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An Investigation into Older People's Browsing Activities

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ABSTRACT

This paper presents quantitative data on browsing activities with 63 respondents aged 55 years old and over from three countries. The questionnaire explored frequently browsed topics, browser's functions used, browsing tasks performed, problems with standard browsers and features to add to a standard browser to make it more ageing-friendly. The study revealed various aspects of Internet uses, including the topics accessed and places of access, browsing tasks, problems and assistive features required. This study makes several contributions to the field. First, it provides comprehensive account of older persons' browsing activities. Second, it uses Exploratory Factor Analysis to unravel the underlying factors beneath older persons' browsing tasks. Finally, this is a cross-country study, which arguably makes the findings less susceptible to cultural bias.

Keywords: *Ageing, web browsers, elderly, older adults, human computer interaction.*

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1. Introduction

According to the US Census Bureau, by 2030 the world's older population would have increased by at least 50% (Mann, 2004). Previous research has shown that the Internet can potentially help older persons maintain their independence and improve their quality of life (Helander, Landauer, and Prabhu, 1997). It is therefore encouraging that older people's adoption of the Internet rose quite dramatically in the past few years. A survey performed in February 2006 revealed that 72% of Americans aged 51-59 years old, 54% of 60-69 years old, and 28% of 70-79 years old went online(Fox, 2006). In 2005, 42% of people 55-64 years old living in the UK and 14% of people aged 65 and older used the Internet (Richards, 2006). However, whilst this trend is echoed throughout most of the Western countries, it is not yet the case in other parts

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of the world. For example, only 3.2% of Thai population aged 50 years old and older were online in 2004 (National Electronics and Computer Technology Center, (2005).

A survey on older adults' use of computers in 2003 shows that the World Wide Web and e-mail are the most commonly used applications (Goodman, Syme, and Eisma, 2003). However, the survey also shows that the use of the web and e-mail declines with increasing age due to decline in perceptual (visual and auditory), cognitive (attention and memory) and motor (mostly haptic) capabilities. Decline in visual acuity necessitates adjustment in the presentation of information (e.g. font, contrast, size) (Helander, Landauer, and Prabhu, 1997); while cognitive decline impairs user ability in interacting with complex systems; memorizing commands and text; and handling complex layouts (Salthouse, 1996). As some studies had shown, older persons face unique problems when using the Web. For example, even when older persons were able to complete most of information search tasks, they took more steps to find the information than did younger persons (Meyer, Sit, Spaulding, Mead, and Walker, 1997).

A number of approaches aimed at addressing the problems faced by older people when interacting with the web were reported in detail in (Kurniawan, Evans, King, and Blenkhorn, 2006). The first approach concerns the application of accessibility guideline (e.g. W3C). However, even if a website is fully compliant with these guidelines, there is no guarantee that it will be usable for older users, mostly due to the large individual differences among older persons, which makes accommodating all users at the design stage difficult.

The second approach uses a specially designed browser, which allows reformatting of web pages to account for impaired spatial ability or severe visual impairment (e.g. by linearising web pages, enlarging text and possibly diagrams, or voicing text) and creating a custom interface that can directly address ageing-related decline. An example of this system is BrookesTalk (Zajicek, 2001). The problem with this approach is that it requires significant development effort to cope with rapidly changing technology and it duplicates the features of standard web browsers. A closely related approach that suffers from similar technological difficulties is the use of a transcoding proxy server to reformat web pages on a machine between server and client (Fairweather, Hanson, Detweiler, and Schwerdtfeger, 2002). This approach is not popular with the older generation as they require additional installation (in the case of specially designed browser) or knowledge of the URL of the proxy servers (in addition,

proxy servers cannot handle encrypted transmission such as when accessing secure sites, which makes most online shopping activities impossible).

The third approach uses a standard web browser (such as Microsoft Internet Explorer or Mozilla Firefox) and its own accessibility features, often with added assistive systems such as a screen magnifier or a screen reader, especially for users with severe impairments (Blenkhorn, Evans, King, Kurniawan, and Sutcliffe, 2003). Unfortunately, screen magnifiers and screen readers provide minimal information about the global context (Kurniawan, King, Evans, and Blenkhorn, 2003). Various studies showed that using a standard web browser and its accessibility features is the most used and useful approach by older persons (as long as the websites were designed with accessibility in mind, such as by using relative font and table sizes) (Kurniawan, Evans, King, and Blenkhorn, 2006).

