18 information search tasks (six tasks on each of the three depths) on health-related topics.



Example of a Shallow hierarchy (depth=2)



Example of a Deep hierarchy (depth = 6)

The participants were given booklets containing 18 task cards. Each card contained a specific task that the participant had to complete on a specified website hierarchy structure. The order of presentation was balanced across participants and hierarchical structures and care was taken so that each task was performed by an equal number of older and young people.

Examples of tasks included asking the participants to find: information about nursing homes; an overview of optic neuritis; advice about fraud and insurance for long term care; a website describing why older people can be at risk when taking medicines; information for people with an eye disorder called cataracts.

To enable participants to find the answers without being under any pressure the tasks were not time limited. In addition, each participant was able to choose when to take a break and for how long, at the end of every task to minimise fatigue and boredom, and to maintain their interest in the browsing process.

Participants were also asked to complete a number of tasks on six other websites; three local government sites in London (Camden, Islington and Hackney local councils), and three UK government sites (Direct.gov, the website of the Pension Service, and the Department of Work and Pensions). Tasks included finding information about recycling rubbish, disabled parking permits and government payments for older people and carers. These were thought to be realistic issues for older people and the sites were chosen to represent different navigation options with similar content.

The experiments were conducted in the City Interaction Lab a new research facility at City University, which has been established with the generous support of The Vodafone UK Foundation.



The City Interaction Lab

Findings

Mouse Movement Tasks

The results of the mouse movement task were consistent with a well established model for mouse movement (Fit's Law) which suggests a simple relationship between the time to complete a task and its difficulty. For all levels of difficulty the study found that older users required more time than the younger users, on average close to about 40% more time, to complete the task.

Online Reading Tasks

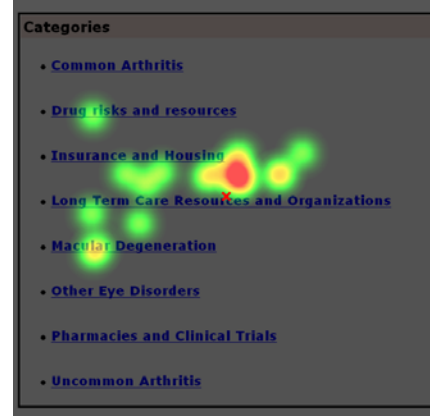
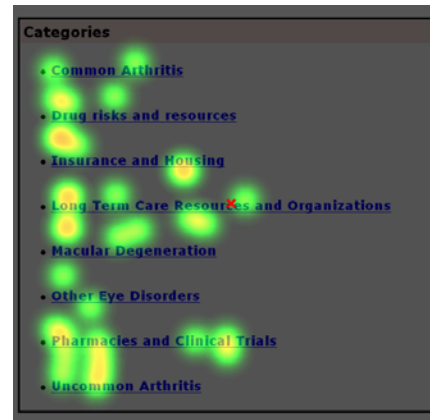
Although reading speed exhibits high individual differences that might contribute to the variability of the total information search time, average speed was not significantly different between the two groups.

Browsing Tasks

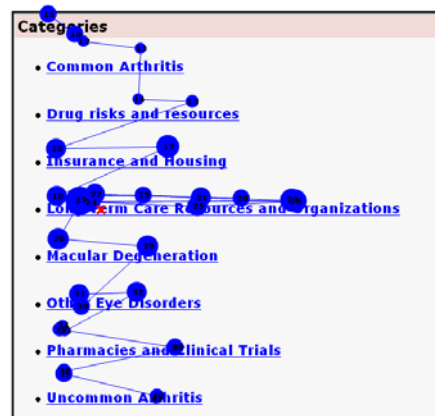
All participants completed the 18 tasks. Overall, older people made fewer clicks than younger people (on average 15% less) but took longer to complete the tasks (on average 25% longer). This might imply that older people take longer deciding which link to click, but they tend to be more confident where to click than younger people. In other words, younger people are more likely to make a quick decision on which link to click and are ready to risk making a mistake. However, whilst when the website had few options per page older people took significantly longer to complete the task than the younger age group, this was not the case when there were more (two options 60% more time; four options, 4% more time; and eight options 6% more time).

