Al-Wabil, A., Zaphiris, P. & Wilson, S. (2007). Web navigation for individuals with dyslexia: An exploratory study. Universal Access in Human Computer Interaction: Coping with Diversity, 4554, 593 - 602. doi: 10.1007/978-3-540-73279-2_66 <http://dx.doi.org/10.1007/978-3-540-73279-2_66>

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Original citation: Al-Wabil, A., Zaphiris, P. & Wilson, S. (2007). Web navigation for individuals with dyslexia: An exploratory study. Universal Access in Human Computer Interaction: Coping with Diversity, 4554, 593 - 602. doi: 10.1007/978-3-540-73279-2_66 <http://dx.doi.org/10.1007/978-3-540-73279-2_66>

Permanent City Research Online URL: http://openaccess.city.ac.uk/1051/

Web Navigation for Individuals with Dyslexia: An Exploratory Study

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Abstract. In this paper, we present an exploratory study of the web navigation experiences of dyslexic users. Findings indicate that dyslexics exhibit distinctive web navigation behaviour and preferences. We believe that the outcomes of this study add to our understanding of the particular needs of this web user population and have implications for the design of effective navigation structures.

1 Introduction

Dyslexic users can have problems with web pages that have heavy textual content and poorly built navigation structures. Although web sites utilise various navigation aids aimed at facilitating the navigation process, it is unclear whether these mechanisms are helpful for dyslexics. Dyslexia is a highly individual condition; it can assume several different forms, and its severity can affect people to varying degrees. In our examination of web navigation, we consider a broad view of dyslexia rather than one that concentrates solely on reading and writing difficulties. Common problems associated with dyslexia that could affect web use include weakness in working memory, visual processing, organisation, sequencing of letters and numbers, spatial awareness, motor control, and auditory processing.

Previous studies have investigated the specific needs of dyslexics in their general use of computers. The development of the personal word processing environment SeeWord involved dyslexic users in the design process and highlighted the need for a highly configurable system to meet the varying needs of different dyslexic users (Gregor, Dickinson, Maccaffer, Andreason, 2003). It also showed that using a computer for reading could reduce the severity of the difficulties experienced by dyslexics. Blankfield, Davey, Sackville's (2002) study investigated the accessibility and usability of WebCT for dyslexic students and suggested a set of guidelines for the design of course materials for dyslexics. Petrie, Weber, and Fisher's (2005) MultiReader study examined personalisation and navigation in multimedia reading systems for print-disabled users. It revealed that the readability of electronic documents can be ensured when users are involved in the iterative development process of multimedia web content.

Research has mainly focused on interface design issues concerned with alleviating dyslexics' reading difficulties. However, dyslexics' ability to navigate the web is affected by a range of issues beyond the readability of the text such as the cognitive load of working memory, sequencing and organisation of information. Despite the existence of web design guidelines for dyslexics (BDA, 2004; Evett and Brown, 2005) and attempts to understand their needs in terms of technology to overcome their difficulties (Gregor et al., 2003; Evans and Blenkhorn, 2005), dyslexics' own reports of what they experience when browsing or searching for information on the web have not been examined. In this study, we explore the barriers that inhibit access to the web for people with dyslexia, with a focus on the strategies and personalised approaches that they employ in their web navigation.
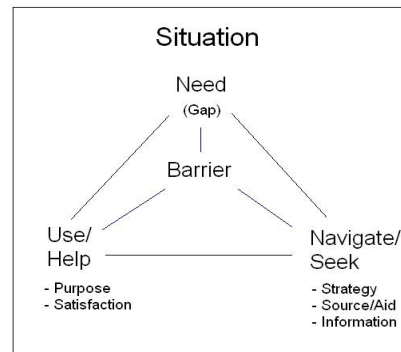

Fig. 1. Process Model of Web Navigation

This study employed Sense-Making Methodology (SMM) in the formulation of research questions and data analysis (Dervin, 2002). The SMM is a user-centred approach to studying and understanding users and designing systems to serve their needs. In our utilisation of SMM, we search for patterns in how dyslexics make sense of what is presented on web pages. Guided by the Sense-Making theory, we developed an expanded process model of sense-making in the context of web navigation (Fig. 1). Based on the main concepts in the model, the following research questions were developed:

