4.4. Gaining Access To Information At A Municipality Website A Question Of Age?

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Abstract
The number of senior citizens is increasing quickly. The use of new media is also on the rise in our information society. Websites are an important tool for (local) governments to provide information to their citizens. If we want information supply through ICT to remain available to senior citizens in order to ensure their access to the digital information sources, we need to gain insight into their navigation behaviour. This paper therefore presents the results of an explorative eye-tracking study at a Dutch municipality which focuses on the question whether senior citizens do indeed navigate websites differently from younger citizens.

Keywords
Navigation Behaviour Of Different Age Groups, Eye-Tracking, Heatmaps, Accessible Websites For All, Designing For Dynamic Diversity

Introduction
The number of senior citizens and the use of new media in our information society are on the rise. In the year 2000, the Council and the Commission presented the eEurope Action Plan, entitled 'An Information Society For All', which set out the following three main objectives: 1) the realization of a cheaper, faster, secure Internet, 2) investment in people and skills, and 3) stimulation of the use of the Internet. The second objective specifically stated that: 'the Lisbon European Council recognised that special attention should be given to disabled people and fight against "info-exclusion". (…) As government services and important public information become increasingly available on-line, ensuring access to (local) government websites for all citizens becomes as important as ensuring access to public buildings.' [6]

It is interesting to note that, while the e-Europe Action Plan made explicit mention of disabled people, it wholly failed to address the group of senior citizens. In the light of the growing number of older users in our information society, this is a group whose concerns also merit attention. ICT must remain available to senior citizens, to ensure their access to the digital information sources provided by (local) governments, offering products and services they need. Some researchers argue that there is a widening generational 'digital gap' between those people who are able to use ICT and those who are not. It was Prensky who coined the notions of 'digital natives' and 'digital immigrants' [23]. From an educational point of view, he considers students to be 'digital natives' who 'are all native speakers of the digital language of computers, video games and the Internet. So what does that make the rest of us? Those of us who were not born into the digital world but have, at some point later in our lives, become fascinated by and adopted many or most aspects of the new technology are, and

always will be compared to them, Digital Immigrants.' Prensky (2001: 1-2) Do they really exist, these 'digital natives', who are identified as the generations who grew up with new media? And is there really an older generation of 'digital immigrants' playing catch-up by trying to learn how to use new media? Other researchers, e.g. Lenhart & Horrigan (2003), take a different perspective [16]. They introduced the notion of a 'digital spectrum', in which people use ICT to varying degrees, depending not only on age but also on factors such as sex, educational background and frequency of internet use.

If we want the supply of information through new media, such as websites to remain accessible to senior citizens in order to ensure their access to the digital information sources provided by (local) governments and the much-needed products and services offered there, we need to gain insight into their navigation behaviour. This paper therefore presents the results of an explorative eye-tracking study which focuses on the question whether older users do indeed navigate websites differently from younger users. Or are the differences within this group (due to factors such as sex, educational background and frequency of internet use) bigger then differences between younger and older website users?

Characteristics Of Navigating Older Users: A Quick Scan

Are there studies which furnish insight into the way senior citizens navigate websites and the factors which help or hinder their ability to gain access to such digital information? The proceedings of the 4th International Conference on Universal access in human computer interaction at Beijing in July 2007, edited by Stephanidis, offer some insight into the way senior citizens looking for information navigate websites [24]. Part IV of 'Understanding Diversity: Age' indeed presents several studies focusing on senior citizens using new media and how this can make their lives more comfortable. One of the contributions entitled 'Older adults and the Web: Lessons learned from Eye-Tracking', by Tullis put forward empirical research results about differences between younger and older U.S. users in the way they scan web pages: 'An eye-tracking study of a prototype website was conducted with 10 younger adults (ages 20-39) and 10 older adults (ages 50-69) to determine if there are differences in how they scan web pages. They performed the same task on the website. On the average, the older adults spent 42% more time looking at the content of the pages then did the younger adults. They also spent 51% more time looking at the navigation areas. The pattern of fixations on almost all pages showed that the older adults looked at more parts of the page then did the younger adults. (…) One thing we did not see was any difference in the likelihood of older and younger users to view page content "below the fold" (i.e., that they had to scroll the view).' Tullis (2007: 1030, 1038) [26]

This study shows interesting patterns which may be validated by comparable empirical research. An example of such research is that of Houtepen who in 2007 conducted an explorative eye-tracking study in the Netherlands with 13 younger users (18-25 years) and 7 older users (older than 50) [13]. They were requested to perform a task (in this case, finding health care information). The results showed that:

- the older users needed more time to fulfil the task (almost 6 minutes compared to the 2.5 minutes the younger users spent to fulfil their task);
- senior citizens read more and make less use of the website's search box facility.

