

Design of navigational support for task oriented reading in e-newspapers

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Abstract. This paper aims to explore how the navigational support in an e-newspaper should be designed to support the users task oriented reading behavior. An e-newspaper is a newspaper produced on e-paper, which combines the readability of paper, with the possibilities of digital media such as streaming updates, interactivity and multimedia. One advantage with the e-paper technology is its high contrast and readability; it uses no backlight and only consumes power when the pages are updated. This study is part of the European DigiNews project where three high fidelity e-newspaper prototypes has been produced in cooperation with readers and newspaper designers. These prototypes have been tested on 36 readers to examine how to design navigational support to aid task oriented reading. Six guidelines for have been generated from the results of the study which covers information structure, hyperlinks, feedback and visual cues.

1. Introduction

Newspaper reading can be described as a passive form of reading, where the reader can be surprised while browsing through the newspaper. It's relatively easy to navigate and to find different parts because most of the newspaper publishers has the same structural layout. The most significant news in the newspaper can be found on the front page. From the front page the readers have page references to each section. The format and the structure of the newspaper

makes it possible to fast scan and browse through the newspaper for an outline of its contents.

The online newspaper demands a more active form of reading, allowing the reader to choose the articles that seems to be the most interesting (Ihlström, C. & Lundberg, 2004). Many online newspapers contain much information and are hard to navigate. One reason for this is the dynamic content that is constantly updated (Shneiderman, 1998; Preece et al., 2002; Dix et al, 2004). Another phenomenon that makes the navigation more difficult for online newspapers is the “lost in hyperspace” problem. This problem can for instance mean difficulties to move from a node to another, the reader is lost in the hypertext (Edwards & Hardman, 1989; McAleese, 1989; Nielsen, 1995; McKnight, 1996). The newspaper is still the most appealing experience compared to information sources on Internet (Treese, 2003).

The reading of a newspaper can be divided into two different behaviors; the ludenic and play theory, and the uses and gratification theory (Watters & Shepherd, 1997). The ludenic and play theory can often be associated with reading habits and reading at certain occasions during the day. It’s characterized by a period of entertainment and also by a spontaneous, peaceful reading without any proper structure. The ludenic and play theory can also be said to be very individual. The uses and gratification theory on the other hand is characterized by searching specific news or information, the reading is task oriented. These behaviors are related to newspaper reading and are probably not connected to a specific news medium.

Today the newspaper publishers are looking for new alternative mediums that are more profitable than the traditional newspaper (Ihlström & Palmer, 2002; Ihlström & Henfridsson, 2005). One alternative is the e-newspaper that can be an additional channel for the readers. The print and readability are very close to the newspapers and together with mobile technique it’s possible to make a mobile, continuously updated e-newspaper.

Since an e-newspaper is expected to become a convergence of the newspaper and the online newspaper (Ihlström, Åkesson & Nordkvist, 2004), the challenge is to design both a physical and graphical user interface that supports different reading behavior from both earlier media (Åkesson & Ihlström, 2006). The navigational support of an e-newspaper should support the same reading behavior as in other newspaper media, in other words both the reading based on ludenic or play theory and uses and gratification theory. The design should also support both sequential and non-sequential reading and despite an assumed smaller format, with dynamic updated content, it should offer an overview of the content.

This article describes the making of three different e-newspaper prototypes, designed by newspapers designers with cooperation and input from readers.

These prototypes have been evaluated to examine the research question: *how the navigational support in an e-newspaper should be designed to support readers task oriented reading behavior.*

The purpose with this study is:

- based on navigational theories, domain knowledge from newspaper designers and preferences from readers, design navigational support for an e-newspaper, and
- to evaluate the proposed navigational support and from the result present guidelines how navigational support should be designed to support task oriented reading in an e-newspaper.

2. The DigiNews project

The DigiNews project (ITEA 03015) explores the possibilities to present news in an e-newspaper (instead of the newspaper). The goal of the DigiNews project is to suggest a solution that includes all parts needed to produce, distribute and consume digital news. Within the DigiNews project, we are in the last phase of the development and design of the e-newspaper. The e-newspaper is a newspaper published on e-paper. The e-paper is a non reflecting display, giving the reader same experience as paper such as high contrast, good color representation and the possibility to read in sunlight. The e-paper is thin, flexible and non-sensitive. In addition, it does not require high battery performance, the screen image is fixed even when there is no electrical voltage applied (Philips Research Technologies, 2005).

The e-newspaper is predicted to be presented on a very thin and foldable device, combining the readability and overview from the printed newspaper with the possibilities of digital media such as constant updates, interactivity and video.

One of the biggest challenges in the DigiNews project is to present the newspaper in a smaller display. To gain user acceptance the e-newspaper needs to match the users expectations and support current reading behaviors from other newspaper channels [1]. The user should be able to read and navigate the newspaper in an easy and natural manner.

3. Related theory

3.1 Landmarks, routes and overview

Spatial knowledge (sense of room and place) is created in three steps; knowledge about landmarks, route knowledge and survey knowledge (Siegel & White, 1975; Thorndyke & Hayes-Roth, 1982). The learning doesn't necessary need to follow

in this order, for example survey knowledge can be received before route knowledge. The learning progress depends to a certain extent of the personal learning and of the surrounding environment (McDonald & Pellegrino, 1993).