1. In what kind of situations do dyslexics navigate/use the web? (Situation)
2. How do dyslexics describe their needs for navigating and finding information on the web? (Need)
3. How do dyslexics navigate the web? (Navigate/ Seek)
   a. What strategies of navigation and information seeking do dyslexics use? (Strategy)
   b. What navigation aids or sources of information do they use? (Source)
   c. What sense do they make of the received information? (Information/meaning)
4. How do dyslexics use navigation aids? (Use)
   d. What is the perceived purpose of the navigation element? (Purpose)
   e. To what extent does the element satisfy their needs? (Satisfaction)
5. What barriers do dyslexics experience in navigating the web? (Barrier)

2 Method

Semi-structured interviews were conducted with dyslexic web users to develop an understanding of their web navigation needs. Ten dyslexics were interviewed face-to-

face about their various dyslexia-related difficulties and how these challenges have affected their use of the web. Also noted were the participants' use of assistive technology, their computer use, and their use of the Internet.

Participants. Ten participants with a confirmed diagnosis of dyslexia took part in the study, nine of whom were female and one male. Their ages ranged between 18 and 49 with a mean age of 29.7. Three of the participants reported having other Specific Learning Difficulties (SpLDs) or disabilities in addition to their dyslexia, two with dyspraxia (difficulties with fine and/or gross motor control) and one with both sensory defensiveness and dyspraxia. Participants' computer use ranged from six to twenty years, with a mean of twelve years. All participants had been online for periods ranging from five to ten years, with a mean of seven years, and all reported being online for at least six hours per week.

Materials. Interviews were audio recorded for subsequent transcription and analysis. During the interview sessions, a presentation with samples of web sites was projected on a SmartTech[1] digital whiteboard. The projected slides presented illustrative examples of web navigation approaches for discussion. Max QDA[2] qualitative analysis software was used for data coding and analysis.

Design. Interviews were conducted in the Interaction Lab of the Centre for HCI Design at City University. Interviewer and participant were seated at a computer with the presentation slides projected on the digital whiteboard. Sessions took from 50 minutes to over an hour each, depending on the amount of information given by the participant. Interview sessions began with a questionnaire designed to collect demographic information and data pertaining to the subjects' SpLDs, their computer and Internet use, their perceived difficulties in accessing web sites, and any adjustments they implement on their computers to make the web more accessible. The text was presented in the recommended font type for dyslexics, Arial 14 pt, and the questionnaire was printed on colored paper, as some dyslexics find the high contrast of black text on white paper difficult to read. Participants were assisted in filling out the form if their condition was severe or they had writing difficulties. The second part of the session was a semi-structured interview. Topics for discussion were introduced with illustrative examples of web sites projected on the whiteboard. Each slide displayed one topic for discussion; topics covered browser features, layout and presentation, web navigation aids and site structure. For each slide, the topic was introduced and participants were asked specific questions, guided by the SMM process model. Participants were encouraged to share their thoughts and personal experiences on the topic. The snapshots of web sites and different examples allowed the interviewer to explore a slide's topic in more depth than would otherwise have been possible and provided participants with visual representations and examples of elements they "liked" or "disliked" that would have been difficult to recall.

The interview sessions with the first two participants were conducted with live Internet access where suggestions of additional web sites from participants were examined in the session. The initial presentation had eleven slides covering the main topics. Analysis of data from the first two sessions revealed that interview questions related to two topics—namely search results and site structure—would benefit from

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[1] http://smarttech.com

[2] http://maxqda.com

more detailed illustrative examples. This resulted in a refined presentation of topics with fifteen slides, which was eventually used in the eight subsequent sessions in the study.

Data analysis involved a number of steps. First, we developed a code list reflecting the research questions. The codes represented the elements in the process model and the related discussion topic. Interview questions for each slide in the presentation were designed to address all elements in the model for that specific topic. The code list was kept flexible to accommodate new issues the participants might raise in the semi-structured interview session. Second, participants' responses were coded using the codes from the final list. Third, answers to the research questions were sought by examining the codes across all cases, in which the units of analysis were the web navigation contexts and elements, rather than individuals. This process was aided by the use of qualitative analysis software.