Like Tullis' study, Houtepen's research shows that older users need more time and follow a different reading pattern. A measurement study, using three websites and a Web-wide task, with 20 senior citizens and a control group of 20 users between the ages of 21 and 55 conducted by Pernice & Nielsen (2002) confirms the differences in time on task: 12:33 minutes for the senior citizens versus 7:14 minutes for the younger control group. They also offer an explanation for this difference: 'Websites tend to be produced by young designers, who often assume that all users have perfect vision and motor control, and know everything about the Web. These assumptions are rarely upheld, even when the users are not seniors. However, as indicated by our usability metrics, seniors are hurt more by usability problems than younger users. Among the obvious physical attributes often affected by human aging process are eyesight, precision of movement, and memory.' Pernice & Nielsen (2002: 4) [22]

The studies conducted by Tullis (2007), Houtepen (2007) and Pernice & Nielsen (2002), as well as literature reviews in this field ([1], [4]) offer insight into differences related to time on task and navigation patterns between younger and older users. However, a few critical comments would seem in order:

- The number of participants in the studies was very low, making empirical research with more users necessary.
- These studies focused only on age, omitting to take into account the role of factors such as sex, educational background and frequency of internet use. It is therefore unclear whether differences within an age group are bigger than the differences between older and younger people.

Eye-Tracking Study: Research Questions And Methodology

What is needed is research based on empirical studies with larger groups of older and younger people. Public websites are an interesting research object. They are an important tool for (local) governments to provide information to their citizens. I therefore conducted an explorative eye-tracking study at the website of Maarssen, a Dutch municipality. Senior and younger citizens performed a search task on this website [31]. They had to find information related to parking facilities for people with disabilities in their municipality which could be found at a specific web page of this institution. Their navigation behaviour (use of the search box and reading patterns (eye-movements)) was then analyzed, not only by using eye-tracking data (heatmaps) [32], but also by paying specific attention to effectiveness (search task completed successfully or not within 5 minutes), efficiency (the time they needed to fulfil their search task) and user satisfaction (rating usability); see also [8] and [14].

Older people often are considered to be a more diverse group than younger people. Bouma (2000: 68) for example explains that 'Education and job specialization have been rising all through the 20th century, and the new generations of older citizens have learned to be both assertive and active. It is certain that they will be a heterogeneous group, since cumulative life experiences vary so much more than among young adults.' [2] In my explorative eye-tracking study I therefore also paid attention to the effect of sex, educational background (higher or lower level of education) and the frequency of use (daily or not daily) on the navigation behaviour of senior citizens.