Eye Tracking Results

The patterns of eye movements across the screen revealed that older people looked at more of the screen than younger people. Characteristic hot spot plots based on browsing behaviour for an older and younger participant are shown opposite. Eye-gaze plots which give the sequence of eye fixations are also shown opposite. The bigger the blue dot the more time the user spent on that spot for the same scenarios.



Characteristic browsing behaviour hot spot plots for an older (top) and younger participant



Characteristic browsing behaviour eye-gaze plots for an older (top) and younger participant

Discussion and Implications

Conclusions

Older participants reported less confidence in using computers than younger people and more problems with: finding information on the web; returning to a page that they once visited; determining where they can go; and visualising where they are on the web.

When using the web, older people took longer to complete browsing tasks compared to younger people, but made fewer clicks and errors than younger people in order to complete a search task. They took the longest time to complete the task when the website design had deep structures (only two options per page but more steps) and the shortest time to complete the tasks when using a shallow website structure (with eight options per page).

Older participants encounter more problems with deeper than shallower web structures possibly because of their scanning strategy. For example, deeper structures require more decisions to be made, which appears to be slower for older than younger participants.

The eye-tracking results showed that the younger users tended not to look at all the options on a page or spend time thinking about the different options. When older people come across a website with a number of options (links) to select from, they tend to perform an exhaustive search and to consider all choices before deciding which to click. This results in slower performance but fewer errors. On the other hand, younger participants use scanning strategies which are more dynamic, usually making a decision before reading all options on a page. This is possibly because of their higher confidence in using the web. This might result in more errors, but given their experience with using the web they usually still manage to complete the task more quickly than older participants.

Suggestions to Practitioners

The results from this study offer important contributions to the area of human-computer interaction, especially for older information users. The findings demonstrate significant age-related differences in performance when browsing hierarchical online information structures. These have implications for web design, especially for sites which provide online information for older people. This research suggests that where possible, shallow hierarchies should be used instead of deeper hierarchies.

Suggestions for Future Research

This study has illustrated a number of key issues in the use of the web by older people. However, there is a need, to consider more complex hierarchical structures, which are increasingly common on the web.

The study has shown the value of eye tracking data for research into web browsing behaviour. This produces very rich information about the browsing strategies and the thought processes which influence cognition and decision making used by older and younger people. Further analysis and data could greatly strengthen our understanding of how older and younger users browse the web, how they visually scan online information, and how they encounter and recover from difficulties.

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The Study

The study received financial support from SPARC of £26,600 and ran for 14 months ending in March 2008. Additional support was provided by City University London.

More information about the study can be found on the SPARC website www.sparc.ac.uk and obtained directly from the investigators.

Bibliography and Key References

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SPARC

SPARC is a unique initiative supported by EPSRC and BBSRC to encourage the greater involvement of researchers in the many issues faced by an ageing population and encountered by older people in their daily lives. SPARC is directed, managed and informed by the broader community of researchers, practitioners, policy makers and older people for the ultimate benefit of older people, their carers and those who provide services to older people.

SPARC pursues three main activities:

Workshops to bring together all stakeholders interested in improving the quality of life and independence of older people.

Advocacy of the challenges faced by older people and an ageing population and of the contribution of research to improving quality of life. SPARC is inclusive and warmly welcomes the involvement of everyone with a relevant interest.

Small Awards to newcomers to ageing research, across all areas of design, engineering and biology and at the interfaces relevant to an ageing population and older people. In 2005 and 2006 SPARC received 185 applications for support in response to two invitations for competitive proposals of which 34 were supported.

Executive Summaries

SPARC is supporting its award holders through funding, mentoring, a prestigious dissemination platform, professional editorial assistance, international activities and provision of contacts. Each of the projects has been small, yet the enthusiasm for discovery, and impatience to contribute to better quality of life for older people, has more than compensated for the very limited funding which was provided.

This executive summary is one of a series highlighting the main findings from a SPARC project. It is designed to stand-alone, although taken with summaries of other projects it contributes to a formidable combination of new knowledge and commitment by newcomers to ageing research, with a view to improve the lives of older people. This is a tangible contribution towards ensuring that older people receive full benefit from the best that research, science and technology can offer.