Knowledge about a landmark is to recognize a place and the characteristic of the place without any knowledge about its position in relation to other landmarks (McDonald & Pellegrino, 1993). Places to change routes, or a node that ties many possible choices of routes, are often good landmarks (Siegel, 1981).

Survey knowledge is characterized by knowledge about different landmarks and their relative positions to the world around. This knowledge is achieved by a careful study of the environment or to study a map of the area. Landmarks and routes are elements in the survey knowledge and constitute bricks to receive survey knowledge (McDonald & Pellegrino, 1993).

3.2 Metaphors and users mental models

Metaphors are used in design of graphical user interface to support the creation of mental models (Preece et al., 2002; Barfield, 2004). Users have different experiences from systems, or from real environments, that affect how these persons are interpreting the new system. If it's possible to use these earlier experiences and build a metaphor on these, it's easier for the user to create a correct system model. A correct system model leads to faster learning and enables the user to solve their tasks faster and more effective (Dix et al., 2004).

The broadsheet metaphor can be a strong metaphor to build upon when designing the graphical user interface for news mediums (Golovchinsky & Chignell, 1997). The front page of a newspaper can for example work as a landmark where all the most important articles are shown. From this page the user get references to where in the newspaper the article can be found (Golovchinsky, 1997).

If the user is interpreting the elementary structure of the system as different from how it actually is structured, there will be problems (Preece et al., 1994). It's important to structure the information so that it appears to be logic to the user and so that the user can create a correct mental model over the hypermedia system (Schneiderman, 1998). This helps to avoid disorientation and also makes it clear for the user what information is to be found in the hypertext, and most importantly what not to be found in the hypertext.

3.3 Hypermedia and information structures

One of the advantages of hypermedia (hypertext) compared to normal linear text is the possibility to move freely between similar information areas within e.g. in an article or between several different articles in a newspaper (Shneiderman, 1998). But, there is a risk for hyper chaos – a phenomena which is often called

lost in hyperspace (Conklin, 1987; Dix et al., 2004; Shneiderman, 1998; Nielsen, 1998; Preece et al., 2002).

But, one of the problems with hypermedia is the navigation (Dix et al., 2004). Users often don't know how to go to the beginning or the end of a hypertext. It's a natural consequence of the vast possibilities to navigate in hypertext compared to a newspaper or a book.

Another problem connected to the fact that hypermedia can be very complex and compact, is that the user can feel unsure of which information that is explored and which isn't (Shneiderman, 1998; Dix et al., 2004). This brings a certain amount of uncertainty to the user compared to linear text. It's also difficult for the user to know if there is more information offered in addition to the routes presented as links to related areas in the hypertext (Dix et al., 2004).

Edwards and Hardman (1998) describe the disorientation problem on the basis of three parts:

- The user doesn't know where to go next.
- The user knows where to go, but not how.
- The user doesn't know where he/she is compared to the other information structure.

It's necessary for the user to have an overview of the information structure to be able to effectively collect and summarize wanted information (Darken & Sibert, 1996). It has also been shown that users don't want to do more than three "clicks" to find their wanted information on the web (Nielsen, 1995).

The structure of information is normally divided into three overall categories; linear structure, linear structure with "side-streets" and tree structure (Barfield, 2004). Linear structure means that the user follows a certain path created by the designer. The user browses the information structure step by step and the linear structure is often used to tell a story or other information with a clear and sequential classification. The linear structure with "side-streets" is the same as linear structure with the difference that it's possible to navigate deeper into the information structure in certain or all steps. The tree structure consists of information nodes hierarchically connected. A combination of above structures, a hybrid structure, is also quite common (Barfield, 2004).

There is no universal answer to the question of which information structure that should be used in certain environments (Barfield, 2004). It's most important that the structure is easy to understand and suited for the specific users.

Finally, the chosen information structure can affect the feeling of information overload. Information overload occurs, according to Wurman (1989), when the user:

- Don't understand the available information.
- Feel overwhelmed by the amount of information that needs to be processed.
- Is unsure of the information accessibility.
- Not knowing exactly where to find the information.

- Knowing the location of the information, but not how to find it.

3.4 Feedback

When designing a new navigational support it's crucial to outline a framework regarding placing and appearance. If for example the appearance and placement of the navigational support changes during the interaction, the user will experience difficulties (Fleming, 1998). Users depend on the interface and its consequent behavior. In this way the interaction becomes easier (Dix et al., 2004).

Presenting relevant and understandable feedback at the right moment for the users is important (Barfield, 2004). Feedback from the system is an indicator of success or failure for the user when navigating the environment. Additionally, feedback lends a helping hand in the interaction and supports the decisions that have to be done. It allows the user to interpret a task and guides the users to the next step in the interaction (Dix et al., 2004). Feedback to navigational tasks is just as important, for example, visual cues about the whereabouts are essential for orientation (Lynch, 1960). In a newspaper, this is commonly done by section headings and page numbering.

3.5 Support for task oriented navigation

The task oriented navigation has four steps (Downs & Stea, 1973):

- Orientation – to decide position relative to nearby objects and goals.
- Route decision – choose a route that leads to the goal.
- Route supervision – supervise the chosen route to make sure that the correct route is chosen and leads in right direction.
- Goal recognition – to know when the goal is near and when it's found.