However, there are some questions that the studies reviewed above did not answer thoroughly. Those are:

1. Does the applications that older persons use for browsing play a role in helping or hindering their effective use? A 2003 study on older adults' use of computer using a questionnaire and interviews with 353 participants over the age of 50 reports that difficulties with computer interactions are usually caused by the complexity of applications and their documentation, in contrast, only three participants mentioned physical difficulties (e.g. visual or motor) (Goodman, Syme, and Eisma, 2003). This forms one motivation of the reported study: the investigation of the use of various functions of a standard web browser.
2. How can this knowledge be translated into improving a standard browser to make it more ageing-friendly?

The above questions can be broken down into three sub-questions: 1) What and how do older persons browse online? 2) What functions in a standard browser do they use? 3) What functions can be added to a standard browser to make it more ageing-friendly? This study aims to answer these questions using a questionnaire. Questionnaire was chosen purely due to practicality reason: it allows us to reach a large number of participants in a limited amount of time.

As Tim Berners Lee stated, the web is designed as a universal space. Therefore, we felt that it would be useful to gather data from more than one country (ideally representing more than one continent). The data are gathered through paper questionnaire mailed or hand-delivered to elderly organizations in three countries: UK, USA and Thailand (the questionnaire was translated into Thai for respondents from

this country). The questions in that questionnaire were derived, using content analysis technique, from various studies on older people and web browsing (Kubeck, 1999; Hanson and Richard, 2004). The choice of paper questionnaire was made after consulting some instructors in senior centres, who indicated that older persons often hesitated to fill in online surveys due to privacy concerns. The questionnaire was then piloted with 2-3 respondents from each country. It was during this pilot study that the suggestion to use the word 'Internet' to represent 'web browsing' was made (as in 'Internet experience'), as for many older persons the word 'Internet' was more familiar and was synonymous with 'web browsing'.

2. Stimuli and Participants

The questionnaire was printed on standard paper with black ink in Tahoma 18pt. It was distributed during the months of March-April 2006. The questionnaire is available from the contact author. The inclusion criteria for participating are that they had some Internet experience and that they were 55 years old or older at the time of the study.

The respondents were 10 Thais (9F/1M), 40 British (25F/15M) and 13 Americans (8F/5M). Out of the 10 Thai respondents, nine were 55-59 and one was 60-64 years old. A quarter of the UK respondents were 70-74 with the remaining three quarters spread equally in other age brackets. Eight out of the 13 US respondents were 65-70 years old. Table 1 provides the breakdown of their Internet and computer experience, which were investigated through the following three questions:

1. How long have you used computers? (Options: 1 = Less than 6 months, 2 = 6-11 months, 3 = 12-23 months, 4 = 2-5 years, 5 = More than 5 years).
2. How long have you used the Internet? (Options: 1 = Less than 6 months, 2 = 6-11 months, 3 = 12-23 months, 4 = 2-5 years, 5 = More than 5 years).
3. Internet usage per week (Options: 1 = Less than 5 hours, 2 = 5-9 hours, 3 = 10-19 hours, 4 = 20 hours or more).

	Thailand	UK	USA
Computer Experience	4.6 (0.97)	4.4 (1.03)	5.0 (0.00)
Internet Experience	3.8 (1.55)	3.7 (1.59)	5.0 (0.00)
Weekly usage	1.8 (1.14)	2.5 (1.40)	3.7 (0.48)

Table 1. Respondents' Computer and Internet Experiences. Numbers show Mean (S.D.)

In term of computer experience, almost all respondents stated that they had used computers for more than 5 years (all of them, in the case of US respondents). All of the US respondents also stated that they had used the Internet for more than 5 years, while the Internet experiences of the UK and Thai respondents varied considerably. The weekly access frequency also varied; with the Thai respondents mostly accessing the Internet for less than 5 hours per week. The One-way ANOVA statistical analysis revealed that the only non-significant mean difference by country is on respondents' computer experience. Please note that as there are only 10 respondents from Thailand and 13 from the USA, the statistical results should be treated as indications rather than conclusive evidence. Post-hoc analysis revealed that Thai and UK respondents were not significantly different in their Internet experience. However, the respondents from those three countries significantly differ in their weekly usage of the Internet.

3. Results

3.1 Internet Usage

When asked where they usually accessed the Internet from (they could check more than one locations, which are home, friend's or relative's computer, library or community centre, work and other location that they needed to specify), 53 people checked home.

