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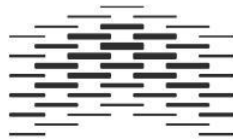
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Universal Design of ICT

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Enhancing Accessibility through User-Controlled Adaptation: Case of Library Search Tools

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Preface

The main target group for this paper is web designers, librarians and those with an interest in user-controlled adaptation, development of accessible search interfaces, or universal design.

The main topic in this paper is user-controlled adaptation, which is the concept of allowing users of websites to adapt the site to their own specifications so they can improve accessibility for themselves. This is due to the need for different solutions to solve accessibility barriers for people with different disabilities, and even the same disabilities, as everyone has their own preferred way of dealing with it, or use a specific set of tools. Seeing as there does not exist a universal solution to this problem, this paper aims to test if allowing the users themselves to adapt the site will improve accessibility.

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Abstract

The purpose of this thesis was to gain an improved understanding towards the concept of user-controlled adaptation and its applicability in terms of accessibility and usability in ICT. While it is a relatively unexplored area within the concept of universal design and human-computer interaction, the results gathered are promising in relation to future applications of this approach when designing websites.

The scope of this project was to understand how user-controlled adaptation could be used to improve accessibility and usability for users with disabilities. However, it was decided to limit the scope to focusing on library Resource Discovery Tools(RDTs), and limiting the user group to people with print disabilities. This decision was made to make the project realistically possible to complete within the outlined timeframe and the amount of resources available.

Therefore, the research questions were limited to the following two questions:

Would giving users control over the presentation level contribute to improve the usability and accessibility of RDTs for users with print disabilities?

How can developers facilitate for users controlling the presentation level of a Search interface?

To answer these questions, it was decided to adopt a qualitative approach that would base itself around gathering data through a prototype which was tested by the participants, a comparison between two existing solutions followed by interviews. Then a thematic analysis of the gathered data was used to draw conclusions from, which then led to suggestions for future work as well as for designers of future library RDTs.

It was discovered that there was much room for improvement in existing RDTs, as the prototype spurred lots of feedback and comparisons to existing library RDTs by the participants, and that the RDTs would benefit from implementing several functions, most of all the ability to filter before performing a search and being able to adapt the presentation of the search results to prevent an information overflow and needless searching through large blocks of text to find the relevant information.

The conclusions made after this study is that more research is required, but this approach towards accessibility seemed promising, especially in such an information-heavy interface as library RDTs. Being able to alter the presentation and limit the amount of unwanted information being given to the users was deemed by the participants to be a great feature. Some of the suggestions for future designers of RDTs, or websites that use similar concepts, are to limit the information exposure to the user, and to provide clear instructions for functionality. If possible, it is preferable to grant the user control over the information presentation, so they can decide what information they find necessary.

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1 Introduction

Websites in general are often amazing to behold, especially for those of us who remember the early days of the internet. Normal and bland HTML-sites with little to no design were the standard back then, with some few exceptions usually found with the larger corporations. Then CSS was invented, and design started becoming an increasingly bigger part of websites. With focus on making websites easier to navigate and information more accessible, the average user started spending more time on the internet and started to find it to be their main method of obtaining information and knowledge. While this is considered the current state of affairs, and the internet is generally considered freely available to anyone, it is not accessible for everyone.

The internet has become a medium for web-based services including information services provided by libraries. Today's libraries provide their users access to a multitude of electronic resources stored at different geographical locations via nothing more than a keyboard and a search interface. Therefore, the accessibility of the information resources is now longer only dependent on the quality of the ebooks, journals, etc. in the databases. It is also dependent on the quality of the search interfaces which are designed to provide users with information resources. There have been several studies that have examined the accessibility of library websites and databases by evaluating their conformance to established accessibility guidelines. However, studies also show that the same guidelines do not inherently solve all accessibility issues. This study has selected some recommendations from past studies on how to make library search tools more accessible and attempted to examine their practicality. Next, this chapter discusses the problem statement, presents the research questions, informs of the design concepts utilized, as well as possible alternative approaches, and explains the organization of this research

1.1 Problem Statement and Research Questions

There's one thing all users of the internet have in common, and that's their search for information. Every user of the World Wide Web is looking for some sort of information, and the best way to gather information is to search for it using a search interface. The most famous

search interface in the world would perhaps be Google, as the word "googling" or "googled" is considered a verb now. But when one looks for research papers or other scholarly articles, it could often be better to search a library database for it. Libraries traditionally store information resources of various types, genres etc, systematically organized to be accessed via search tools, such as Resource Discovery Tools (RDTs). Especially when you are trying to gather information pertaining to an educational subject or project, as source criticism plays a major part in writing academic papers or project reports. And while it is often quite easy to access a library's online database and gather the information you desire; the situation can be quite different if you have a disability or an impairment.

Lee in 2005 (as cited in Tatomir & Durrance, 2010) discovered that those pursuing scholarly topics whom have a visual disability find that approximately 50 to 80 percent of printed and visual materials remain inaccessible to them. Though the study cited is older and there have possibly been some breakthroughs since then, it provides a glimpse of problems people with print disabilities might have. "Generally, a print disability may be defined as the inability to access print due to a visual, perceptual, or physical disability" (What is a print disability? N.D.) There are also issues on library resource discovery tools (which are also called library discovery layers). A library RDT is something that "provide an improved end-user interface used by researchers to submit queries, receive results, and make content selections. " (Breeding, 2015). In simplified terms, a library RDT is the interface end-users use when they interact with a library's database to access their resources. The RDT is what handles every search made by, and what presents relevant resources to users.

With the focus on improving the accessibility of library RDTs through user-controlled adaptation, two research questions have been proposed:

Would giving users control over the presentation level contribute to improve the usability and accessibility of RDTs for users with print disabilities?

How can developers facilitate for users controlling the presentation level of a Search interface?

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1.2 Accessibility and Websites

While one might think that availability and accessibility meant the same thing, they do not, especially not in regards to ICT. While the internet is generally available to everyone, meaning websites can be accessed by pretty much any user (barring exceptions, such as login-required sites, sites behind firewalls etc.), these sites are not necessarily accessible to everyone. The term "accessible" in ICT means something that everyone can access and utilize equally, or at least with an equal opportunity to achieve their desired goal (W3C, 2005).

Users that suffer from disabilities or impairments are the ones mainly struggling with accessibility. This can often be solved through a specific kind of design, namely Universal Design (UD). This type of design bases itself around the concept of designing products and environments so that any person, regardless of age or ability can use it (Persson et.al., 2014). This can be done through an abundance of techniques or guidelines, but the most widely known guidelines are the Web Accessibility Initiative - Accessible Rich Internet Applications Suite (WAI-ARIA), which is often used to help Assistive Technology (AT) navigate the site for the user, and the Web Content Accessibility Guidelines 2.0 (WCAG) guidelines, which are based around making general changes to the design so as to enable a more accessible and usable site for users both with and without AT.

Yet that is not all there is to UD. UD is much wider in scope, as it is not limited to disability, but instead also encompasses different aspects of the human existence.

The World Wide Web Consortium (W3C) (W3C, 2010) define universal design as "[...] designing products, such as websites, to be usable by everyone to the greatest extent possible, without the need for adaptation."

This means that the main goal to achieve when attempting to make a universally designed website, is to allow for as many users, regardless of their situation, to use it to the "greatest extent possible, without the need for adaptation". Kelly et.al. (2009) state that "such technical attributes alone cannot, as has been shown, solve all the accessibility problems".

Web Adaptability is a mainstream concept as distinguished from those focused specifically on accessibility for people with disabilities. It encompasses the disabilities that are occasioned by contexts, recognizing the inclusive "social" definition of disability, and adopts the curb-cut approach to accessibility that has something for everyone (Kelly et. al., 2009).

This project focuses on the concept of adaptability, and will focus on testing the possible effects of user-controlled adaptation.

Adaptation is a term used for altering the design or functionality of a site based on its user and their needs. Things like recognizing a user with visual impairments and thus increasing the magnification on the site automatically is a form of adaptation. User-controlled adaptation is simply having the user control the adaptation to as large an extent as possible.