There are three principals for how to design an overview to help the user with navigation (Darken & Sibert, 1996). The first is to show all the elements and their relations in the information structure. The second is to always notify the user about the current position in the information structure. The third is to always orient the overview in relation to the user's position and experience of the information structure.

4. Method

Qualitative research within the IS field focus on peoples assumptions, knowledge and experiences (Orlikowski & Baroudi, 1991; Walsham, 1995). The conducted study is based on qualitative research divided into 3 main phases:

- Phase 1, a feasibility study with 8 workshops conducted with newspaper readers and newspaper staff (designers, journalist, etc.). The main aim with

this phase was to receive user generated data concerning navigational support that supports reading behaviors.

- Phase 2, an iterative design phase with two focus groups, one involving newspaper designers and one with readers.
- Phase 3, an evaluation phase with 36 respondents. Three different prototypes were tested to evaluate which navigational solutions and which information structure the readers preferred.

An overview of the empirical work is presented in table I, a brief summary of every phase is presented below.

Activity	Type	Participants	Focus	No.
Phase 1				
1	Workshop/ Focus group	Readers	Future workshop	6
2	Workshop	Newspaper staff	Future workshop	6
3	Workshop	Readers	Future workshop	6
4	Workshop	Newspaper staff	Future workshop	8
5	Workshop	Readers	Future workshop	6
6	Focus group	Designers	Analysis of mock-ups and start of prototyping	2
7	Workshop	Newspaper staff	Future workshop	4
8	Workshop	Readers	Future workshop	5
9	Workshop	Newspaper staff	Future workshop	3
Phase 2				
10	Focus group	Designers	Prototyping	4
11	Focus group	Readers	Scenarios and mock-ups	5
12	Focus group	Readers	Test of prototypes	4
13	Focus group	Designers	Prototyping	3
14	Focus group	Readers	Test of prototypes	5
15	Focus group	Designers	Prototyping	3
16	Focus group	Designers	Prototyping	5
Phase 3				
17	Focus group	Readers	Pretest prototypes	3
18	Pilot test	Readers	Pilot test prototypes	1
19	Test	Readers	Evaluation of prototypes	6
20	Test	Readers	Evaluation of prototypes	6
21	Test	Readers	Evaluation of prototypes	6
22	Test	Readers	Evaluation of prototypes	6
23	Test	Readers	Evaluation of prototypes	6
24	Test	Readers	Evaluation of prototypes	6

Table I. An overview of the empirical work.

4.1 Phase 1, feasibility study

The first phase contains a feasibility study based on future workshops (Junkt & Müllert, 1996; Kensing & Halskov Madsen, 1991) with readers and staff.

Eight future workshops were carried out, four with readers (23 persons) and four with newspaper designers (21 persons). The readers were reached by an advertisement in four online newspapers; Sydsvenskan, Göteborgs-Posten (GP),

Hallandsposten and Sundsvalls Tidning (ST). It contained a call for interest to be a part of this project. The aim of the selection was to get a representative group of readers as well as a dynamic group for the workshop. It was an even distribution concerning gender the distribution of age was in the interval between 20 to 70 years.

The applied future workshop method in the DigiNews project was modified to include the creation of scenarios and mock-ups to support both design and requirement specification (Ihlström, Svensson & Åkesson, 2005).

4.2 Phase 2, the iterative design phase

The iterative design phase aimed to produce prototypes from the outcome of the feasibility study. To continue the involvement from the users and to receive the publishers domain knowledge two different focus-groups have been used in this study (table I). To bring a design into line with its context, it's important to have an active involvement from stakeholders (Löwgren & Stolterman, 2005; Preece et al., 2002).

The user focus group consists of six readers that have answered the call for interest in the local newspaper (Hallandsposten). The user focus-group consisted of two women and four men in the age of 29 to 82 years. The participants have different education and all of them are working except one, who is retired. In this study, five sessions with user focus-group have been conducted.

The design focus group consists of four newspaper publisher from Aftonbladet, GP, Norrköpings Tidningar och ST. All of them are involved in the DigiNews project. Five sessions with the design focus-group have been held to discuss and create design ideas. In these sessions the prototypes have been developed iteratively and results from the tests with the user focus-group have been discussed. The navigation menu implemented in GP (presented in 5.2) was developed in a separate study (Lindqvist, Söderblom & Henriksson, 2006).

4.3 Phase 3 – the evaluation phase

The evaluation phase aimed to test the different solutions of the navigational support created in the different prototypes.

It total 36 tests were conducted with readers, 12 tests on each prototypes. The prototypes were tested on readers that were used to read the paper version or the online version of the corresponding newspapers. The selection of test persons was also based on age and gender. The aim was to get an equal sample regarding gender and the age selection was based on a study on who reads the morning newspapers [3].

The test has been design to investigate task oriented navigation. Since ludenic reading is relative difficult to investigate due to personal preferences (Watters &

Shepherd, 1997) and that the navigational support should be the most important when performing task oriented reading, a task-based test was chosen.