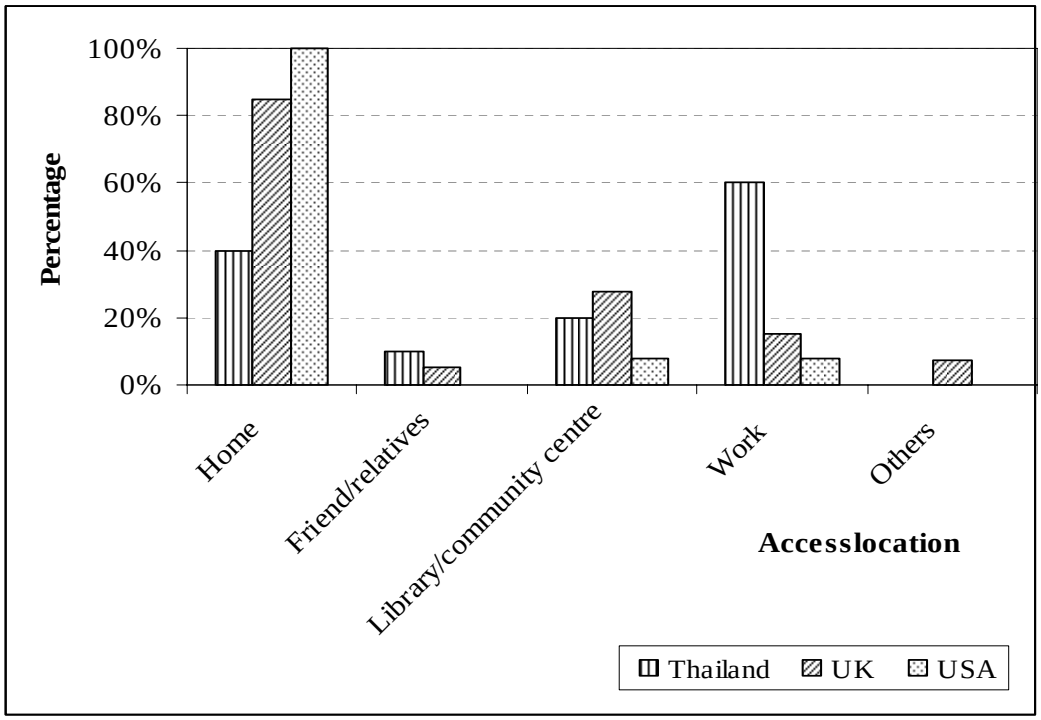

Fig. 1. Access locations by country

Figure 1 depicts the distribution of access locations by country. It is interesting to notice that unlike in the USA and UK, more Thai respondents accessed the Internet from work than those who accessed it from home. As expected, the one-way ANOVA revealed significant differences in the percentages of the respondents from these three countries that accessed the Internet from home and work.Forty-one people accessed the Internet using Broadband, the rest used either dial-up or LAN connections, showing that older persons are quite up-to-date with the current technology for connecting to the Internet.

One section of the Internet usage questionnaire explored the reasons/topics for going online. Some of the options were adopted from an article that suggested the top 10 reasons of why older adults were online (Reaves, 2006) and another article from the Guardian newspapers that listed the online activities that older persons normally performed (The Guardian, 2004). The most frequently chosen reason for going online was to keep in touch with family, relatives and friends. The least frequently chosen reason was to check or research stocks and investments. Table 2 provides breakdown by country as well as the whole sample. Two thirds of the respondents use email clients (such as Outlook and Eudora); only a third used web-based email applications such as Hotmail or Yahoo!Mail. This is an interesting finding, as setting up email clients usually requires more effort than setting up web-based email applications, once again demonstrating that older persons are quite informed about advanced setting that might be required to perform certain online activities. Eighty nine percent used only their glasses to view web pages, indicating that the respondents are mainly older persons with mild visual impairments. Expectedly, 73% used Internet Explorer as their browser. Only two respondents did not know what their browser was called.