3   Findings and Discussion

The transcribed interviews produced a considerable amount of information about the problems dyslexics experienced in web navigation. Interview transcripts were examined to identify patterns in dyslexic users' information-seeking and web navigation behaviour in accordance with the SMM process model of web navigation that we developed. Recurring themes of web navigation behaviour emerged: Namely, the following:

- Navigating within a web site and finding content on a web site. Patterns emerging in the use of navigation aids such as sitemaps, site index, search box, back and forward buttons, and navigation menus were examined.
- Keeping track of websites and returning to previously visited web pages. This was examined in the utilisation of browser features such as history and bookmarks.
- Navigating within a web page and finding specific content on a web page. This involved examining patterns that emerged with difficulties in scrolling, layout and presentation of content.
- Navigating the web and finding information across web sites. This was examined in the structure of information in web directories and the use of search engines for information seeking tasks.

In this paper, we report the patterns that emerged in the first theme, navigating and finding content within a web site. Different methods can be used to move around a website. Complex navigation structures were cited as sources of 'disorientation' and frustration by participants. Under this theme we look at patterns that emerged in the use of navigation aids such as sitemaps, site index, search box, back and forward buttons, and navigation menus.

Search Box. Many web sites offer a search box on their home page and sometimes throughout the site to allow users to search for information within the site. We explored participants' utilisation and perception of the usefulness of this navigation aid and the alternative approaches they employ.

All participants reported attempting to use local search boxes in web sites. However, only two of the ten participants perceived them to be useful. One of these

had severe visual processing difficulties and reported using the search box first on web pages before scanning the menus or text on the page. Eight of the ten participants cited using the search box when they are stuck in navigation; most reported using it as a last resort. Participants reported two problems with using this navigation aid, namely: (a) the quality of the results and (b) the fact that spelling mistakes were not accounted for or 'picked up' as in search engines, and especially in cases where participants reported difficulties in spelling. One participant stated, 'I usually have a Word document open at the same time, so that I can type and check spelling errors…because web page search boxes do not recognise my spelling errors.' Some users reported forgoing the site's search box after a few attempts in favour of using a search engine. As one dyslexic student stated, 'It is really frustrating in our university web page search box. I tend to use Google to search that site for information.'

Navigation Trail. Many web sites provide textual representation of navigation paths, sometimes referred to as breadcrumb trails or navigation trails, across the top of the page to situate the current page relative to its parent nodes. As this method is a textual representation and is normally displayed in a smaller font and in a linear sequence, we explored the following: dyslexic web users may have difficulties in accessing smaller fonts, therefore is the navigation trail readable? Does it add to the complexity of the page for those with visual processing difficulties? Does the linear sequence help or hinder their understanding of where they are within the site?

Four of the ten participants were not familiar with navigation trails and had not noticed them on web sites - even web sites they reported visiting quite often such as Amazon and eBay. Interestingly, all four reported - earlier in the questionnaire - difficulties in reading small fonts in their reporting of the adjustments they make to their computers to access the web.

Patterns emerged among the six participants familiar with navigation trails, depending on their key weakness or difficulty:

Not Useful. Two participants did not perceive navigation trails as useful due to lack of visibility. One participant had Meares-Irlen Syndrome (i.e. visual perceptual disorder) and reported experiencing visual stress when trying to read smaller texts. This participant described navigation trails as, '…something I would use if it [were] clear.' The other participant explained, 'It took me a long time to realise what they were. It is not easy to see… I just ignore it.'

Shortcut. Three participants found navigation trails useful in returning to previously visited pages in a single click. However, they did not perceive them helpful in understanding where they were within the site. They described their preference for alternative approaches such as using the back button or jumping back to the home page and retracing their steps, to understand their location. This was evident in comments such as '..I find being able to see the page itself makes it a lot easier to know where I am than to know from the title of the page.' and '..you don't know for sure what those pages are [pointing to the hyperlinks]. When you go back, you can see it visually and recognise it as opposed to the words.' Upon closer examination of the participants' dyslexia characteristics, it was interesting to find that all three reported difficulties in short term memory (STM), one with severe weakness in visual STM (people with this difficulty do not carry a visual image of what they saw for long). This points to the need to consider unambiguous wording of the links and clear descriptions to indicate the destination of the link in the path.

Location. Finally, only one participant found the navigation trail useful in understanding their location within the structure of web site. This participant reported having good visual-spatial skills and described it as one of many approaches used for this purpose (e.g. back button's pull-down list).