The users were asked to think aloud (Dumas, 2003; Nielsen, Christiansen, Clemmensen & Yssing, 2003). In each test a test-leader and an observer, which documented the observations on paper, was present. After every completed task, additional questions were asked to get feedback on for example perceived problems. The tests ended with a post interview, giving the opportunity to ask specific questions about the navigational solutions and any problems the user experienced.

The prototypes were tested on two different “tablet-pc”. All the tests were documented using video that recorded the view of the prototype screen, additionally an MP3 player recorded the sound.

5. Results

In the following chapter the result from the three phases is presented.

5.1 Phase 1 – the feasibility study

The produced mock-ups (figure 1) has been studied and analyzed twice. The first time together with the design focus group where the mock-ups were studied together with the video presentations that explained the mock-ups. The primary goal was to identify new innovative ideas.



Figure 1. Examples of produced mock-ups.

At the second analysis of the mock-ups the different navigational support where documented and a general list of different navigational support where produced. This list was derived on the most common navigational solutions identified from the mock-ups:

- Information structure – sections and sub sections should have clear differences.
- Index – separated in three levels (front page, index page containing sections and subsections and presentations of articles).
- Menus – provide simple navigating to the different sections and pages
- Page indicator – distinct indicators that displays current location and supports the feeling of beginning and end for the user for example; Page 35/60.
- Visual support concerning location of which section and sub section the user is at. This could be done by colour markings etc.
- Thumbnails – this method supports overview.
- Headlines – use of different headlines could help the user to orientate the environment.
- Support for sequential and non sequential reading:
 - Page turning function – offers support for both traditionally reading (page to page) and skimming
 - Hyperlinks – offer support for fast navigating thru the newspaper's different articles and sections.

5.2 Phase 2 – the iterative design phase

The prototype that was build by Aftonbladet is a bit smaller than the A4 format. The information is structured in four different levels; front page, table of content, section index and the article level (figure 2-4). The forth level, the article level, is build with a linear structure to support sequential reading with the possibility to navigate up one level to the section index or to the table of content, two levels up in the hierarchic tree structure. The table of content (figure 3) is designed to provide an overview of the newspaper, but also the front page provides an overview (figure 2). The prototype supports both sequential and non sequential navigation using the forward and back arrows. The hyperlinks via the thumbnails in the section indexes leads directly to the articles in the selected section (figure 4). Nothing else in the prototype is hyperlinked.



Figure 2. Front Page



Figure 3. Table of content



Figure 4. Section Index

The prototype built by Göteborgs Posten is designed for the A5 format, but is compatible for A4 as well. The users interact via touch screen using a pen or their fingers. This prototype is built solely on one information level, but it has clear point of references to support the sequential information organization. Examples of point of references are the direct navigation to the index page (figure 5) and to the beginning of the different sections (figure 7). The prototype supports three possible navigational routes; hyperlinks on the front page, subsections links on the index page and sequential page turning. The navigation menu is transparent, moveable and has a hide function. The front page (figure 5) contains hyperlinks to the different articles that are presented on this page. The Index page (figure 6) only displays links to sections due to the small screen.



Figure 5. Front Page



Figure 6. Table of content



Figure 7. Section

The prototype built by Sundsvalls Tidning is also designed for an A5 format but was tested in a bigger format on the tablet-pc. The prototype consists of three information levels; the front page (figure 8), section indexes (figure 9) and the

article level (figure 10). ST has a composite information structure which support both linear and non linear navigation. The section indexes can be reached by hyperlinks in the menu on the right side of the prototype. The different sections of the newspaper are the same as in the traditional newspaper. The menu to the right, together with the browsing arrows at the bottom, is enabling browsing page by page or section by section. Direct navigation to the articles is supported by hyperlinks both at the front page and in the section indexes.



Figure 8. Front Page



Figure 9. Section index



Figure 10. Article

5.3 Phase 3 – The evaluation phase

Below is a brief summary of the results from the tests on the three prototypes.

5.3.1 The evaluation of Aftonbladet

During the observations and interviews throughout the test it became evident that many test persons had trouble to know under which section an article could be found. The prototype only used four sections which made it quite hard for the test persons to know where to look when they received a specific navigational task. 6 test persons used the main index active during their search for articles. The other half based their search on their conclusions of where the article could be found. Of the 6 persons that used the main index active, 5 checked under what section an article could be found (very few noticed the page indication).

Overall, most of the test persons had trouble finding information on the main index due to the amount of presented information. No one really browsed the newspaper, most test persons navigated to the section indexes and used the hyperlinked thumbnails to the articles.

In the concluding interviews, 10 of the 12 test persons thought it was easy to find the articles and for the most part mentioned the section indexes as to why. The most frequently mentioned problem was the lack of direct navigation from

the table of content and the front page. All of the test persons said that the navigational support was easy to learn and they also liked the information structure regarding the different levels of information. 10 of 12 test persons said it was easy to get an overview of the information. The overview was provided through the table of content and the front page according to the answers.

7 persons said it was hard to get a feeling of how much information there were in the newspaper. The same test persons also stated that it was hard to get a feeling of what was read and what was not. 7 individuals stated that the visual cues were easy to notice and therefore they were used. 5 test persons stated that they didn't use or noticed the visual cues. 3 of these 5 individuals stated that they wanted to have the total amount of pages indicated instead of just the actual page number.

Table II and III summarize how the test persons perceived the prototype, how much it resembled the paper edition compared to the online version.