Lima et.al. (2012) state that the less effort required by a user, the more accessible an environment is. In this case, the environment is the search interface. Based on this, we can state that even though adaptation is defined by W3C as unnecessary for a universally designed website, adaptation can actually lead to a more universally designed website. The study also state that while the WAI/W3C guidelines are definitely useful, "Subjective aspects and circumstances applicable to specific groups of people with disabilities beyond the scope of W3C/WAI are not included in those guidelines" (Lima et.al. 2012). This further proves the need for user-specific adaptation, which is easier to do on a user-by-user basis, which in turn is solved by granting the users themselves the options they need to adapt the site to their own preferences and/or needs.

1.3 Designing Accessible Search Interfaces

The general concept of Universal Design is interestingly enough often things that many outside of the field consider to be "common sense" when explained to them. Some examples of this "common sense" are ensuring an easily readable font is used or having proper coloring so it's easier to differentiate the foreground and background. While the field itself does go more in-depth than what "common sense" usually does, it is still grounded within that basic of "common sense" in terms of designing for visual impaired users or users of AT, as well as a host

of other more specific impairments. However, when the design starts to focus more on smaller groups of users with specific impairments, you start finding some problems. While X solution could work well for Y user group, it can also cause some issues for Z user group. For example, making the entire website in high contrast colors would be suitable for users with a certain type of visual impairment, but would alienate most others as it is considered extremely uncomfortable to view a website in high contrast colors.

Based on studies he reviewed, Beyene (2016) concluded that designing an inclusive library RDT would be challenging because one would have to address several issues, not just in the interface design, but also issues with the results presentation and resource description. Comeaux & Schmetzke (2007) state that "Library web pages serve as gateways to a broad array of online resources and services. Barriers in these gateways, if severe, keep people from ever reaching the desired resource or service." If the barriers found in library RDTs are too severe, it's users will look for another method for gathering information, which can both drive users away from library RDTs and lead to an unnecessary amount of frustration during the use of those services.

Different studies have indicated that library search tools are difficult to use when compared with Internet search engines (Yoon, Hulscher & Dols (2016), Rector & Ghaphery (2008)). Therefore, internet search engines like Google have become the favorites to many users who seek access information resources (Beyene, 2016). This shows that the design of search interfaces affects the usability of not only the interface but also the multitude of information resources behind the interfaces which libraries spend a lot to maintain. In that sense, a good search interface design is the key to ensure the findability and usage of books, ebooks, journals, and other information resources. In other words, improving the accessibility and usability of the search interfaces is crucial for improving the usability of the thousands of information resources found behind the interfaces.

The efforts to improve the efficiency of library catalogs have led researchers to emulate Google in introducing web-based resource discovery tools (RDTs) that provide the user a single point of access to resources available in different databases and repositories. The interfaces have

evolved from displaying multiple search boxes linked with Boolean operators to a single search box that supports both full-text and keyword based searches. However, the usability and accessibility studies conducted on library RDTs show that they are still too complex to be used easily, especially by people with disabilities. The task-based evaluation of a library RDT by users with print disability (Beyene , 2016) showed several aspects of the search tools that makes them difficult to be used by those groups of users. The difficulties range from display issues such as background and foreground colors to presentation of search results and then to the eventual navigation to retrieve a particular resource. The study has shown variances in needs and preferences even among people with similar disabilities. This study has also shown that library search tools should once again attempt to emulate Google, this time Gmail specifically, to provide different views (standard and simplified) to their standard users and to those who want a simplified view of the interface.

For this project, we will introduce options and preferences that will allow the user to control the adaptation of the site, specifically being able to decide on which information they want to be shown by the search results.

1.4 Alternative Approaches

As mentioned in pt. 1.2, there exists approaches towards designing accessible and universally designed websites, specifically the WAI-ARIA suite and WCAG 2.0. While following these have proven to make websites more accessible, they do not inherently solve the problem of accessibility in and of itself.

Considering how widespread and widely accepted the WCAG is, one might believe that most sites that are follows and fulfills the WCAG would be considered fully accessible, but this is not the case, as stated by Kelly et.al. (2009). They inform in their introduction that there's been found limitations in the WAI model itself, and the guidelines it's comprised of (Kelly et.al., 2009). They have also concluded that requiring full conformance with the WCAG, Authoring Tool Accessibility Guidelines (ATAG) and User Agent Accessibility Guidelines (UAAG) has "failed to have a significant impact" (Kelly et.al., 2009).

While Lima et.al. (2012) presents six distinct approaches to website accessibility, namely Accessibility by Sassaki, Universal Design, W3C/WAI, Access for All (AfA), Petrie e Kheir Research, and Accessibility and Behaviour Seeking by Carvalho, this project aims for an adaptation approach, more similar to the Web Adaptability approach suggested by Kelly et.al. (2009).

This project aims to propose a solution where developers and designers can grant users the ability to alter the appearance, and to some degree the functionalities, of web pages to suit their accessibility needs, using library search interfaces as the basis to test the plausibility of this solution.While this project will also focus on a single user group, the intent is to find a technique for allowing users to alter web sites in such a way as to allow any user to adapt the site themselves, allowing any assistive technology, or the user themselves, to easily perform their goal. This will be done based on the description of the three levels on which adaptation can occur by Paternò & Mancini(2000), namely the presentation, information and navigation levels. Beyene (2016) states that there is a vast difference between users that have the same disabilities, and they can often prefer completely different methods of accessibility to solve the accessibility problem. Due to this, it would be best to include them into the design process. As this problem involves the users with disabilities both as the main user group for the prototype, as well as the main operators of it, it would be a good idea to develop the prototype by following a user-centered design approach (Fuglerud et.al., 2015).

While the literature review performed did not yield any existing solutions that did exactly what this paper proposes, there were two existing solutions that seemed to attempt similar things by following the adaptability model (Atkinson et.al. 2012). These two solutions were the Accessibility Toolbar (ATbar), found on atbar.org, and the homepage of Funka.com. From their own page:

Funka works with accessibility in digital interfaces in regards of content, design and technology, web, ICT and documents in all possible formats, apps, ticket machines and ATMs, but also signs and other kinds of information (About Funka, n.d).

As for ATbar:

The ATbar, with its user preferences for the way individuals wish to interact with web pages, was originally developed in 2009 as 'StudyBar' by a team in ECS (Electronics and Computer Science) at the University of Southampton as part of the Web and Internet Science Research Group. (About ATbar, 2011)

These two solutions will be part of this project, and will be used for data gathering by comparing the two solutions to each other, as well as the prototype to be made. More on this in pt. 3.3.

1.5 Organization of the Thesis

This paper will present a literature review (pt. 2), followed by the methodology used for the study (pt. 3) before presenting the results gathered (pt. 4) which are discussed in pt. 5 before finally reaching a conclusion in pt. 6. Following the conclusion is the reference list used for this paper and the appendices, consisting of the consent form, interview guide and full transcripts of the user tests.

2 Literature review

Kelly et.al. (2009) have claimed that many users cannot benefit from a WCAG conformant website. They state that this might be due to limitations on the user's side, through either their skills, browsing or AT. They further state that one of the main limitations with the WCAG is that such technical attributes alone can't solve all accessibility problems, and that the WCAG as such is not enough to ensure accessibility of a website (Kelly et.al., 2009).

It is important that user interfaces can be adapted in such a way as to better support the achievement of different goals by different types of users (Paternò & Mancini, 2000). But how does this work when the different users have the same goals, but are not able to interact with the interface in the same way? This is often the problem with people with print disabilities when they attempt to retrieve information through an RDT. Dermody & Majekodunmi (2011) state that several studies show that students with disabilities experience unique challenged when they access online library resources. They continue with stating that students who rely on

screen readers experience barriers that those interacting with the interface without the screen reader would never notice. These barriers are attributed to the rich graphical interfaces and complex web designs of proprietary online databases (Dermody & Majekodunmi, 2011).

Dermody & Majekodunmi also refer to one study that surveyed users who were blind or visually impaired and found that design had the greatest impact on the accessibility of the databases named in the survey. Their own survey which surveyed students with a vision related disability discovered that the largest reason for students not completing the tasks set was due to accessibility errors encountered while searching, where one of the biggest seem to be inaccessible PDFs. This is usually due to the PDF being registered as an image and not text, which means screen readers are unable to identify the text and read it for the user. Due to this, html full text is considered to be the most accessible and preferred platform by the disability community (Byerley et al., 2007).