In summary, participants with reading difficulties reported having difficulties reading the small text, so they did not bother making use of this navigation aid. Those with STM weakness reported liking it, as it offers shortcut links to previously visited pages. However, when STM is a key weakness, they reported a preference for the back button as it gave them visual snapshots of the pages that they had already visited

Site Maps. Web sites often provide detailed site maps that aim to help visitors understand the site's structure and find desired locations, and as an alternative method of navigating the site. Participants were asked what they thought of sitemaps and whether they found them useful. Different types of sitemaps were displayed on the screen to probe further into what they thought of each particular design. The designs displayed were a bulleted list, a hierarchical tree structure of pages, and a categorised sitemap.

Four of the ten participants reported not noticing sitemaps on web sites, even sites they regularly visit. This is not surprising as Neilsen (2001) reports that users were aware of sitemaps on web sites only 15% of the time. Three participants reported trying them and perceived them as something that exacerbates their disorientation and frustration. Interestingly, all three confirmed difficulties in understanding maps of any kind.

Two participants found them useful only in the case when they were lost and all other search options were exhausted. Reasons cited by participants were the visual complexity, the heavy textual content, and the way information is structured on site maps. Although these problems affect the interaction with web sites for all users, dyslexia-related difficulties seem to exacerbate the problems and inhibit access to the web page content, particularly visual perception difficulties. For example, this participant explained, 'I find those [referring to types of sitemaps] difficult to look at' and had to look away from the screen shortly after each site map was displayed. In probing further, this participant had visual processing difficulties and described, 'The text gets blurred and starts moving around. Sometimes I feel a bit of anxiety coming and I need to take a break.' The one participant who perceived sitemaps to be useful explained, 'It tends to be a lot easier to use things like a site map rather than using a search box, because it can bring up a lot more irrelevant information. It can be quite frustrating to sift through what is right and what is wrong.'

As for the presentation and design of sitemaps, we continued to discuss various types of designs to see what all participants would think of their usefulness and clarity – even those that were not familiar with sitemaps at all, or with a particular design. It was interesting to note that the majority preferred the hierarchal tree structure followed by categorised/block structure for presenting pages in a site map. Most stressed the importance of how text is presented within the map, as one commented, 'I could use any of the sitemaps if the text was right.'

Site Index. Some web sites provide an alphabetical listing of topics and pages in what is generally called a site index. As difficulties in sequencing of letters and numbers are a characteristic of some dyslexics, we explored the perceived usefulness of this aid in web navigation. Nine of the ten participants reported using the index

mainly in the context of information seeking in large web sites. None of them reported using it for browsing new and unfamiliar sites.

Two patterns emerged in exploring the use of this navigation aid. The first was the group of participants that experienced difficulties in the use of the index and tended to use this aid after exploring alternative methods. The difficulties reported were the alphabetic sequencing and in one case spelling and vocabulary, for example one participant stated, 'Sometimes when I am looking for something that I don't know how to spell such as xylophone, I wouldn't find the site index useful. I would give it a couple of tries before trying to find the correct spelling using my strategy of using Word and thesaurus.' It was not surprising that all four participants reporting difficulties in sequencing of letters, numbers, or both, were in this group. For example one participant stated, 'I've used the index and it always confuses me' then added, 'when you are looking for a letter such as 'J', you have to sing the alphabet, or say the alphabet to yourself even though you can spell.' Participants in this group stressed the importance of having a clear and visible alphabet key.

The second pattern was for participants that favoured the use of this aid over other navigation aids. However, they reported frustrations about not knowing which category or under which letter the information is listed under. This is illustrated in this participant's comment, 'I don't mind navigation aids with alphabetic listings. The problem would be in that I hesitate in which letter to use when I am looking for something specific. Like the street St. John, would it be S for St. or J for John?' This points to the need for categorising information to match the user's mental model and to consider listing information under different letters if various titles are applicable.

Back and Forward Buttons. Browsers have back and forward buttons to aid in navigation. The back button allows users to return to pages they have visited recently and was reported by all participants to be one of the most heavily used browser elements. The forward button allows users to move forward in their navigation path after backtracking. Duplicating browser features in web sites, such as including back and forward buttons, adds to the cognitive load of users in trying to learn new methods of navigation (Gregor and Dickinson, 2006). In our study, eight of the ten participants reported a preference for using the browser features and avoiding the duplicated web page navigation element as much as possible to avoid 'learning' the page's navigation scheme.