Test person	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Paper	25	20	30	100	70	40	80	0	75	70	20	80	50,8%
Web	75	80	70	0	30	60	20	100	25	30	80	20	49,2%

Table II. Newspaper feeling, Aftonbladet, at the beginning of the test.

Test person	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Paper	50	20	30	100	70	25	50	0	60	80	20	50	46,3%
Web	50	80	70	0	30	75	50	100	40	20	80	50	53,8%

Table III. Newspaper feeling, Aftonbladet, at the end of the test.

5.3.2 The evaluation of GP

The results from the observations and the interviews showed that most of the navigational support in the prototype was used without any trouble. 3 test persons had big problems using the "thumb navigation", the rest mainly used this navigational support. One major problem that was observed in all but one case was a misunderstanding regarding the hyperlinks on the index page. The test persons misunderstood the index page which only contained links to sections and not directly to the articles. In most cases there was no trouble finding information on the index page and therefore most users got to the right section. But 6 of 12 individuals reported perceived problems with the lack of hyperlinks to the articles from the index page.

The other half of the users didn't report any perceived problems regarding navigation and there were also no critical problems observed. In the concluding interviews 11 persons reported that they thought it was easy to find information in the newspaper, but most of them had comments like:

- *"The news was far inside the newspaper"*
- *"relatively, I would like the headings of the articles function as hyperlinks"*

6 test persons thought the “thumb navigation” were easy and functional to use. 3 persons said it was hard to use and the remaining 3 persons thought it had unclear icons or that the menu was disturbing the view of the articles. Despite that, all but one thought the navigational support in the prototype was easy to learn.

Overall the users were positive to the information structure. Some felt that the index should be rearranged to match the traditional newspaper or that it was hard to find information on it. 8 persons felt it was easy to get an overview of the information and 4 of these mentioned the front page as the reason and 3 mentioned the index. 11 test persons said it was hard to get a feeling of how much information the prototype contained and 8 users said it was hard to get a feeling for what was read and what was not. Finally, 6 persons were positive to the visual cues regarding pages and sections and 5 individuals reported that they had not seen these visual cues.

Table IV and V summarize how the test persons perceived the prototype, how much it resembled the paper edition compared to the online version.

Test person	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Paper	15	0	30	50	60	30	93	50	70	10	0	60	39%
Web	85	100	70	50	40	70	7	/	30	90	100	40	57%

Table IV. Newspaper feeling, GP, at the beginning of the test.

Test person	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Paper	15	70	30	50	65	35	85	50	70	30	0	60	47%
Web	85	30	70	50	35	65	15	/	30	70	100	40	49%

Table V. Newspaper feeling, GP, at the end of the test.

5.3.3 The evaluation of ST

The observations and interviews showed that 10 of the 12 test persons used all parts of the navigational support. Most people used the right menu and the section indexes to navigate. The browsing function was used quite sparsely and overall very few problems were observed. Also, hardly anyone of the test persons reported any perceived problems after finishing the different tasks.

In the concluding interviews all 12 test persons said it was easy to navigate and find information. The test persons mainly mentioned the menu to the right as to why. The overview given by the front page and the section indexes was also reported to be a reason to why it was easy to navigate. Finally, the structure of the section indexes was stated as a reason. All users said that they understood how to browse, 2 test persons had suggestion to change the function to the same functionality as the web: *”More as on the web, back to where I were and not one page back. I would probably read in the same way as on the web and not as I read on paper”*.

All users were positive to the menus in the prototype and thought it was easy to learn. The test persons also were very pleased with the information structure of the newspaper. 9 of the test persons thought it was easy to get an overview of the information due to the right menu. 2 individuals said that they would like more informative pages and said that the front page did not support an overview. Only 2 test persons thought that they could get a feeling of what was read and what was not. Very few of the users noticed the visual cues regarding section, page number and total amount of pages. 4 persons thought these visual cues were good and that the total number of pages supported their reading.

Table VI and VII summarize how the test persons perceived the prototype, how much it resembled the paper edition compared to the online version.

Test person	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Paper	0	10	85	60	80	30	50	25	80	50	75	20	47%
Web	100	90	15	40	20	70	50	75	20	50	25	80	53%

Table VI. Newspaper feeling, ST, at the beginning of the test.

Test person	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Paper	80	10	85	60	80	40	60	25	80	40	75	30	55,5%
Web	20	90	15	40	20	60	40	75	20	60	25	70	44,5%

Table VII. Newspaper feeling, ST, at the end of the test.

6. Discussion

The navigation is an important factor when designing a newspaper that supports the reading behavior of the users. On the web there are still many problems related to navigation. The users have difficulties finding information and are lost in hypertext (Edwards & Hardman, 1989; McAleese, 1989; Nielsen, 1995; McKnight, 1996). This study has investigated how the navigational support in a future e-newspaper should be designed to support users reading behavior. This has been carried with the help of both readers and domain experts, which have influenced the design of the navigational support. It would have been difficult to be able to create a well functioning design without this procedure. As Löwgren and Stolterman (2005) say it's necessary to get users as well as domain experts input to create well functioning IT-artifacts.