In today's society, accessing information is considered a necessity for most people. A lot of people will use some form of RDT when trying to retrieve information. While this can often be considered simple by the average users, most users with a form of disability often struggle, as they have to overcome different barriers or need to use AT to access the RDT. It's worth mentioning that RDTs are available as both commercial and as open source products, and depending on their design, their interfaces could include advanced search options, options for filtering search results, search term highlights and more (Breeding, 2015). While there already exist several implementations for adapting websites to users' characteristics, most of these are focused on a single user group (Valencia et al., 2013).

Library search tool development is driven by a need to improve usability, but considering the demands of universal design and the benefit in reaching as many potential users as possible, accessibility is also an important issue to consider along with usability (Beyene & Ferati, 2017). These issues can be considered of equal importance when considering the benefit of improving accessibility along with usability. This benefit will likely be a higher amount of visitors and repeat visitors for the system/site as more users will be able to properly access the site and

utilize the features and functionalities that they previously were unable to due to accessibility barriers. The proposed solution should increase the accessibility of these systems/sites if used.

2.1 Library Resource Discovery Tools

Libraries have evolved from keeping analog catalogs over their content to their current web-based resource discovery tools which implement a simpler interface for users to submit queries, receive results and choose their desired content (Breeding, 2015). Most include features such as search interfaces and the corresponding results, and some also include links, visual cues to the results and the tools to make a faceted search for the wanted content (Breeding, 2015). This digitalization is a method for libraries update themselves to allow users easier access to the information resources present in the libraries.

There are studies that show that library search tools are much more difficult to use when compared to internet search engines, such as Google or Bing (Yoon et.al., 2016). One study revealed that graphically rich interfaces and complex web designs could pose barriers to users with a need for screen readers (Horwath, 2002). Beyene (2016) further supports this by confirming the presence of improperly labeled links.

There are further possible problems regarding the resources themselves, as many of the resources available from the RDT are not accessible to users who need to use screen readers, or the content might even be unavailable due to a paywall (Beyene, 2016). There have been suggestions made to add a metadata field to describe the accessibility of a resource, such as it being accessible to screen readers or not, and that this would help a user to decide on which resource is suitable for them (Beyene & Godwin, 2018, Nganji & Bradshaw, 2015).

These examples shows that to ensure accessibility through the library search tools, it is important that the designer of the search tool comply with accessibility guidelines, but it is also important that the librarians and the database vendors follow similar guidelines when organizing the database.

2.2 UD principles

"There are various types of users, who want to perform various tasks, in various contexts, that can access the same Web site. Thus it is important to have user interfaces able to adapt to these different user requirements to facilitate the accomplishment of the desired goals." (Paternò & Mancini, 2000). As they stated, while many users can visit the same site, they often have different reasons to. This means that if a website is supposed to cater to several different types of users or needs, it needs to be adaptable in some sense. While Paternò & Mancini's work are based on content, this statement also holds true for universal design (UD). Though with UD in mind, this statement is also true when different users access the same site with the same goals, if one or more of these users have a form of disability.

"For users with disabilities, "design in the online world matters as much as it does in the physical world"" (Comeauz and Schmetzke, 2007 as cited by Tatomir & Durrance, 2010). Students who rely on screen readers experience barriers when accessing information due to the rich graphical interfaces and complex web designs of proprietary databases (Horwath, 2002 as cited by Dermody & Majekodunmi, 2011). Based on this, the design of the RDT will be crucial for the accessibility of the site, and is thus one of the highest priorities. The interface will need to be simple and easily accessible for assistive technology. "Overpopulating" an interface with different features is a typical interface design issue that causes both usability and accessibility problem for users, in particular those with visual impairments or print disabilities who might use various assistive technologies (Beyene & FeratiCooper et.al.(2012, as cited in Fuglerud et.al., 2015) states that despite the increased focus on accessibility, through both politics and legislation, there are still significant barriers for people with disabilities when trying to utilize web services or web products. This is also backed up by Kelly et.al.(2009) who analyzed the concepts of web adaptability and criticized the Web Access Initiative (WAI) model for its failure to solve all accessibility problems, and thus conformance to the model wasn't enough to ensure the accessibility of a web site.

The adaptation approach used in this project attempts to add options to the user to ensure their own needs can be met, thus improving accessibility. It will also aim towards making a

search interface that, instead of presenting the results in a specific way, will allow the user to choose the method of presentation. This will hopefully prove to cover the gaps in the WAI model, or at least be a step towards a more wholesome solution that will be able to increase accessibility for everyone.

Fuglerud et.al. (2015) says that a one-sided focus on compliance with the WCAG one cannot ensure full accessibility, and also run the risk of missing out on potential benefits and opportunities that could result from a more user-centered approach. A user-centered approach means that the developers consider the user as the main focus when developing a system or a website, and that they try to emulate the user and their experiences when using the site, thus discovering potential problems they might otherwise not have been found (Fuglerud et.al.,2015). This is taken a step further by often including users in testing the system or web site before they complete it, so they get feedback that can be used to improve it before the final release.

For this project, the focus was on one specific user group, namely those with print disabilities and their interaction with library RDTs. The term "print disability" is generally used as a blanket term for disabilities that cause problems for the users when utilizing printed text, either due to some form of learning/physical disability or visual impairment (Blansett, 2008). The aim is to improve the accessibility of the search tools in regards to users with print disabilities and explore how granting them control of the presentation level of the website would help accessibility of search interfaces. The presentation level is "where it is possible to differentiate the type of media, the layout, the attributes of the perceivable elements (such as font type and size)" (Paternò & Mancini, 2000).

Other potential design elements that can prove to be an accessibility issue are: suitability of background and foreground colors, font type, size and intensity, as per the study Beyene performed in 2016 (as cited in Beyene & Ferati, 2017). This will both be useful for the initial design of the prototype, as well as knowing which parameters the users should be allowed to alter when granted control of the presentation level.

Paternò and Mancini have stated that they prefer to leave full control to the user when using an adaptive support. While this project aims for an adaptable solution, this is still relevant. They claim two ways of performing this, namely allowing the user to explicitly indicate when to activate the support, and having the system itself provide suggestions based on the user interactions and leaving it up to the user if they wish to allow the system to show this information (Paternò & Mancini, 2000). This solution will employ the first way, namely having the user explicitly indicate when to activate this support, so as to grant the user full control of this adaptability. They also express the importance of informing the user about these changes through feedback for the user, as well as granting the user control of these choices that will be done by the adaptive system (Paternò & Mancini, 2000). This is also a general principle within universal design of ICT and will be prevalent throughout the solution proposed.

It is worth noting that RDT interfaces are often rich with functionalities that could offer alternative ways of searching and filtering, yet this abundance of features have been found to be "overwhelming" or "confusing" for some users (Beyene, 2016) Beyene also stated out that RDTs need to be designed to emphasize simplicity and flexibility for addressing the needs of various groups of users. One of their participants with a visual impairment suggested that the examined system would be accessible and usable to all if it emulated Gmail by providing a standard html view, as well as a basic html view, devoid of most design. The participants of Beyene's study also stated that they would prefer it if RDTs could offer them what they wanted simply and with minimal effort on the user's part, as well as expressing a desire for limiting their activities between the search box and the corresponding results list. There also seemed to be a preference to getting the alternative content (PDF, HTML, audio etc.) availability of the results listed so the participants could know if the content was in a format that was accessible to them (Beyene, 2016).

When developing using user-centred design, activities such as focus groups, field observation, customer interviews etc. are used, and the most common evaluation techniques used to ascertain the usability and accessibility of a site are usability testing, testing if the site is compliant with relevant guidelines, and expert evaluations (Fuglerud et.al., 2015). These are all activities that will need to be incorporated in the system to ensure improved accessibility. As

for the current project, the main focus will be on establishing a baseline for the preferences desired by the users. It's also recommended to involve users with disabilities in the process, as part of the user-centered design (Fuglerud et.al., 2015). It's also important to consider having an interdisciplinary design process, which allows the developers to take the whole usage context into consideration, as well as involving a wide array of users (Fuglerud et.al., 2015).