When asked to comment on their preference for using back and forward buttons, three patterns emerged depending on the participants' key specific difficulties.

1. The buttons are visible and consistently in the same place. As one participant explained, 'I know exactly where they are…I prefer to use things I am familiar with. I will not spend more energy searching for it [the previously visited page] if I know there is a more universal way of accessing it.' This was stressed by participants who had difficulties in reading and/or visual processing: they reported trying to avoid reading textual content in the form of links as much as possible.

2. They allow rapid return to pages recently visited. This was stressed by participants with poor eye-hand coordination who reported trying to minimize movement across the screen and frequently clicking the wrong links and those with visual processing difficulties who find it hard to find the cursor on the screen.

3. They allow the user to retrace their navigation path visually, as one commented, 'I use them regularly and tend to navigate that way. I can retrace my steps with the

back button.' This was stressed by participants with STM difficulties who preferred to see the actual pages to recall the content rather than trying to remember from a visual representation of their location such as in sitemaps or textual links describing the pages such as those in navigation trails.

Navigation Menus. The internal links of a web site generally appear consistently on every page and are called navigation bars or menus. Since the location of main navigation menus can affect the users' interaction with the site's content, participants were shown examples of different sites with left, right, top and bottom menus and asked what they think of different navigation methods.

All participants stressed the importance of having navigation that is consistent throughout the site, regardless of location within the page. Inconsistent navigation in a web site confuses users and may lead them to think they have entered another web site (Shubin and Meehan, 1997). This was confirmed by comments from most participants and illustrated in a statement by this participant explaining how inconsistent navigation causes frustration, '…because when you open up any page, you know where everything is…either on the left, top, or right hand side of the page. You have your main function there [pointing to the navigation bars in a web page]. You know something is going to be the same - it is something regular. A lot of web sites like to make themselves very individual and different and new on every page, but that is confusing.' It was noted that participants reporting difficulties with scrolling stressed the need to have the whole of the navigation bar visible at all times, as this one stated, 'I like for the navigation bar to always be there, wherever I move….I don't think I have a preference between down, side, top or both as long as it is visible.' This points to the need for employing a technique to keep navigation visible at all times, thus avoiding the scrolling issue.

Dynamic navigation elements. Recently, many web sites employ dynamic navigation schemes such as collapsible lists, menus with hover elements and multi level drop-down navigation. There was ambivalence from dyslexic participants on how they perceived the usefulness of these navigation schemes. Two trends emerged in the experiences of dyslexics with these menus.

Some participants, mainly the ones with poor eye-hand coordination, reported infuriating experiences in trying to navigate with dynamic menus, particularly when menus are sensitive to cursor movements. For instance one participant stated, 'Sometimes you scroll over something and you are still trying to read it when something else pops up or the original [menu selection] would disappear if you lose focus.' Another participant added, 'It is annoying when menus close or disappear when I lose focus. It is something that happens a lot in my case.' This was stressed by the two participants with dyspraxia as they described, '..with my dyspraxia I find it [dynamic menu] difficult to use as it is hard to hold the cursor' and '..they sort of jump and disappear you can't click over it. When you can't click over what you want, it is quite frustrating.' This points to the need to offer users some control over this type of navigation, as one participant suggested: 'The ones you can click down and stay, they are fine. It is just the ones that are very sensitive to movement are quite difficult.' It is thus important to keep the active navigation section expanded when the user is moving to another part of the menu.

On the other hand, users with reading or visual processing difficulties had positive things to say about their use of dynamic menus. Reducing the visual complexity of the

page was cited as the main reason for their reported preference for this type of design. Participants commented, 'I like the idea here. It is not cluttered. If you need to navigate, you don't get a load of information that you do not need.' Another reason is that it allows them to explore navigation routes without having to actually travel that path. Thus, reducing the chance of them getting 'lost' in the web site as one described, 'It saves you having to go to different places or be so specific about what you want before seeing what else is out there… If you don't know exactly what you want, but you've got some sort of idea of what you want, then it gives you another option of exploring before you move.' This indicates that presenting information gradually and in smaller chunks (be it navigational information in this case) is a good design option if presented in a more stable way.