To be able to succeed with the aim of the study, several kinds of design solutions were created. These different solutions were then evaluated to be able to get an insight in what is most important for the navigation support in connection to the readers' behavior. The material from the feasibility study together with the theories of navigation and graphical user interface, were the basis for the design of the navigational support. The design was created through an iterative process with participation from the users/readers as well as domain experts. This was done continuously to be able to eliminate any possible problems with the design

during the process. The design ideas that were developed during the process were realized by newspaper designers and students at Halmstad University. The fact that newspaper designers created the layout was necessary because otherwise it had been difficult to create trustworthy prototypes that infuse newspaper feeling.

The result of the feasibility study and the design phase were the creation of three different prototypes. These prototypes were built with different navigational structures, visual feedback, viewing content and hyperlinks. The prototypes also included parts that were designed in conflict to general guidelines for design, just to be able to evaluate what is most important –newspaper feeling or design guidelines. One example of this is Aftonbladet that was designed with an inconsistent menu that changed depending of where in the newspaper structure the reader was. This way of designing menus is definitely breaking the guidelines for creating a consistent interface (Shneiderman, 1998).

6.1 Landmarks, routes and overview

Navigation is made from three important aspects – knowledge about landmarks, route knowledge and survey knowledge (Siegel & White, 1975, Thorndyke & Hayes-Roth, 1982). The front page seems to be a very important landmark and if readers can't reach it they get frustrated. As this is the first encounter for the reader they seem to base their navigational route from that point. In all three evaluations this result was found. Other important landmarks seem to be the table of contents and the index pages in the three newspapers. Just as Siegel (1981) found out, the landmarks that contain areas where the reader change their route of reading or areas that tie different possible choices of routes together, are of big significance.

The table of content in Aftonbladet seems to work as a landmark to many test persons. This landmark seemed a bit problematic; the users had to go back to the table of content to be able to choose a new section. However, the possibility to create routes from the table of contents was highly restricted since the headlines weren't linked directly to the articles. The test persons therefore found it difficult to create alternative routes and shortcuts which McDonald and Pellegrino (1993) mean is important to be able to use the overview knowledge and to create effective navigational strategies.

In all the tests it emerged, more or less, that it's important to create a brief overview in the front page. This can be compared to the online newspaper in which the readers return to the front page to choose a new article (Ihlström & Lundberg, 2004). Above all, the front page of Aftonbladet, which is like a front page in a newspaper, got several comments that it gave the users a good overview. According to Darken and Sibert (1996) a user must have an overview of the information structure and it's content to be able to find the information in an effective way.

6.2 Metaphors and support of the user's cognitive model

The conceptual navigation is important to give the user a quick understanding for how the system works (Preece et al, 1994). This has been done by using metaphors both from the online newspaper and from the newspaper. Metaphors are an efficient way to support the user's mental model (Barfield, 2004). Most readers understood the e-newspaper prototypes as a hybrid of these two medium. One problem addressed during the design phase was which metaphors should be used and how they should act as intermediary to support the reader to get a correct mental model of the prototype. The tests showed that one half of the test persons choose to use the newspaper metaphor and the other half used the online newspaper metaphor as intermediary to get a correct mental model of how the e-newspaper prototype was structured and working.

The browsing buttons used in all the three prototypes was designed as arrows. In the prototype of ST above all, readers misunderstood the functionality. They thought it was the same functionality as in a web browser. This can depend on several things, but presumably it was the appearance of the browsing buttons similarity to web browsing navigation. Another aspect that could have been affecting was that the readers weren't as much dependent of the browsing function as they were in the other prototypes. They used lesser browsing than the readers using the other two prototypes and didn't learned how it was working.

6.3 Hypermedia and information structures

The remaining navigational aspect concerning the newspaper metaphor from the printed edition was the fixed navigational structure used in Aftonbladet. The prototype rendered mixed feelings among the readers, some liked it but almost everybody made remarks about the "missing" links on the front page and the table of content. On the contrary, ST had such features which the readers were pleased with. These web metaphors and informational structures gave the readers more options when navigating the e-newspaper and they were positively toward it. The GP prototype is a mix of the two prototypes concerning the hyperlinks and the informational structure. When testing this prototype readers asked for hyperlinks.

Regarding the question about how many levels in the information structure that should be used, the results points to that three or four levels works best depending of how they are related. Aftonbladets readers expressed that it was unnecessary to constantly navigate through the table of content when searching for another page. GP's readers asked for section indexes like those that were used in Aftonbladet, with hyperlinks to pages or individual articles.

When interacting with the prototypes no form of "lost in hyperspace" could be identified. This could be the result of various reasons, but the fact that the prototypes were built with non scrollable pages could be an important thing. The linear structure which the prototypes used on the article level could be another

reason. One more reason is that the prototypes were not a complete edition of the e-newspaper and therefore were not that information intense.

Aftonbladets table of content seemed to contain too much information for the bigger part of the test group. In the interview answers, and during the tests, comments like Wurman (1989) used for explaining the phenomenon “information overload” emerged. The readers felt overwhelmed by the information and was not sure were to find the information. Another problem was the article headlines which had a different arrangement than the paper edition. An example of this is the editorial which is displayed on the lower part in the index page, in contrary to what the readers found more logical, upper left part of the page.