2.3 Potential problems

Majors(2012) performed a study looking into vendor-provided discovery interfaces from a User Experience (UX) standpoint. In this study, the participants reported several problems they encountered. The most noteworthy was the problem with library jargon and practices, namely that library terminology was a significant obstacle and that the nicknames given to library catalogues were found to be non-intuitive, and the need to log in to perform a search, which was considered by the participants to be an unacceptable hurdle. The participants also had several suggestions for improvements, such as adding an advanced search option, which would allow participants to pre-coordinate limits of one sort or another or making it easier to find and use existing options, which means they struggled to find or use existing features. They also wished for an increased reliability of full-text links, as there were several links for journal articles in the results with supposed links to full-texts of the article that would not resolve properly. They also wished for richer metadata, and the ability to limit the search thereafter, so it would be easier to find the resources wanted in the platform most accessible to them, as well as context to be provided so it is clear what has been searched and what has been excluded from the search, and an easier way to get help when needed (Majors, 2012).

Majors also noted down some of the participants' behaviour, and took note of how participants treated a single search box as a "Google"-like search and would use the search interface in a similar way to Google's own interface, using many features and functions that were not supported by the discovery interfaces testet. This lead to the discovery that the discovery interfaces did not alert the users about which functionalities did not work, something that seemed to make the experience more confusing to the participants, who had to resort to using a trial and error methodology to figure out which of the user tasks that were actually

supported. Also of note, the participants generally scanned at least one page of search results in full before selecting which resources to look at more closely. Very few participants bothered to move beyond the first page of results, often opting to refine and reiterate the search instead of looking at the next page of search results. This can be interpreted as users utilizing the search feature of RDTs as though they were the same as Google's. This means we must either inform the user about which functions are existing and can be utilized, as well as how to use them, or we must imitate Google's own search engine so as to grant users the possibility of searching an RDT as if it was a Google search.

Majors (2012) also reported that some participants spent a considerable amount of time looking around for features that they hoped or presumed to be present which would allow them to complete their task. This indicates a need for clarity in explaining the functions that users can utilize when using the system, and it should be taken into account when explaining both the parameters that the users can change and the functions available to them when using the search interface.

The study conducted by Beyene(2016) showed that it could be a mistake to profile users by their disabilities, as two users with similar impairments would have opposing preferences on the same thing. There are different preferences for each user, even when they have the same impairment (Beyene, 2016). The same study stated that "In general, usability issues involving RDTs are related to interface level issues [...], end-user features [...] and resource description and organization [...]." The problem areas stated by this study will need to be addressed during the project, as it will have a large impact on both the usability and accessibility of the prototype.

2.4 Proposed changes

Paternò and Mancini (2000) identified two different type of adaptation in their paper, namely the adaptable and the adaptive systems. The adaptable system allows the user to define some parameters and the system will then adapt accordingly, while the adaptive system will adapt itself to the user based on the information gathered. While the latter is the easiest for the user,

as they themselves need not input parameters or make any effort to adapt the site, it can be problematic to users with cognitive impairments, as well as confusing for normal users if the change is sudden and visible to the user. The aim of this project is to allow each user to ultimately control the layout of the site themselves, so they can alter the site to fit their own needs. This would also require the user to get control of the two other levels of the web site, namely the information (content) and the navigation (links) levels (Paternò & Mancini, 2000). We propose an adaptable system where the user will alter the parameters for the three different levels in such a way that they themselves can adapt the site to fit their own needs.

It should be possible for users to know what platform their search results are available in. It would seem prudent to inform users about this, so they can know if the content will be accessible to them. While presenting the user with as much information as possible is a general goal for information-based websites and tools, such as RDTs, it is important to note that ""too much information" would frustrate some users" (Beyene, 2016). Granting users control of the information level of the website could potentially eliminate this problem. While such control could prove beneficial in some cases, it can also be challenging for some users, especially if not explained properly. Some users might not understand the jargon used when altering the parameters, and as such might make mistakes and become frustrated as a result. This makes the naming of parameters crucial when allowing users to control any level of the website.

Regarding the accessibility of platforms, it has already been said that HTML full-text is considered the most accessible. While this is true, there are still other forms of electronic publications that will not be available as such. One of these are the electronic books (e-books). E-books are in essence normal books that are digital. They are considered text and are generally readable by screen readers but libraries often have some problems related to them. There is often an absence of limiters or facets in many RDTs, thus making it hard to limit the search by filtering the results based on research methods, statistical techniques etc. as these are often stripped out by RDTs that have no way of handling them (Walters, 2013). This can cause a problem for people with disabilities, as they often desire the ability to narrow down searches due to the effort required by them to verify each source individually.

Granting users control of the adaptation of the web site can give useful possibilities, but it is also important to note the possible drawbacks, namely that it can confuse users if they are not properly informed that the site is adapted or the system changes its behaviour, especially if the user is not aware that the changes are intentional (Paternò & Mancini, 2000). This is especially true if the user does not ask for these changes themselves. While this could be considered a problem for normal adaptive solutions, the adaptable solution this project aims to create will not have this problem inherently as the user will be responsible for any changes themselves. The risk remains that the user will be unaware that they themselves are making any changes and this risk must be minimized by adding sufficient information to the user about what the solution aims to achieve, how it will do this and how the user gets control. The user will also be granted limited options for adaptation, so as to ensure both the security and integrity of the web site as well as the user experience. Limiting the options also serve to lower the experience required for the user, as well as serving as a way to make the experience less "scary" for users who might be concerned with "breaking" anything.

Beyene (2016) had participants who stated that there were too much on the interface of the RDT that they tested, as well as that the two JAWS(a screen-reader software) were confused as there were two search boxes at the home page of the library search interface, which would make it hard for them to identify which of the search boxes they should use, and what their meaning actually was (Beyene, 2016). Thus we propose that the search boxes should be marked in a way that allows users with screen readers to identify them properly. The interface should also be simplified with fewer shown functions and features so as to not confuse the user.

Beyene (2016) found that researchers recommended search systems to incorporate spelling suggestions, providing feedback for queries that don't return any results, allowing users to replace difficult terms, increased error tolerance and an autocomplete feature. While this will be done for the prototype to a certain extent, it is important to note that the more advanced suggestions will be difficult to implement due to the limited resources of this project.

This project will look into granting users control of the presentation level of the web site through making their own "preferences". ""Preferences" are the trade-offs the user is willing to

make when an adaptation is made, as adaptations often impede the flow of information in order to make that information that is presented clearer in some way." (Atkinson et al., 2012). Atkinson et. al. brings up an interesting point, namely that the flow of information can be either lost or be impeded through preferences as it might alter the layout due to the adaptations performed by the system to such an extent as to impede the flow or hide information. By granting the user control of their own preferences, the possibility of this happening can be considered high, but if steps are taken to ensure the flow of information the risk and potential consequences can be minimized. One of the ways to do this is to ensure that the user can choose which information they desire to be shown, namely granting them control of the information level of the web site. While this will likely not be done in the current project, future work will be aiming towards achieving this.

2.5 Compatibility with AT

Fuglerud et.al. (2014) state that "Compatibility with assistive technology (AT) such as screen readers is a precondition for universal design of ICT", while also mentioning that UD is about designing products and environments to be usable by everyone to the greatest extent possible, without the need for adaptation or specialized design. Yet assistive devices are exempt from this, as there are many users that require assistive devices to access the internet, and as such it's necessary to accommodate these users so they can avoid being discriminated against. Thus UD has become something that attempts to do make websites accessible in general, as well as facilitate for the usage of AT.

The main problem with making an AT-compatible site is that there is no way to ensure it to the fullest extent. While it can be complying with the WCAG and the WAI-ARIA guidelines, it is still possible that certain ATs are incompatible with the site. This is due to the simple fact that all AT work differently as they are made by different vendors (Fuglerud et.al.,2014). Fuglerud et.al. (2014) continues by mentioning that there is also a problem regarding the lack of knowledge regarding AT with the developers. While it would be desirable with a compatibility testing service with the possibility of testing compatibility across the many different ATs, the reality is that it does not exist, and most developers tend to test AT compatibility through using

one AT, usually Jaws for Windows as it is the best known screen reader, and concluding that it is sufficient if it works on that one AT (Fuglerud et.al., 2014).