	Thailand	UK	US	Total
Business	2.9 (1.91)	3.9 (1.58)	3.8 (1.69)	3.7 (1.67)
Stay in touch	3.4 (1.65)	2.5 (1.57)	1.5 (0.88)	2.4 (1.56)
News/Events	2.6 (1.65)	3.4 (1.58)	1.6 (0.87)	2.9 (1.62)
Hobbies/ Interests	3.7 (1.70)	3.0 (1.58)	1.8 (1.01)	2.8 (1.60)
Health info	3.7 (1.77)	4.1 (1.24)	2.5 (1.20)	3.7 (1.44)
Online shopping	4.9 (0.32)	4.1 (1.27)	3.5 (0.88)	4.1 (1.17)
Products/ services	3.8 (1.62)	4.0 (1.21)	3.2 (1.01)	3.8 (1.26)
Stocks/ investments	4.8 (0.63)	4.4 (1.26)	3.9 (1.71)	4.4 (1.30)

Table 2. Reasons for going online (1 = everyday, 2 = twice a week or more, 3 = once a week, 4 = once very 2-3 week, and 5 = once a month or less or never).

3.2 Most Favourite Websites

The respondents were asked to list as many favourite websites as they would like to. The three most frequently mentioned websites were Google (13), Yahoo! (9) and BBC (9). However, many answers did not refer to any specific URL but rather stated the domains of the sites, such as health, news, family's and friends' sites, sites for retirees, etc.

3.3 Browsing Devices and Windows

When asked which input device the respondents used to manipulate their browsers or navigate, 58.7% answered that they only used mice while the rest stated that they used 'both mice and keyboards' or 'only keyboards' (very few respondents). The respondents were split almost equally between opening only one browser window at any one time (35%), opening 2-3 windows (41%), or opening 4 or more windows (24%). This contradicts a past study on design guidelines for ageing-friendly websites, which suggested that only one window should be open at any one time (Kurniawan, and Zaphiris, 2005).

A third of the respondents browsed long pages by using the wheel in the middle of the mouse buttons. The rest either dragged or clicked the scrollbar or used Page Up/Down buttons.

3.4 Browsing Tasks

To investigate the functions in standard browsers that older persons used, we performed a cognitive walkthrough exercise. A cognitive walkthrough is a usability technique where an expert (or a group of experts in this study) 'walks though' design to identify potential problems that a user might have using psychological principles. We came up with 27 browsing tasks:

1. Open new browser window
2. Print web pages
3. Preview web pages before printing
4. Check/alter the page setup before printing
5. Save web pages in your hard drive or diskette
6. Copy and Paste information between web pages or programs
7. Select and copy all web page contents to other programs

8. Use search function to find information within a web page
9. Browse a website from saved items in Favourite or Bookmarks list
10. Add a website to Favourite or Bookmarks list
11. Organize your Favourite or Bookmarks list
12. Go back to previous page
13. Go to browser's default web page (Home page)
14. Stop and reload a webpage
15. Change text size
16. Change language preference
17. View HTML source of browsing page
18. View browsed web site (History)
19. View a web page in full screen
20. Show or hide any toolbar
21. Set your browser’s home page
22. Set proxy server
23. Set browser's advanced options e.g. set Java, ActiveX control
24. Change text and background colours
25. Turn off images
26. Learn from browser's help or tutorial
27. Close web browser

For each task, we asked whether the respondents had ever performed it (stating whether it was performed using a mouse, a keyboard, or both). More than half of the respondents (36) never set proxy servers. This is interesting, as past study suggested one way of facilitating accessibility for older web users was through proxy servers (Kurniawan, Evans, King, and Blenkhorn, 2006). Another task that around half of the respondents did not perform was changing the language preference. We could assume that this was because most users would never need to change the language preference. This setting would need to be performed once if ever needed (it came as default for English, and the Thai language preference would have been set as the default by either administrators or computer stores in the case of Thai users).

Most tasks were performed either using mice or mice in combination with keyboards. Using only keyboard was not very popular with the respondents, except, to a certain degree, using the CTL+P for printing web pages.

3.4.1 Exploratory Factor Analysis of Browsing Tasks

As there are many tasks being investigated here, it is rather difficult to see the patterns of tasks performed by the respondents. To investigate this underlying pattern, a multivariate data reduction technique called Exploratory Factor Analysis (EFA) was employed. EFA is a widely utilized and broadly technique to uncover the underlying structure of a set of variables. It is called 'exploratory' because there is no prior theory of how the variables would group together, which is the case of this study. In recently published studies, EFA was used for a variety of applications, ranging from developing an instrument for the evaluation of school principals (Lovett, Zeiss, and Heinemann, 2002) to sensitivity analysis of a large scale transportation simulation (Rousseau, and Bauer, 1996). After a successful EFA, a large number of variables are reduced to a smaller number of underlying factors. There are various ways to 'extract' variables into factors, the two most common being Principal Component Analysis (PCA) and Principal Axis Factoring (PAF). PCA was suggested as the extraction method for EFA while PAF is more appropriate for another type of factor analysis to confirm an established theory of the underlying structure of the set of variables, called Confirmatory Factor Analysis (CFA). After extraction, the researcher needs to consider how many factors to retain for further analysis. Both over-extraction and under-extraction of factors retained for rotation can have deleterious effects on the results. The default in most statistical software packages is to retain all factors with 'eigenvalues' greater than 1, called the Kaiser criterion. Another popular method is through a scree test, which involves examining the graph of the 'eigenvalues' and looking for the natural bend or break point where the curve flattens out.