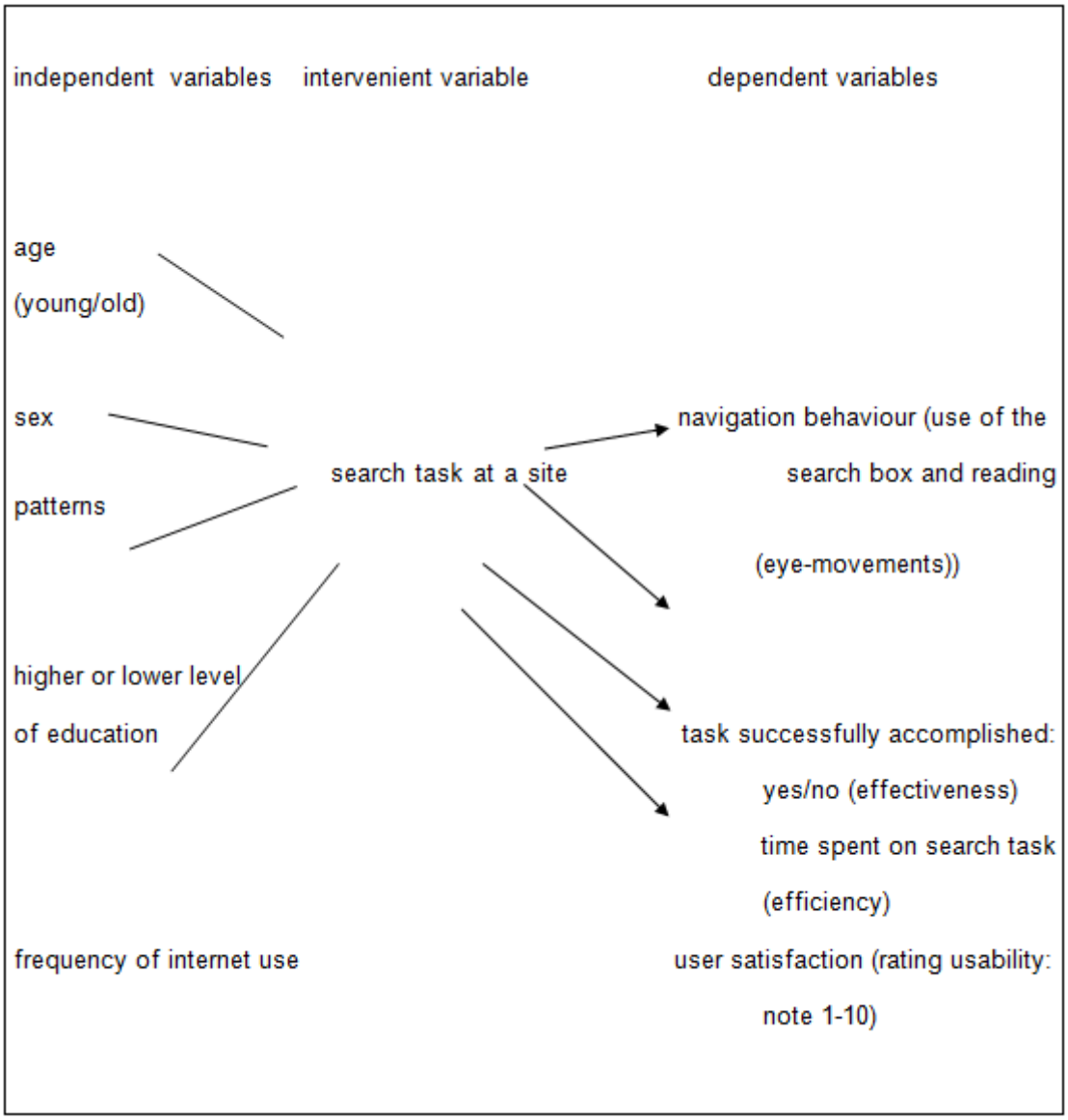
If we conduct eye-tracking studies with larger groups and pay attention, not only to age, but also to the above mentioned factors, we will gain a better understanding of the differences

and similarities related to navigation behaviour. The question is, obviously, how to set up and conduct such a study. In this paper, I make use of the data from the eye-tracking study I conducted among 29 younger and 29 older users (respectively about 21 years old and 65 years and older) in the Netherlands in April 2009.

User group	**N**
All users	58
All older users	29
All younger users	29
All female users	28
All male users	30
All younger female users	14
All younger male users	15
All older female users	14
All older male users	15
All older users with higher education	19
All older users without higher education	10
All older users using internet daily	18
All older user not using internet daily	11

Different user groups

Compared to earlier empirical research conducted in this field, a relatively large number of participants were recruited to my eye-tracking study. The number of 2 x 29 participants far exceeds the minimum of 8 participants per user type in usability tests specified by the NIST CIF (see [9] and [28]) [33].



Research design

Results

Use of the search box

The heatmaps presented in the next section show us that the majority of users made no use of the search box during the search task. Next Table confirms this result:

- The differences between the older persons used and the younger age group related to the use of the search box were rather small: respectively 37.9% versus 41.4%.

Other striking results presented in next Table:

- The percentage of the younger female users making use of the search box was lower than that of the younger male users: 28,6% versus 53.3%.
- Only 26.7% of the older male users made use of the search box versus 50% of the older female users.

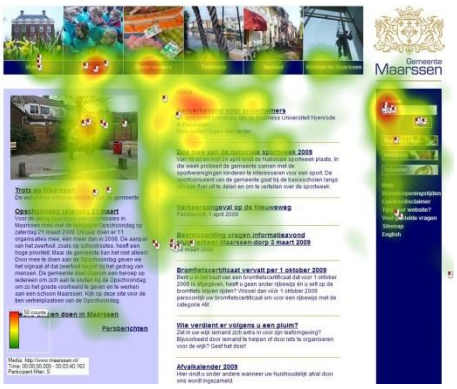
	Search box used during search task		Search box not used during search task	
User Group	N	%	N	%
All users	23	39.7	35	60.3
All older users	11	37.9	18	62.1
All younger users	12	41.4	17	58.6
All female users	11	39.3	17	60.7
All male users	12	40	18	60
All younger female users	4	28.6	10	71,4
All younger male users	8	53.3	7	46.7
All older female users	7	50	7	50
All older male users	4	26.7	11	73.3
All older users with higher education	7	36.8	12	63.2
All older users without higher education	4	40	6	60
All older users using internet daily	7	38.9	11	61.1
All older users not using internet daily	4	36.4	7	63.6

Use of the search box

Navigation areas

The navigation patterns of senior citizens using the municipality's website differ from those of younger people to a certain extent [34]. Older users read more text than younger users. Heatmap (1) shows that their reading pattern at the homepage is much broader than the reading pattern of the younger users in map (heatmap 2):

Heatmap (1): all older users



Heatmap (2): all younger users

The eye-tracking studies conducted by Tullis (2007) and Houtepen (2007) showed a similar result.