Another problem that often occur is the difficulty of finding the reason for an error regarding AT, as the AT itself usually does not offer any form of debugging options for developers (Fuglerud et.al.,2014). Developing the prototype to handle these problems as well as attempting to test the prototype on several types of AT will be required before the final release, and this is one of the areas where the participants of the user tests will be contributing the most.

Another aspect of the design that will impact AT compatibility will be the usage of the WAI-ARIA language that "allows the addition of semantic annotations to HTML code so that assistive technologies can better manage interaction elements." (Valencia et.al.,2013). This will let the screen reader know which elements that are possible to interact with and which elements can be safely ignored. While this is set by the developer, it is an important step towards AT compatibility. The way it does this is by defining interaction elements based on their roles, which allows the assistive technologies to benefit from this feature and make the websites more accessible to users with disabilities (Valencia et.al.,2013)

2.6 Designing for users with print disabilities

While general UD principles will play a major part of the design process, it is still important to focus on making the prototype accessible for dyslexic users and users with vision impairments. This is due to the fact that the main user group will be recruited among dyslexic users and persons with vision impairment. A significant amount of the global population have symptoms of dyslexia (such as slow or imprecise reading, difficulty when spelling etc.), ranging from 15 to 20% (Santana et.al., 2012).

Santana et.al. (2012) propose a set of guidelines when developing for accessibility for dyslexic users. Some of these guidelines point out that a navigation menu should be consistent and visible all the time, with static menus that do not use transparency, as well as ensuring that if images are used for navigation, they have a significant alternate text (Santana et.al.,2012). They

continue by expressing the need for a logical structure of the pages, that "textual breadcrumbs should have a text size that allows comfortable reading" and that there should not be any functions that interfere with the browser's back and forward buttons, as these are the main navigational tool that dyslexic users use(Santana et.al.,2012).

Santana et.al. (2012) also mention that for headers and such one should avoid capitalizing entire headers and avoid the use of italics. Text sizes should never be small or unusual text alignments, as it slows the reading for dyslexics. The recommended smaller text size is from 12 to 14px. One should also avoid pure white as the background color, as the white can obfuscate the text for dyslexics. A light gray is considered a decent alternative (Hexadecimal code #FFFFE5)(Santana et.al.,2012).

Regarding the layout, Santana et.al.(2012) stated that one should prioritize the information and use a simple design, as well as avoiding large columns of text and horizontal scrolling. The most interesting part of the guidelines they suggest would have to be the End user customization aspect, where they state that the website should be easily customizable by users (Santana et.al.,2012). They suggest allowing the user to configure the color scheme, with both background, text and print colors, the font type as well as text size. Finally they mention that developers should assure that the website can be read by screen readers, and tag abbreviations and acronyms in such a way that screen readers can understand them (Santana et.al.,2012).

While several of these aspects are already covered in the WCAG 2.0, it is important to ensure the compliance with the guidelines presented as they will enable dyslexic users to access the content more comfortably (Santana et.al.,2012).

Regarding the search system itself, there are some aspects that can be improved upon. Berget and Sandnes (2015) have concluded that due to the extensive focus that dyslexic users grant the keyboard while typing, "a high tolerance for spelling errors may be as useful as autocomplete functions for dyslexic users". Another helpful function could be to display a red line beneath a misspelled word in the search field, so as to inform the user of their mistake (Berget and Sandnes, 2015). Berget and Sandnes (2015) finally conclude that the results gathered from their study "seem to strengthen the assumption that search interfaces with a

low tolerance for spelling errors and no query-building aids are not accessible for users with dyslexia."

One of the main challenges of persons with visual impairments is the lack of compatibility of web content with screen readers (Lazar & Jaeger, 2011). This can often happen if developers fail to appropriately tag graphics, forms, tables or links (Lazar & Jaeger, 2011). Beyene (2016) mention that users with visual impairments want to know whether an item is a book or if it has an audio alternative, and would therefore appreciate it if a search tool would provide more information per result. Such information could be summaries, target audience information or anything that would help users know if the material was accessible to them or not (Beyene, 2016).

3 Methodology

For this project, it was decided to employ a standard qualitative methodology (explained in pt. 3.1) in combination with a hi-fi prototype (explained in pt. 3.2) to test some of the recommendations the previous studies had used, and some other websites as best practices to discuss the importance of their features with the participants (explained in pt. 3.3.3). This chapter is dedicated to explaining the methods used for gathering and analysing data in this study.

3.1 Qualitative methodology

Williams (2011) stated the following about qualitative research:

What constitutes qualitative research involves purposeful use for describing, explaining, and interpreting collected data. Leedy and Ormrod (2001) alleged that qualitative research is less structured in description because it formulates and builds new theories. Qualitative research can also be described as an effective model that occurs in a natural setting that enables the researcher to develop a level of detail from being highly involved in the actual experiences (Creswell, 2003).

Based on the research questions, and the lack of existing solutions that solve the problems this project attempts to solve, it was decided that an exploratory methodology would be the most optimal. Due to the nature of this project being based around finding solutions to accessibility issues, it is imperative that the end-users be involved directly in the research, so as to ensure that their needs are met and that their views and opinions are considered. Based on these requirements, the natural conclusion was that a qualitative methodology would be more beneficial than a quantitative methodology. A qualitative methodology also allows more in-depth data gathering than a quantitative one, yet it is also more time-consuming and costly. A limited number of participants is also a problem of qualitative methodology, as the resources required to host the same amount of participants as a quantitative methodology would make it extremely cost-inefficient.

3.2 Participants

For this project, the user group was people with low-vision impairments. There was no specific age required to be a participant, as low-vision impairments are not distinctly related to a specific age group. Yet out of the four participants, three were more than 50 years of age, and the youngest being in the age group of 18-30. The participants all had different professions, one being a student while being on disability welfare, another having been retired, a third being an advisor and the fourth was a part-time student and worked part-time in marketing. The participants were mainly recruited through an information letter sent out to members of "Norges Blindeforbund" (Norway's union for the blind) calling for participants with low-vision impairments or any form of print disability. Three participants were recruited through this, and the fourth participant was recruited through a fellow student. All the tests and interviews were conducted in a study room at OsloMet University.

3.3 Data Collection Methods

The main method of gathering data will be a qualitative approach to user tests and interviews with the purpose of gathering quality data on the user's own experience with the prototype and possible suggestions for improvements for the next iteration (Anyan, 2013). The user test will be used to gather information about user patterns, potential problems that users have not mentioned, accessibility/usability problems, potential upgrades/changes to the prototype and the user experience of the prototype. We have opted to go for a user test combined with an interview in two parts, as described below. A semi-structured interview was chosen as it allows for a flexible method to communicate freely about the user test (Anyan, 2013).

3.3.1 Prototype

To best gather information from the users and to show a visual example to the users, it was decided that a prototype would be the best solution. This would allow the users to see a visual example of what the project proposes as a solution, and also allows them to test it to a certain extent. It was also meant to spark the imagination of the user, so they can come up with their

own proposed changes to the solution, thus allowing them to freely make suggestions that they themselves would prefer to see in a finalized solution.

Designers that have participated in inclusive design have found that the opportunity to interact with people with disabilities is particularly useful and valuable, which often results in the designers becoming aware of problems they would not have predicted otherwise (Dont et. al.2003 as cited in Fuglerud et.al., 2015). As for the actual development, general consensus is that compliance with the WCAG is an important prerequisite for achieving UD, but it is not sufficient by itself (Fuglerud et.al., 2015). While the prototype was compliant with the WCAG, it was important to include users in the development. Due to the limitations of this project, it was not be possible to include users with disabilities in the design and development of the first iteration of the prototype, but the prototype was intended to be an evolutionary prototype that would be improved after each user test that will be performed based on the data gathered. This is based on Harder & Begnum (2016) stating that iterative development with focus on users with disabilities throughout the entire design process as well as focusing on the entire user experience are some of the key principles for an inclusive design. This did not become the case, as it was not possible to do with the resources available at the time of this project.

The prototype was based around the concept of universal design with a user-centered design focus. Fuglerud et.al.(2015) has summarised universal design by saying that UD denotes both a design goal and a design process, where the goal is to develop solutions that are accessible and usable for as many as possible (Fuglerud et.al.,2015). While the essence of this prototype was to enable others to make sites accessible for themselves, it was also important to base the prototype around universal design.