It is common that each observable variable is related to more than one factor – and this is difficult to interpret. This interpretation can be simplified through a technique called a factor rotation, which can be oblique (where the factors are allowed to correlate) and orthogonal (where the factors are uncorrelated).

A survey of a recent two-year period in PsycINFO yielded over 1700 studies that used some forms of EFA. Well over half listed PCA with an orthogonal rotation called varimax as the method used for data analysis, and of those researchers who reported their criteria for deciding the number of factors to be retained for rotation, a majority use the Kaiser criterion (Costello, and Osborne, 2005). It should be noted that this combination is the default option in SPSS, which might influence some studies. This combination was employed for the analysis of the data in this study. To improve the reliability of the analysis, the varimax rotation was confirmed with an oblique rotation

called direct oblimin. Similarly, the Kaiser criterion was also confirmed by observing the scree plot. Only the results of the varimax rotation are reported in this study. To make the presentation cleaner, the factor loadings less than 0.5 were suppressed, as studies suggested that factor loadings less than 0.5 indicate weak relationship between the observed variables (in the case of this study, the browsing tasks) and the factors they load on (Costello, and Osborne, 2005). To ensure that the factor naming was sensible, two HCI researchers independently came up with factor names, and then agreed on one name per factor.

Researchers had given guidelines for the minimum sample size needed to conduct factor analysis. Some have suggested the ratio of sample size to number of variables as a criterion: the recommendations range from 2:1 through 20:1. In light of this, the data from three countries would have to be merged to run the analysis properly. Several iterations were performed to see which variables do not group with any other variables or group only with one other variable (some studies pointed out that we should be careful interpreting factors with less than three variables). After several iterations, the final analysis with 17 variables (bringing the sample size to variable ratio to 3.7) resulted in five factors, accounting for 72.3% of the variance.

The first factor is called the Technical Task factor. This factor represents tasks at a more technical level, such as viewing the HTML source of a webpage (with a very high factor loading of 0.81, indicating a very strong correlation between the Technical Task factor and the observed variable of ‘viewing HTML source’) or setting a proxy server. This group of tasks requires quite an advanced understanding of how a browser works, and requires some HTML coding skill. The second factor is Personalization Task. This factor concerns tasks that are performed to personalize how a page is rendered, either to compensate for users’ impairment or to match user preference, e.g., customizing colour or hiding images (perhaps to reduce page complexity).

The third factor, the Navigation Task factor, is to do with navigating around the site, such as going back a page or going to the browser’s homepage. The third task (stop and reload a page) was a bit out of the way, as it is usually performed not to navigate around but rather to refresh pages that do not load. However, the two researchers could not come up with a better name for this factor.

The fourth factor, appropriately named the Transfer Task factor, deals with tasks aimed at transferring information between websites and another place (which could be a favourite or bookmark list, another program such as a Word document, or a storage medium).

Finally, the fifth factor is the Page Task factor. It is about the tasks that users do to the page itself, such as printing it, or searching within a page.

Tasks	Factors and their factor loadings				
	Technical	J Personalization	Navigation	Transfer	Page
view html source	.81				
set browsers' advanced control	.76				
view history	.73				
set browsers' home page	.72				
set proxy server	.66				
change text and background colours		.91			
turn off images		.90			
change language preference		.64			
go back a page			.85		
go to browser's home page			.78		
stop and reload a webpage			.71		
copy and paste information from a web page to other program				.82	
browse a website from Favorite or Bookmarks list				.79	
save web pages in your hard drive or diskette				.65	
print web pages					.84
view page in full screen					.69
search within page					.69

Table 4. Task factors and variables that load on them

3.5 Users' Mental Models

The next few questions aimed at capturing users' mental model of the various components of a webpage/website. When asked about the object that gave away which website they were browsing, almost half of the respondents (46%) chose the website name shown in the address bar. The name shown in the title and the website's logo or banner received 22% each. Very few respondents chose the website's content. Please note that to ensure that the respondents understood what each website representation meant, a screenshot as displayed in Figure 2 was included.