6.4 Consistently designed graphical user interface and feedback

As mentioned before, most readers reacted to Aftonbladets inconsequential navigational menu in the bottom of the page. Many users expressed this in the interviews, further this could be observed during the tests.

All the prototypes were built with different kind of feedback. Aftonbladet used color as navigational support in the sport section and index page, further more the arrows, that marked articles that continued to the next page, and the page numbers, gave the user feedback of location. GP had linked markers on the article level, which only linked forward, additionally the newspaper had a section indicator which displayed the current section page. ST used arrows similar to Aftonbladet and displayed current sections by the use of different colours. Further on a page indicator showing current and total number of pages was used. Some problems occurred when using the linked markers. Some readers thought it was unnecessary with redundant navigational support that confused the users in the initial testing phase of the prototype. This is further more indications concerning the importance of a consistent navigational support (Shneiderman, 1998; Dix et al., 2004).

The marker on article level gave good feedback for the readers which indicated that the article continued on the next page. In the prototype without the marker a number of readers lost their sense of place. The colored parts in ST came out well and a number of readers related to it when they were asked where in the newspaper they were. When it comes to the page numbers, the outcome is not so clear. GP which used a new design solution seemed to please the readers, but a question mark should be raised here, would it have worked that good if the readers didn't had previous knowledge of the paper issue? The indicator had a clear similarity to the one used in GP's paper edition with its sections and different subsections. In the comparative test in Halmstad a number of readers had problems to understand the indicator and its function; they hadn't prior experience of it and could therefore not understand it. Some readers asked for page indications in Aftonbladet like the one used in ST. An interesting phenomenon is that in the ST test, the page indicator was hardly used at all by the

readers. This could be the result of the subconscious feedback because of its placement in the bottom of the newspaper.

In all the feedback was positive according to the reader's comments. Most of them used the headlines in the top of the pages to orientate themselves. Feedback is important for the reader to help them orient themselves and interpret if she is at the right place and how she could continue to explore the system (Dix et al., 2004).

6.5 Task based navigation

Overall the users had few problems with the task based navigation. The prototype which the users found the information fastest in was ST. The users found this newspaper's structure easy to understand and they could get a good understanding for the content. Almost everybody referred to the right side navigation support as to why. Survey knowledge is obtained quickly if a hierarchic information structure is used (Majoor, Rama & Westerink, 2000). In ST the users could navigate to any article or page by only two clicks, this probably effected the task based navigation positively in the prototype. This is supported by Nielsen (1995) which means that users shouldn't have to interact more than three times when reaching the goal.

6.6 Conclusions

The conclusions and guidelines drawn from the results regarding support for task oriented reading are:

- An information structure with three levels is preferred to support users task oriented reading. If a table of content is incorporated, users prefer a structure like the traditional newspaper and that page numbers is presented.
- Users prefer the same sections of content to be used in the e-newspaper as in the traditional newspaper. Too much information in too few sections can be problematic.
- To support task oriented navigation, the navigational support should include hyperlinks directly to articles on all levels in the information structure.
- Thumbnails as representatives for newspaper pages can with advantage be used to present an overview of information.
- Page numbers and section indicator seems to be best placed in the page header. Page numbers that use the same appearance as a traditional newspaper and relate to the total number of pages, gives the reader a feeling of the information quantity.
- Feedback is important, if for example an article continues over several pages, the user should be given feedback to be aware of it.

References

- Barfield, L. (2004). *Design for new media: interaction design for multimedia and the Web*. New York: Pearson Addison Wesley.
- Conklin, J. (1987). *Hypertext: An Introduction and Survey*. *Computer*, 17-41.
- Darken, R. P., & Sibert, J., L. (1996). Way finding Strategies and Behaviors in Large Virtual Worlds. *CHI'96 Proceedings*, 142-149.
- Dix, A., Finlay, J., Abowd, G. D., & , R. (2004). *Human Computer Interaction*, London: Prentice Hall.
- Downs, R. M. & Stea, D. (1973). *Cognitive Maps and Spatial Behavior. Process and Products. I Image and Environment*, (Downs, R.M. and Stea, D. Eds.). Chicago: Aldine Publishing Co.
- Dumas J. S. (2003). *User-Based Evaluations*, i Jacko, J. A. & Sears, A. *The Human-Computer Interaction Handbook*, Lawrence Erlbaum Associates, 1093-1117.
- Edwards, D. & Hardman, L. (1989). *Lost in Hyperspace: Cognitive Mapping and Navigation in a Hypertext Environment*. I McAleese, R. (ed.) *Hypertext: theory into practice*, 105-125. Oxford: Intellect Ltd.
- Fleming, J. (1998). *Web Navigation: Designing the User Experience*. Sebastopol: O'Reilly & Associates.
- Golovchinsky, G. (1997). *What the Query Told the Link: The integration of Hypertext and Information Retrieval*. *Conference on Hypertext and Hypermedia. Proceedings of the eighth ACM conference on Hypertext*, 67-74.
- Golovchinsky, G. & Chignell, M. H. (1997). *The Newspaper as an Information Exploration Metaphor*. *Information Processing & Management*, 33, 663-683.
- Ihlström, C. & Henfridsson, O. (2005). *Online Newspapers in Scandinavia: A Longitudinal Study of Genre Change and Interdependency*, *IT & People*, Vol. 18, No.2, 172-192.
- Ihlström, C. & Lundberg, J. (2004). *A Genre Perspective on Online Newspaper Front Page Design*. In *Journal of Web Engineering*, Vol. 3, No. 1, 50-74.
- Ihlström, C. & Palmer, J. (2002). *Revenues for Online Newspapers: Owner and User Perceptions*. *Electronic Markets: the International Journal of Electronic Commerce & Business Media*, Vol. 12, No. 4, 228-236.
- Ihlström, C., Åkesson, M. & Nordqvist, S. (2004). *From Print to Web to e-paper - the challenge of designing the e-newspaper*. In *Proceedings of ICC 8th International Conference on Electronic Publishing, ELPUB 2004*, Brasilia, 249-260.
- Jungk, R., & Müllert, N. (1996). *Future Workshops - How to Create Desirable Futures*. London: Institute for Social Inventions.
- Kensing, F., & Halskov Madsen, K. (1991). "Generating Visions: Future Workshops and Metaphorical Design", i J. Greenbaum and M. Kyng (eds.), *Design at Work*, 155-168. Hillsdale: Lawrence Erlbaum Associates, Inc.
- Lindqvist, M., Söderblom, M., & Henriksson, S. (2006). *E-newspaper Navigation - Designing navigational aids for a new electronic medium*. To be published in *Proceedings of the 29th IRIS*, Denmark.
- Lynch, K. (1960). *The Image of the City*. Cambridge: MIT Press.
- Löwgren, J., & Stolterman, E. (2005). *Thoughtful Interaction Design : A Design Perspective on Information Technology*. Massachusetts: The MIT Press.
- Majoer, B., Rama, M., D. & Westerink, J. (2000). *Interacting with infotainment applications: navigation patterns and mental models*. *Behaviour and Information Technology*, Vol. 2, 97-106.