The prototype was a simple web site meant to simulate the function of an RDT. It gave limited search results and had been made to aid the users in performing the tasks they desire to accomplish through a library RDT, by reducing the possible options they had. It also included a "preferences" button that would show the user possible filtering options to be used before searching. The prototype did not include options to alter the design of the web site, which was

originally intended to be part of it. This was removed due to time constraints, and to cover for it, the user test was amended to include a comparison between two existing solutions to universally designing web sites.

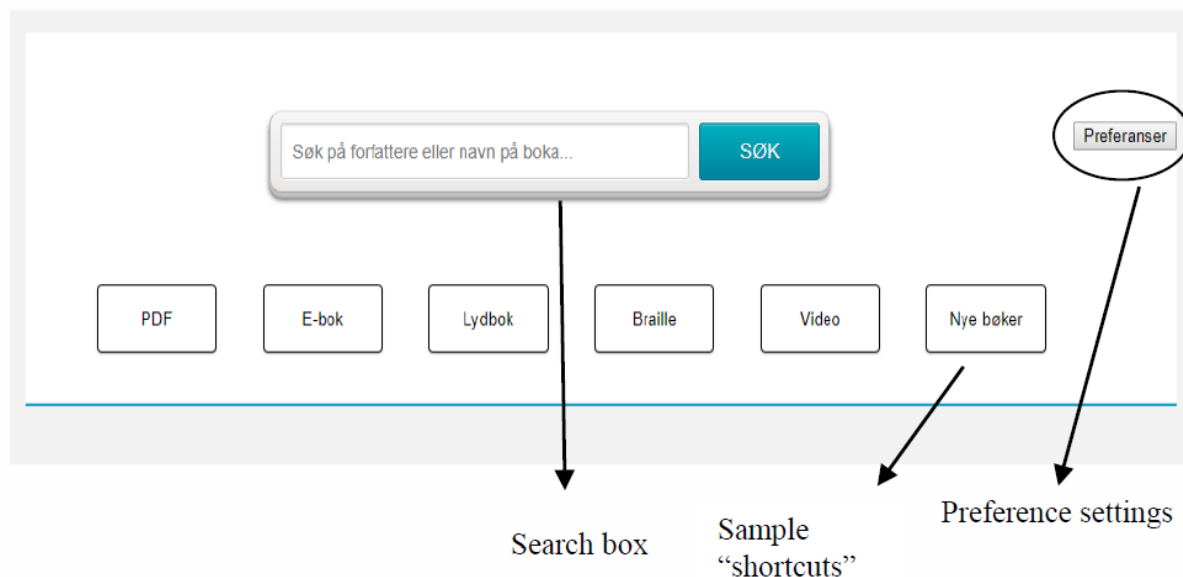The finished version of the prototype is presented here.

Figure 3-1 The search interface of the prototype.

This is the home page, and the first view that meets the user. They will here be allowed to either search immediately, or use the shortcuts to view all resources available in the selected format. They also have the option of entering the preference settings (Fig 2.).
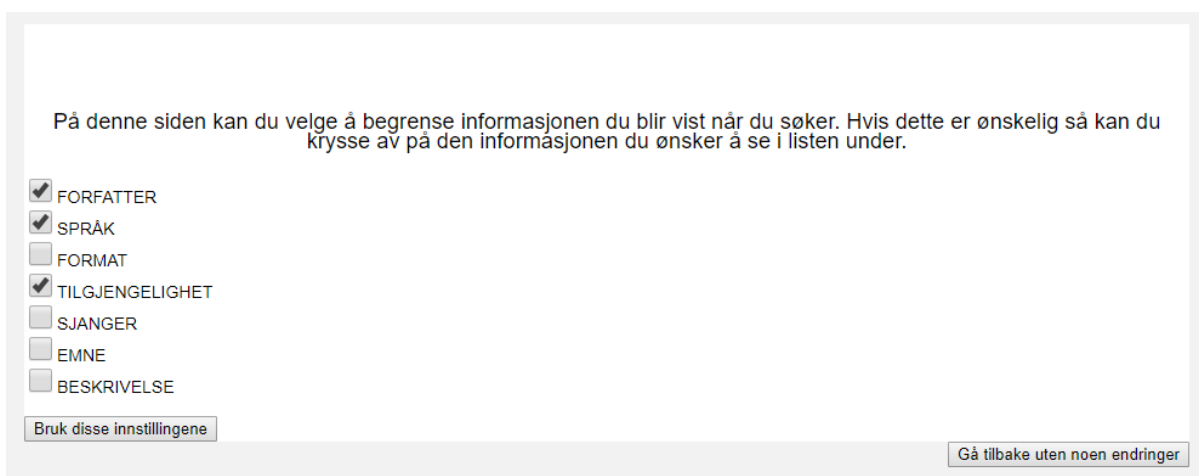
Figure 3-2 The preference settings.

Here the user is allowed to pre-filter their search. This would allow them to choose which metadata they want to be presented to them in the search results, and they can limit the amount of information they are given based on choosing as few or as many options as they want.

Figure 3-3 A sample search result with minimized information

This is how a normal search looks when the user only wants to view the author, language and accessibility metadata of the resource.
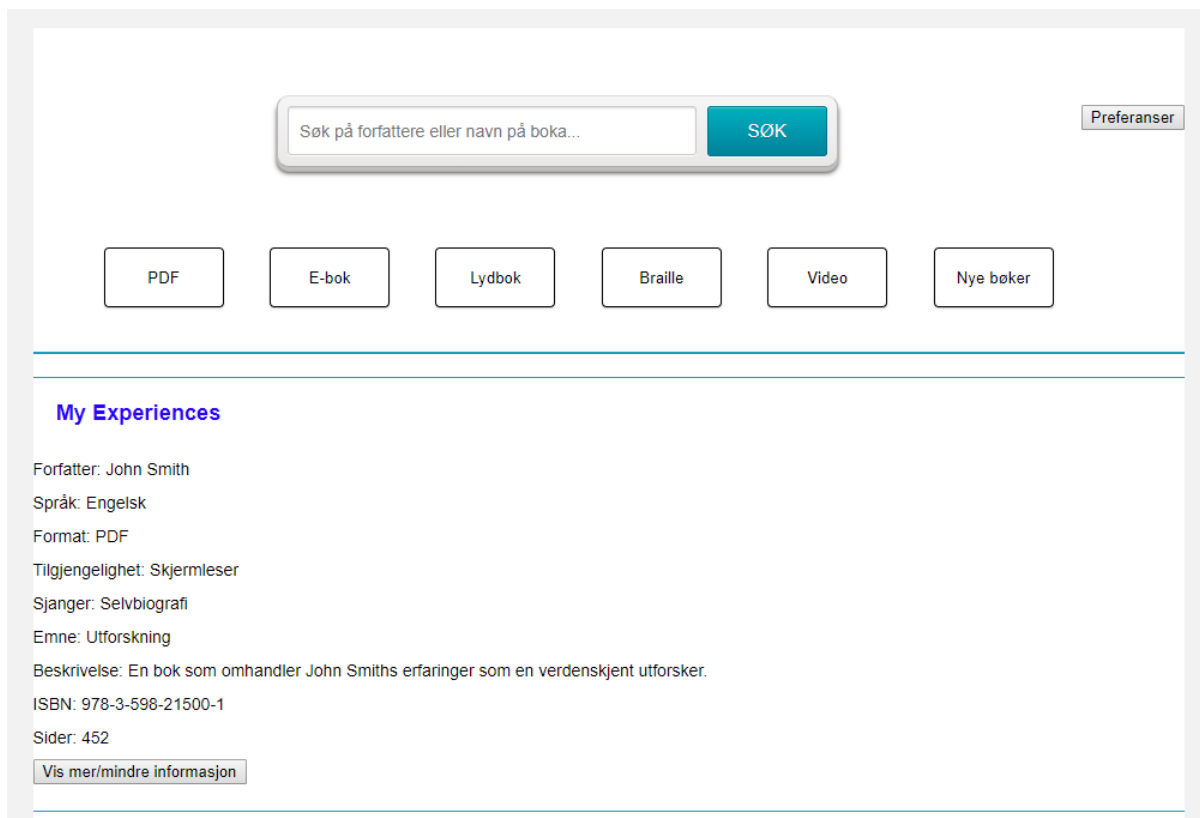
Figure 3-4 A sample results presentation with all the information available shown to the user.