Fig. 2: The objects that give away the website users are browsing

In response to the question on what gave away that an object was a link, 48% chose 'text with underline' while 37% chose 'text with different colour'. The other two options, 'button image' and 'text or image in dropdown menu or sidebar' did not get many votes.

Users' mental model on the page loading status was asked through questions on whether the browser's status bar (see Figure 3) or the browser's animated logo (see Figure 4) provides useful information. Seventy-one percent respondents stated that the browser's status bar did provided useful information, while only 54% said so for the animated logo. This is an interesting finding, as essentially both objects represent the same process with only two major differences: their location and the fact that the browser's status bar provides progress indicator.

Fig. 3: Browser's status bar

Fig. 4: Browser's animated logos

3.6 Problems with Current Browsers or Browsing Experience

In this section, users were asked in open-ended fashion if they had experienced problems with their current web browser or while browsing. Fifteen respondents left the textbox empty, 25 said that they did not have any problem. The rest stated various problems that were categorised into six groups through content analysis:

1. Undesired content: advertisements, pop-up windows, spam and promotional emails
2. Connection: slow connection, low bandwidth, security concern over non-secure connection
3. Broken links (message 404, pages that did not load, etc)
4. Poorly designed pages
5. Compatibility, as exemplified by statements such as 'Some websites only work with Microsoft browser' or 'Opera sometimes hangs and doesn't display Java correctly'
6. Undesired actions: things such as 'pages that refused to close' or 'websites that forced users to register'.

3.7 Assistive Features to Make Standard Browsers More Ageing-Friendly

Finally, the features that should be added to a standard browser to make it more ageing-friendly were looked into. For each feature, the respondents were asked to rate from 1 to 5 with 1 = must have and 5 = unnecessary. Figure 5 lists the ratings of these features. As Figure 5 shows, the features that are high on the 'must have' list are

blocking features (pop-up windows and advertisement). In line with user demographic, where most users only need glasses to view websites, the features that magnify and read the page did not receive high numbers of 'must have'. The last question aimed at investigating a relatively new feature, which is an event or task reminder (very recently offered by some companies, e.g. Google calendar). Expectedly, this feature did not receive very positive ratings from the respondents, possibly because they had not encountered this feature before.