- McAleese, R. (1989). Navigation and browsing in hypertext. In R. McAleese (Ed.), *Hypertext: Theory into practice*. Oxford: Intellect.
- McDonald, T. P. & Pellegrino, J. W. (1993). Psychological Perspectives on Spatial Cognition, i Gärling, T. och Golledge, R. G. (ed.) *Behavior and Environment: Psychological and Geographical Approaches*, kap 7. New York: Elsevier.
- McKnight, C. (1996). What makes a good hypertext? In H. van Oostendorp & S. de Mul (Eds.), *Cognitive aspects of electronic text processing*. Norwood, NJ: Ablex.
- Nielsen, J. (1995). *Hypertext and multimedia: The Internet and beyond*. New York: Academic Press.
- Nielsen, J. (1998). Introduction to Web Design. CHI 98, Conference Proceedings, ACM Press, 107-108.
- Nielsen, J., Christiansen, N., Clemmensen, T. & Yssing, C. (2003). Mindtape - a Technique in Verbal Protocol Analysis, HCI International, Lawrence Earlbaum Associates, 188-192.
- Orlikowski, W.J., & Baroudi, J.J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research*, Vol. 2, No. 1, 1-28.
- Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., & Carey, T. (1994). *Human-computer Interaction*. Wokingham, UK: Addison-Wesley.
- Preece, J., Rogers, Y. & Sharp, H. (2002). *Interaction Design: Beyond Human-Computer Interaction*. New York, NY: John Wiley & Sons.
- Shneiderman, B. (1998) *Designing the User Interface: strategies for effective Human-Computer Interaction*. Massachusetts: Addison-Wesley.
- Siegel, A. W. (1981). The Externalization of Cognitive Maps by Children and Adults. i Liben, L. S., Patterson, A. H. & Newcombe, N. (ed.) *Spatial representation and behavior across the life span: Theory and application*, 167-194. New York: Academic Press
- Siegel, A.W. & White, S.H. (1975). The development of spatial representations of large-scale environments. I H.W. Reese (ed) *Advances in Child Development & Behavior*, 10, 9-55. New York: Academic Press.
- Thorndyke, P. W., Hayes-Roth, B. (1982). Differences in spatial knowledge acquired from maps and navigation. *Cognitive Psychology*, 14, 560-589.
- Treese, W. (2003). Why the newspaper has a great user interface. *Attack of the killer virus COLUMN: Putting it together*, Vol. 7, 13-15.
- Walsham, G. (1995). Interpretive case studies in IS research: nature and method. *European Journal of Information Systems*, Vol. 4, 74-81.
- Watters, C. R. & Shepherd, M. A. (1997). The Digital Broadsheet: An Evolving Genre. *HICSS (6) 1997*, 22-29.
- Wurman, R. S. (1989). *Information Anxiety*. New York: Doubleday.
- Åkesson, M., & Ihlström, C. (2006). Designing and evaluating the calm electronic newspaper. In *Proceedings of the Fourteenth European Conference on Information Systems*, Gothenburg, Sweden.

[1] ITEA (03015). DIGINEWS project: Projektbeskrivning. 2005-07-27. URL: <http://www.itea-office.org>

[2] Philips Research. 2005-12-23. URL: <http://www.research.philips.com/>

[3] Tidningsutgivarna - Svenskt dagspress 2004, fakta om marknad och medier. URL: http://www.tu.se/uploaded/document/2004/5/13/Svensk_Dagspress_2004.pdf