Finally, this is how all the resource metadata was presented to the user.

3.3.2 User test

The user test will be comprised of a short introduction to the prototype before the user will be given tasks to solve in the prototype. The user is e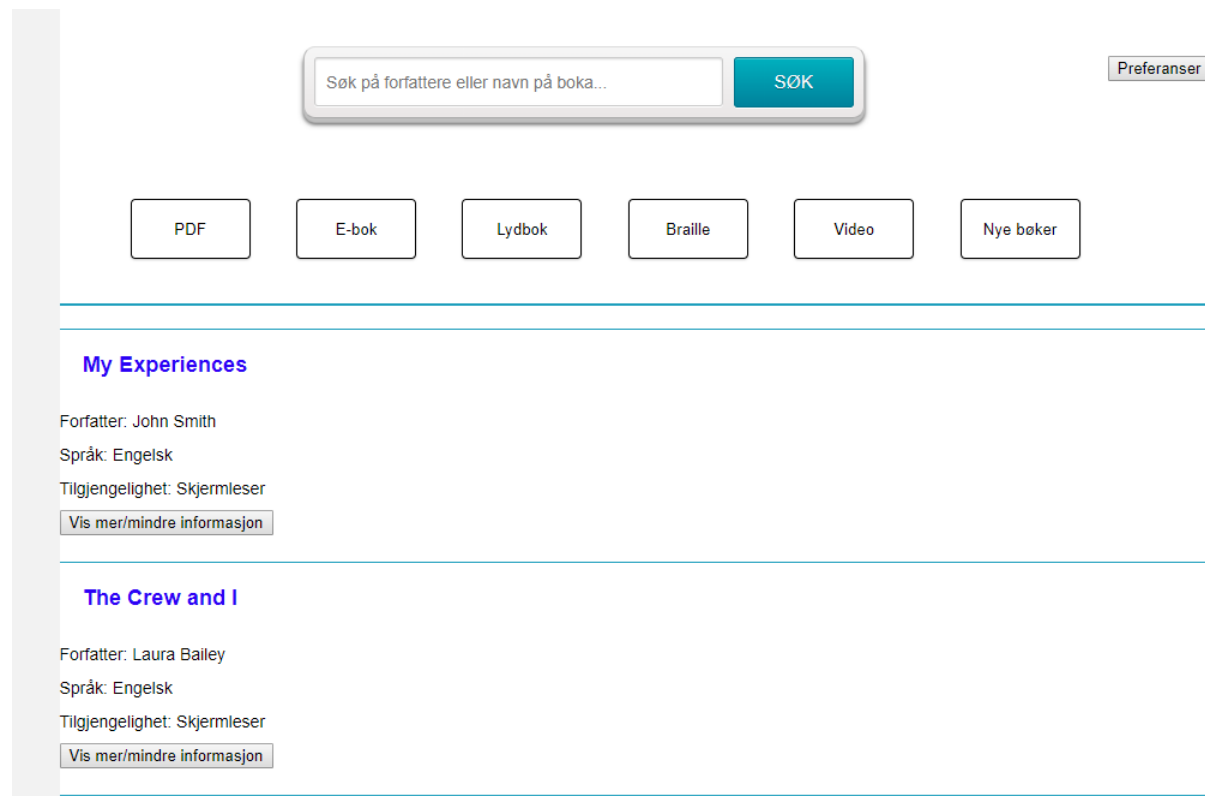ncouraged to "think out loud" and communicate with the researcher while performing these tests, thus allowing the researcher to understand the thought processes the user goes through to accomplish the tasks. During this process, the researcher is encouraged to aid the user with tasks should the user get stuck. While this is not normally the case in user tests, the main goal of this user test is to gather feedback from the users on the features proposed, and not the prototype or it's usability in itself.

Allowing users to freely express themselves during the test allows data gathering on the usability and visibility of the different functions, while also letting users make quick remarks on features or improvements that they would like to see. This proved useful for gathering

suggestions for future improvements and solutions, as discussed in the conclusion chapter of this paper.

3.3.3 Interview

The interview was created to gather information about the user, their experiences with the user test and the comparison between Funka.com's "BrowseAloud" and ATbar.org's "Accessibility Toolbar".

The first part of the interview was regarding the user themselves. Basic information regarding age, occupation and impairments were gathered before continuing on towards having them answer questions related to the user test of the prototype. Here they were encouraged to elaborate about anything and everything regarding the prototype or the user test, and they were allowed to mention any suggestions they had for improvements to the prototype, or if they understood the purpose and saw any potential benefit to the functionalities that were offered through the prototype. In the last part of the interview, the participants were shown two different existing solutions, namely Funka.com's "BrowseAloud" and ATbar.org's "Accessibility Toolbar". As mentioned in the introduction chapter, Funka is one of the leading companies in regards to universal design, thus their site was used as an example of existing solutions. ATbar is a tool that aims to solve accessibility issues through user-controlled adaptation, and was thus decided to be the second example of existing solutions.

Figure 3-5 ATbar's website and demo of the "Accessibility Toolbar"
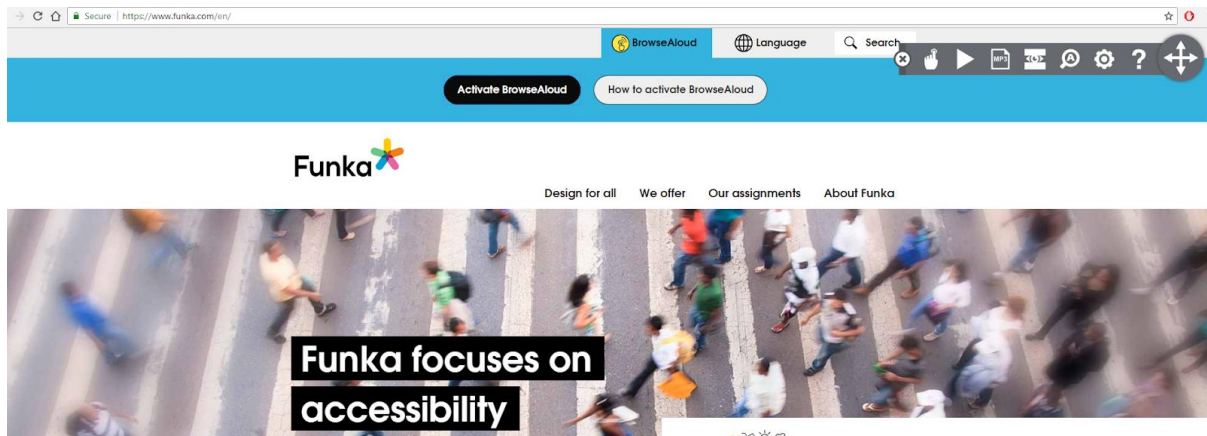
Figure 3-6 Funka.com and their "BrowseAloud" functionality in the top right corner
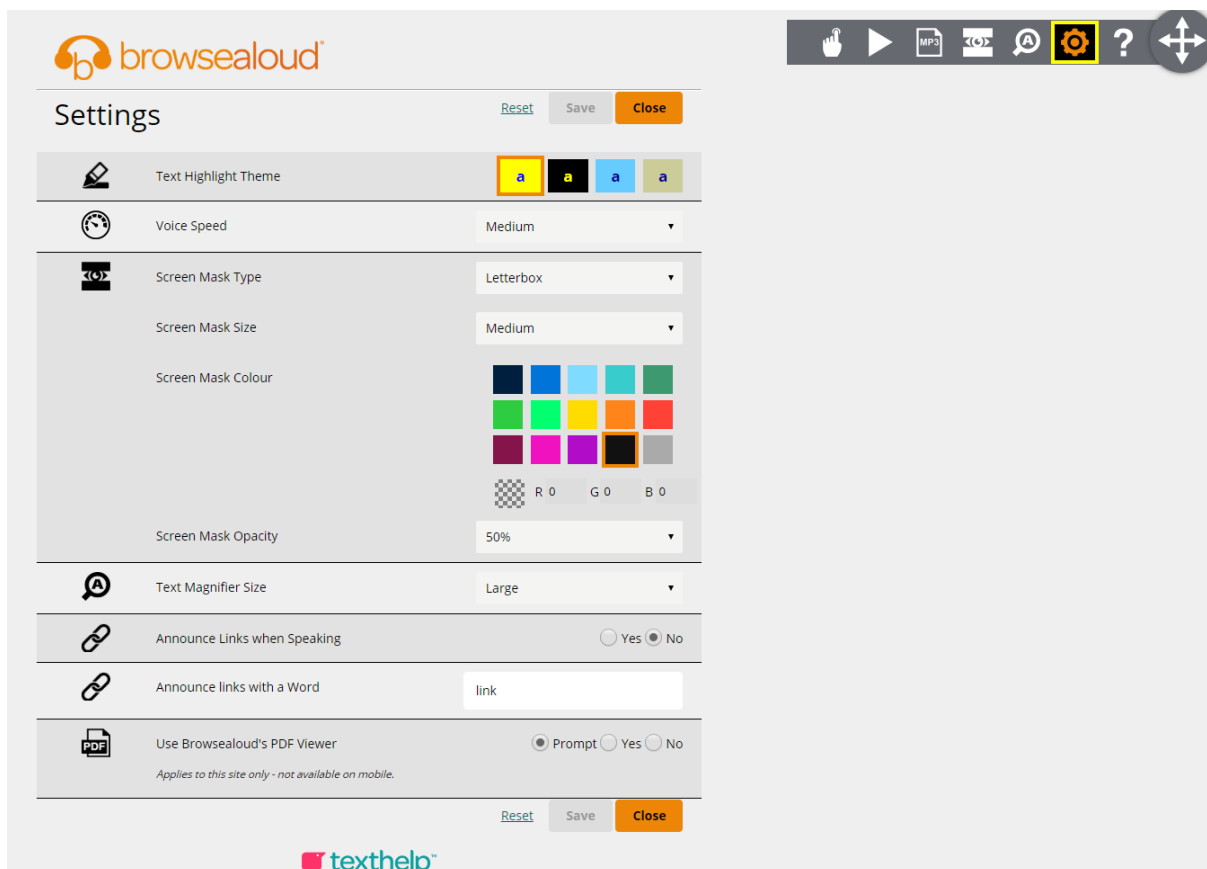
Figure 3-7 The list of settings available to the "BrowseAloud" function