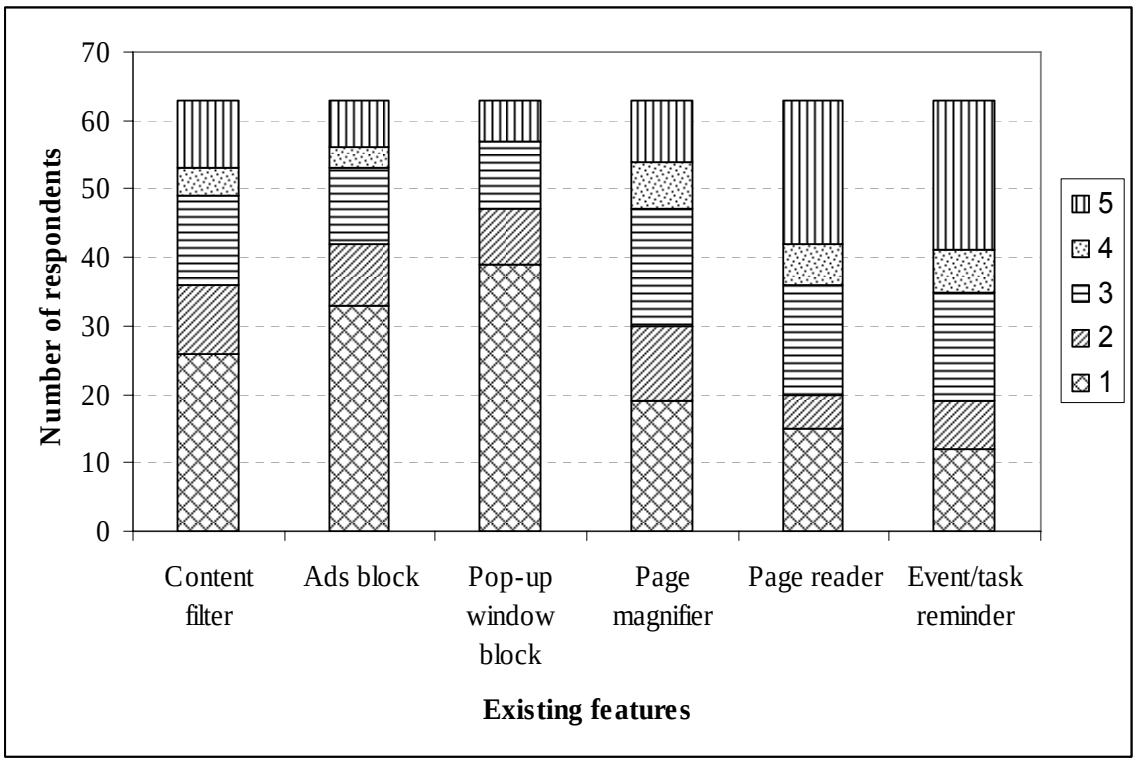

Fig. 6: Users' opinions on existing features

The respondents were also asked for any features that they would like to add to their current web browsers, in open-ended fashion. Only 13 respondents suggested additional features. The rest either left the textbox empty (23 respondents), answered 'None' (24 respondents), or stated that they were happy with their current browsers (3 respondents). These thirteen suggestions were categorised into four groups through content analysis (not in any particular order, as the number of proposed features were too small to differentiate by frequency):

1. Seamless integration between web browser and other applications, as exemplified by a statement of 'Better integration with my mail client and UseNet news reader'
2. Visual aids: things such as 'easier/more-direct "zooming" in/out text AND graphics enlarging'

3. Adaptive help: 'smart help – sometimes I don't know the exact term so anything that works on partial or misspelled keyword within the browser'
4. Automatic removal of undesired content, such as automatic pop-up blockers and spam erasers.

4. Discussion and Conclusions

The study sets out to answer three research questions: 1) What and how do older person browse online? 2) What functions in a standard browser do they use? 3) What functions can be added to a standard browser to make it more ageing-friendly?

The questionnaire used in this study had resulted in some interesting findings, and some other expected ones in response to these three questions.

4.1 Internet Access Information

The study started with inquiring the Internet access information of the respondents. The first interesting finding from this section was the Internet and computer experience information. Reports from national bodies from USA, UK and Thailand indicated that while Internet adoption among older persons in the USA and UK are reasonably high (considering that these older persons are baby-boomers, which did not grow up with Internet technology), the Internet adoption in Thailand among this age group is very low. However, whilst this trend was reflected in the respondents' frequency of Internet use and Internet experience, it was not reflected in their computer experience, showing that the Thai users who participated had used computers for as long as their US and UK counterparts. It should be noted, however, that only 10 Thai respondents participated, and this group might not reflect the experience of other older Internet users from Thailand.

Due to the nature of their job situations (i.e. it is expected that most respondents were retirees – the retirement age in Thailand is 60 years old and it is 65 in the UK and the US), most respondents accessed the Internet from home. Even though the data shows that 6 out of 10 Thai respondents accessed the Internet from work, given the small sample size, the Thai sample might not be representative of older persons in Thailand. The other reason why many Thai respondents access the Internet from work is perhaps related to the cost of Internet access, which is still relatively high in Thailand, and therefore, many Thai Internet users might prefer to access it from work.

Regarding the reasons the respondents accessed the Internet, in general, activities that are related to products and services (such as online purchase, or researching or

checking stocks or investments) were less frequently performed than personal activities such as accessing news, researching health topics or keeping in touch with relatives and friends. It should be noted that the UK and US respondents tended to perform activities related to products and services more often than the Thai respondents did, arguably because they had arrived at a more mature 'online development stage'. As some demographic surveys suggested, older generation follows the same online developmental curve as younger people, starting with email and searching and eventually moving on to shopping and other activities that involve security and privacy concerns (Reaves, 2006), which is perhaps the case of many of the UK and US respondents but not necessarily the Thai respondents.

The most favourite websites were clearly those supporting information seeking (Google, Yahoo! and BBC). Although this fact seems simple, it has its grounding in psychological phenomena of how people use the web as suggested by Maglio and Matlock (Maglio, and Matlock, 1998). The authors suggested that it is not unusual that people name key websites that they often visited in order to get to the target information. These sites are called anchor points by analogy to the notion of anchor points in the cognitive map literature. In addition, the authors also suggested that individuals relied on personal routines when trying to find information (on the analogy to cognitive maps of physical space, personal routines correspond to the familiar routes that an individual uses to get from one landmark to another), so once they have this set of anchor points (e.g. a particular search engine), they tend to stick with this set.