Effectiveness, efficiency and user satisfaction

Effectiveness (search task (not) successfully accomplished within 5 minutes)

	Search task successfully accomplished		**Search task not successfully accomplished**	
User Group	N	%	N	%
All users	52	89.7	6	10.3
All older users	23	79.3	6	20.7
All younger users	29	100	0	0
All female users	24	85.7	4	14.3
All male users	28	93.3	2	6.7
All younger female users	14	100	0	0
All younger male users	15	100	0	0
All older female users	10	71.4	4	28.6
All older male users	13	86.7	2	13.3
All older users with higher education	17	89.5	2	10.5
All older users without higher education	6	60	4	40
All older users using internet daily	14	77.8	4	22.2
All older users not using internet daily	9	81.8	2	18.2

Effectiveness

Above Table shows clearly that most users (89.7%) accomplished the search task within the 5 minute time limit, although some differences were apparent between user groups:

- 79.3 % of all older users accomplished the search task successfully versus 100% of all younger users.
- 86.7% of all male older users succeeded in accomplishing the search task successfully versus 71.4% of all older female users.
- Older users with a higher level of education were more successful than less educated older users: 89.5% versus 60%.

Efficiency (total time spent on search task)

In order to analyse how efficient the users were in accomplishing their search task, only those users were taken into account who succeeded in accomplishing this successfully within 5 minutes.

User Group	**Average search time (in seconds)**	**Median (in seconds)**	**N**
All users	91	76	52
All older users	104	83	23
All younger users	81	69	29
All female users	89	77	24
All male users	93	76	28
All younger female users	69	65	14
All younger male users	92	70	15
All older female users	116	89	10
All older male users	94	76	13
All older users with higher education	94	83	17
All older users with no higher education	131	101	6
All older users using internet daily	98	88	14
All older user not using internet daily	113	84	9

Efficiency

The most striking results:

- On the average, users needed 91 seconds to accomplish their search task.
- Younger users were faster than the older users, averaging 81 seconds versus 104 seconds.
- Older male users were faster than female users, averaging 94 versus 116 seconds.
- Older users with higher education were much faster than older users without higher education, respectively averaging 94 seconds and 131 seconds).
- Older users who did not make daily use of the internet were slower than older users who make daily use of the internet, respectively averaging 113 seconds and 98 seconds.
- Medians for all user groups were lower than the average for those groups, implying that some individuals scored much higher in these user groups.

User satisfaction (usability rated by notes 1- 10)

User Group	Average note	Median note	N
All users	7.4	7.0	58
All older users	7.6	8.0	29
All younger users	7.2	7.0	29
All female users	7.4	7.0	28
All male users	7.4	7.0	30
All younger female users	7.1	7.0	14
All younger male users	7.2	7.0	15
All older female users	7.6	8.0	14
All older male users	7.5	8.0	15
All older users with higher education	7.7	8.0	19
All older users without higher education	7.3	8.5	10
All older users using internet daily	7.4	7.7	18
All older user not using internet daily	7.8	7.8	11

User satisfaction

The most striking results:

- The municipality's website scored a 7.4 average for user friendliness.
- All user groups scored higher than 7.0 average.
- Differences between user groups were rather small.
- Medians for all older user groups were higher than the average for those groups, implying that some individuals scored lower in these older user groups.

Conclusions

In this final section the conclusions related to the most striking results will be presented. The results of this explorative eye-tracking study at a Dutch municipality's website demonstrate in the first place that, to some extent, age has an impact on the way older and younger users accomplish a search task at a website.

- The heatmaps showed that navigation patterns of senior citizens differ from those of younger people to a certain extent. Older users read more text than younger users. The eye-tracking studies conducted by Tullis (2007) and Houtepen (2007) showed a similar result.

- 79.3 % of all older users accomplished the search task successfully versus 100% of all younger users.
- Younger users were found to be faster than older users, averaging 81 versus 104 seconds.