In both groups, two difficulties were cited by participants in their use of dynamic menus. First, the readability of the text when the menu bar is semi-transparent was cited as difficult by seven out of the ten participants because the background was perceived as a distraction while reading. Second, the readability of the text and background elements when the menu pops up over existing text, as this participant described, 'I find that [dynamic menu] helpful...you see step-by-step exactly where you are going. What I don't like is when it comes up over existing text…I have difficulty in reading and letters staying in the same place.' Comments by participants suggested that these menus exacerbated the difficulties experienced by dyslexics in tracking text on the screen.

4 Limitations and Future Research

In this study, we interviewed a relatively small group of individuals. Participants were recruited from a convenience sample of people with dyslexia in the area in which the study was conducted. Moreover, interviews produce accounts of behaviour and reported experience rather than direct observations. However, the aim of this exploratory study was to gain insight into web use by dyslexic individuals and to provide a better understanding of their needs, rather than draw strong conclusions about their web use or for generalising results. This exploratory study yielded results suggestive of the presence of patterns in navigating and scanning web pages for information by dyslexic users that may be different from typical web users. This has set our research agenda for further investigating the visual scanning of web pages by dyslexic users by examining their visual attention and web exploration through eye tracking.

5 Conclusion

This exploratory study examined web navigation experiences of dyslexic users. Using the Sense-Making Methodology to elicit user responses proved a useful approach for identifying the diverse range of navigation problems encountered by dyslexic web users that can contribute to frustration and disorientation on web sites. This study demonstrated that dyslexic individuals face considerable barriers when attempting to

use the web beyond those faced by typical web users. In this paper, we report patterns in preferences and behaviour in the context of navigating within a web site. Patterns emerging in the use of navigation aids such as sitemaps, site index, search box, back and forward buttons, and navigation menus were examined. Our findings show that despite the existence of many web sites conforming to accessibility standards, the web still suffers from many deficiencies and problems in support for navigation around its information space, particularly for users with specific learning difficulties. We believe that these findings add to our understanding of dyslexic users' needs. Also, by detailing experiences of real users, we hope that the outcome of this study will encourage designers and developers to think wider than their assumed audience.

References

1. Blankfield, S., Davey, J., Sackville, A. (2002) Supporting students with dyslexia in the effective use of C&IT in their academic studies. Edgehill University, Teaching and learning development unit. Available online: http://edgehill.ac.uk/tld/research
2. British Dyslexia Association (2004). Dyslexia Style Guide. Available online at: http://www.bdadyslexia.org.uk/extra352.html [date of access 13.01.06]
3. Dervin, B. (1992). From the mind's eye of the user: the sense-making qualitative-quantitative methodology. In Glazier, J. and Powell, R (Eds.) Qualitative research in information management. (pp 61-84). Englewood: Libraries Unlimited.
4. Evans, D., Blenkhorn, P. (2005). Designing a Screen Reader for Fully Sighted Users. HCI International 2005, Las Vegas, Nevada.
5. Evett, L., Brown, D. (2005). Text formats and web design for visually impaired and dyslexic readers – Clear text for all. Interacting with computers, 17, 453-472.
6. Gregor, P., Dickinson, A., Maccaffer, A. Andreason, P. (2003). SeeWord – a personal word processing environment for dyslexic computer users. British Journal of Educational Technology, Vol 34, 3, pp. 341-355.
7. Gregor, P., Dickinson, A. (2006). Cognitive difficulties and access to information systems: an interaction design perspective. Universal Access in the Information Society..
8. Marchionini, G. (1995). Information seeking in electronic environments. Cambridge, England: Cambridge University Press.
9. Nielson, J. (2001) Sitemap Usability: Design guidelines based on usability studies with people using site maps. Available online at: http://www.nngroup.com/reports/sitemaps/
10. Petrie, H., Weber, G., Fisher, W. (2005). Personalization, interaction, and navigation in rich multimedia documents for print-disabled users. IBM Systems Journal, Vol 44, 3, pp. 629-635.
11. Shubin, H. Meehan, M. (1997). Navigation in Web applications. Interactions, 4 (6), pp.13-17.
12. Sweller, J. Cognitive load during problem solving: effects on learning. Cognitive Science, 12, pp. 257-285.
13. Tauscher, L. and Greenberg, S. (1997). How people revisit web pages: Empirical findings and implications for the design of history systems. International Journal of Human-Computer Studies, 47, 1, pp. 97-138.