4.2 Browsing Tasks

To answer the second research question, the respondents were questioned on a list of browsing tasks. Whilst the descriptive statistics of these tasks bring some useful information, the results are mostly expected (e.g., advanced tasks were more rarely performed than common tasks, or that most tasks were performed using a mouse). However, the factor analysis performed on those tasks revealed some interesting findings related to pattern of use.

Essentially, the analysis found five unrelated underlying patterns of use. The most rarely performed factor, Technical Tasks, were perhaps mostly only performed by older persons who were expert users or programmers. The second most rarely performed factor was factor that deals with user personalization. Many studies pointed out that

older persons are not likely to perform user personalization themselves due to lack of confidence (Kurniawan, Evans, King, and Blenkhorn, 2006).

The transfer tasks, the factor that deals with moving information between websites and other electronic media were the next factor that was rarely performed. This is not surprising, because older persons are likely to have a mental model of paper archiving, where the necessary information from a website is transferred to a piece of paper (through printing) rather than to another electronic medium.

The final two factors contain tasks that were performed quite often: page tasks (e.g. printing or searching within a page) and navigation (e.g. going back a page), for clear reason. These are the basic operations of web browsing.

In summary, the pattern of use of older persons does not seem to be very different from that of younger persons, as suggested by established set of literature in web browsing for general population (e.g. Spink, Wolfram, Jansen, and Saracevic, 2001; Tauscher, and Greenberg, 1997). They rarely performed advanced functions and regularly perform basic functions. Arguably, the only set of functions that older persons perhaps use less often than younger persons would be personalization. However, this study has not compared the frequency of tasks of younger and older persons, and therefore, this statement should be treated as a speculative one.

4.3 Assistive Features

To answer the final research question, the respondents were asked to describe problems with the current browsers, to choose from a list the assistive features that they felt had to be provided in a standard browser, and to suggest features to make a standard browser more ageing-friendly. Interpolating these three sections, we can conclude that the most mentioned assistive feature is an automatic function that would remove undesired content (such as pop-up windows and spams). This feature showed up in all three sections. Some other assistive features showed up less often, which range from visual aids to smart help to seamless integration with other applications.

5. Limitations of the Study

There are naturally some limitations of this study, mostly related to the sample's demographics. The respondents generally have very mild visual impairment (as most only wear glasses when accessing the Internet) and have a good understanding of the technology (as shown from their Internet and computer experiences and the types of tasks they performed while browsing) and therefore, this study might not reveal the

issues faced by older persons with more severe impairment or less experienced in using technology.

The study involved respondents from three countries, which were aimed at gathering views that are less culturally biased. Unfortunately, the proportion of the respondents by geographic location was unbalanced, with more than half of the respondents being UK-based, due to the location where the researchers were stationed and the choice of using paper-based questionnaire. An extension of this study, i.e. to complement this paper questionnaire with an online one, which will enable us to recruit more respondents from other countries, is currently in the planning stage. The gender split is quite typical of voluntary studies of older persons, especially those performed at 'senior centres', with more women participating than men, but would need addressing in future studies.

The choice of using a questionnaire for data collection means that it is quite difficult to be flexible with the questions. Even though we consulted an expert older web user and ran a pilot study, our questionnaire still apparently resulted in rather restrictive set of features and activities that we could investigate. Another inquiry method such as focus group discussions and interviews would complement the data gathered from this questionnaire very well.

Despite these limitations, however, the study has managed to answer the three research questions we set off with quite successfully. There are some information that prominently appeared, which could be used to inform design of additional feature to put into a standard web browser, such as undesired content filter. And involving respondents from different cultures had provided quantifiable evidence to the fact that some people might have suspected, that is, the US web users are at a much more advanced 'online developmental curve' (borrowing the term of the Reaves (2006) paper) than the UK web users, and both are definitely in a much more advanced curve compared to the Thai users, which are still at a level of performing online activities related to personal affair while the US and UK users already brave the online purchase or stock research.

This study is a first step toward understanding older persons' browsing activities and would need to be followed up with studies that involve design and evaluation of ageing-friendly web browsers, but hopefully it is a step in the right direction.

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