This confirms the result of the studies conducted by Tullis (2007) and Houtepen (2007).

Yet this eye-tracking study also showed that age is not the only variable explaining differences in navigation behaviour. Sex, educational background and frequency of internet use all also play a role:

- Only 26.7% of the older male users made use of the search box versus 50% of the older female users.
- 86.7% of all older male users succeeded in accomplishing the search task successfully versus 71.4% of all older female users.
- Older male users were faster than female users, averaging 94 versus 116 seconds.
- Older users with a higher level of education were more successful than less educated older users: 89.5% versus 60%.
- Older users with higher education were much faster than older users without higher education, respectively averaging 94 seconds and 131 seconds).
- Older users who did not make daily use of the internet were slower than older users who make daily use of the internet, respectively averaging 113 seconds and 98 seconds.

Finally, we can conclude that, although differences in navigation behaviour in this eye-tracking study are to some extent age-related, differences are also seen within the group of senior citizens ('intra-age variability' [7]) due to sex, educational background and frequency of internet use. The black-and-white distinction between Prensky's 'digital natives' and 'digital immigrants' was absent. [23] Instead, what emerged was far more a 'digital spectrum' rather than a 'digital divide' [16].

Implications For Website Designers

If future empirical research confirms the findings of this explorative eye-tracking study, the implication for website designers (who often belong to a younger generation) could be to take into account diversity between and within generations by 'designing for dynamic diversity' [10], 'the premise of which is that older people are much more diverse in terms of life experience and levels of capability and disability than their younger counterparts.' Chisnell & Redish (2004: 48) [4]

In particular, older users who have little internet experience and have a broader reading pattern on websites ([13], [26]), and the very old who are confronted with age-related limitations owing to declining visual, hearing, cognitive and motor functions ([2], [5], [19]), so called 'age-restricted users' ([4], [11], [12]), have to receive more attention. Bouma (2000: 71-72), for example, comments that age-related functional limitations occur with a certain regularity from the age of 75 onwards, and are common from the age of 85 and over. So, as people grow older, there is no escaping the fact that age can start to play a certain role regarding the accessibility of the digital information, and that it then may be regarded as an explanatory variable. [2] 'Age-restricted users' are at considerable risk from age-related

functional limitations, making it difficult and more time-consuming for them to search information on websites. Economists refer in this connection to 'obsolescence' (also e.g. [17], [25]). Wright (2000: 86) notes that in such a case, 'multi-modal redundancy', for example, using both visual and auditory signs, could help. [29] Zajicek and Morissey (2003), referring to 'multimodality', advocate the use of text and sound. [30] Moreover, White et al. (2001) discuss special software that facilitates the access of groups with age-related functional limitations to our information society. [27]

Researchers and designers working on new 'interface architecture' would be wise to make a note of such insights where older people are concerned. [3] The fear that this might irritate younger and more experienced users is unfounded. A study carried out by Johnson & Kent (2007) showed that, rather than having an adverse effect on a site's user friendliness, it tended to enhance it for all users. [14]

One last recommendation: If you wish to enhance the accessibility of your organisation's website then follow the principle of 'designing for dynamic diversity' by asking various users to participate in usability testing and to proceed in different rounds: 'In most cases I tend to think the ideal numbers of users for each round of testing is three, or at most four. The first three users are very likely to encounter nearly all of the most significant problems [35], and it's much more important to do more rounds of testing than to wring everything you can out of each round. Testing of only three users helps ensure you will do another round soon (…). Also, since you will have fixed the problems you uncovered in the first round, in the next round it's likely that all three users will uncover a new set of problems, since they won't be getting stuck on the first set of problems.' Krug (2006: 138) [15]

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[31] The senior and younger citizens also performed a search task of two other organisations (an association for senior citizens and a health insurance company), see [18],[19], [20].

[32] The output of the eye-tracking instrument (Tobii) which measures the eye-movements of the different user groups are heatmaps, which show how intensely navigation areas are visited by using different colours (red, yellow and green: respectively very intense, moderate and low intensity), based on the number of fixations of individual users or groups of users. See [21] for more information about eye-tracking.

[33] However, this number is still not large. It is therefore accurate to characterize this study as an explorative one, in which I demonstrate trends. For this reason, no standard deviations and p-values are included.

[34] I also created heatmaps of user groups according to sex, educational background and frequency of internet use, but there were no differences in reading patterns between these heatmaps.

[35] See akob Nielsen's March 2000 Alertbox column «Why You Only Need to Test with 5 Users » at http://www.useit.com for a good discussion of this topic,.