After explaining the two different solutions and showing them in action, the user is then asked some questions regarding the solutions and their opinions on the matter. After the user has expressed their opinions about the existing solutions, they are then asked to compare the existing solutions with the prototype, and which features they would like to be added to it. The reasoning behind this line of questioning is to allow the user to see existing solutions and

review those, then suggest further improvements to the prototype, or an ideal solution, based on the existing solutions.

During the user test and the comparison, it was also decided to have the researcher consider the actions that the users took, and to make small notes of these and compare them with the interview responses. This is based on Nielsen (2001) stating that it is more important to watch what people actually do over what they say they do.

3.4 Method of Data Analysis

To analyze the data, a thematic analysis was performed on the transcriptions of the user tests. While several codes were discovered, the main themes of these are best described in the results section (pt. 7) of this paper.

The analysis started by analyzing each individual participants responses to the questions asked in the interview, and then creating codes based on these. Then, the rest of the user test was analyzed, and codes were created based on this as well. Ultimately, the two different groups of codes were combined and used to create themes for each individual participant. After this had been completed for each participant, the different themes were matched up against each other and finally they were combined into the themes presented in the results section. The combinations were made based on the inferred intention of the participants for each theme, and after reviewing the data one final time while focusing on the themes, it confirmed that the themes coincided.

The specific methods were a combination of inductive and deductive thematic analysis, based around the thematic analysis steps presented by the University of Auckland on their website (University of Auckland, N.D.). It was found to be suitable for this study as it is theoretically flexible, and it seemed to be applicable to the responses gained through the interviews.

3.5 Ethical Considerations

The project was reported to the NSD (The Norwegian Centre for research data) and they approved of the preliminary interview guide and acknowledged that no personal information

was to be gathered or printed. The interview guide was slightly altered, yet the part about personal information was not. No personal information has been gathered by any of the participants, beyond age, occupation and health information regarding their impairments, and it should not be possible to identify the participants based on the interviews.

It was important to ensure no personal identification was gathered, and that no one could be personally identified as a participant in this project, as information regarding their impairment was gathered. To ensure the protection of their rights, a consent form was written in english and presented to them for them to sign. The consent form can be found in appendix A. The consent form was read to them, and provided to them in any form they wanted, and a signed copy was made and kept by the researcher. During the presentation of the consent form, they were explicitly informed several times that they could at any point, even after the user test, withdraw their participation, and all information regarding them would be removed.

All of this was done to ensure the rights of the participants, as well as their privacy. While the projects nature is one that does not bring forth any ethical dilemmas, it is important to consider the participants rights and privacy.

The handling of any electronic data regarding the participants has been performed to the largest degree. The user test was recorded on a voice recorder app(on the researchers samsung galaxy S7), and the phone had a normal code and fingerprint lock-screen. The user tests were then transcribed, and when the transcription was complete, the voice recordings were deleted.

4 Results

4.1 UI Issues

This section of the results chapter will include the results that directly relate to the UI, namely the different designs and features that affects the user directly and not any functionality on the server-side of the RDT.

4.1.1 Shortcuts

Customizable shortcuts is a feature that was well-received by the participants, as it would allow them to store specific searches, common searches and other things in a manageable way. Most of the participants agreed that this feature would be close to useless for infrequent users, but it would be a great feature for regular users. If one had a specific search one used often, it would be easier to click one button for it instead of having to set up the search again. One participant said: "Sometimes you know exactly what you're looking for and then it'd be nice to filter, but other times it would be nice to just browse, [for instance], by resource format". Another stated: "Well, I think it's nice to be able to choose formats, but it would also be nice to choose genre and possibly last search or common searches."

One participant also suggested the possibility of combining shortcuts. While this would prove difficult to develop, it would also add more options for frequent users of the website.

4.1.2 Screen Masking

Screen masking is a technology for darkening most areas of the screen except for where the mouse pointer is currently pointing. This allows a natural highlight to occur, not necessarily by highlighting texts or areas, but instead by darkening the "unfocused" areas. This allows the user to more easily focus their eyesight on a specific area. This feature was warmly received by at least one participant, and others acknowledged its usefulness, although they themselves did not use it. This feature should be a selectable tool/option for users on the site, as a helpful tool to make the site more accessible. When asked about the settings they had just seen, one participant responded: "I liked the different color choices, the possibility to get it read for me and the screen masking from Funka."

4.1.3 Screen reading

Supplying the users with a screen reader seemed to be a well-received suggestion for the participants, although it was mentioned that most of the users in need of screen reading already had some sort of software to that end. Yet the general consensus of the participants was that if it would be possible to offer a tool through the site that would allow for screen reading on the site (something similar to Funka.com's "BrowseAloud"), it would probably be

beneficial for users of such tools. If it could also be adapted so one could alter the reading speed when necessary (which is common for screen readers), have it read a specific block of text (such as a single result or the filtered options of said result) or rewind it when the user needed it, that would make it a lot more desirable. When asked about Funka's "BrowseAloud"-functionality, a participant replied: "I liked it a lot, but I would like it to be easier to stop it or pause it, maybe even rewind it a bit, as some texts could be hard to catch at once, but other than that it would be fine just as it is."

4.1.4 Compact information

One participant felt that compressing information to make it more compact would aid immensely, as the participant felt that the prototype currently had too much "gap" between the current information presented in the search results. While possible to fix in the standard version of a RDT, it would probably be more beneficial if the user themselves were able to adapt it to their own liking. Such as being able to choose how much space should be between each result, if it should be marked in a specific way or how the resource's information/metadata should be presented. As one participant said: "I would like everything I needed to find and interact with to be on the same side, so I didn't have to look for it, it's irrelevant whether it's horizontally or vertically."

4.2 Resource Discovery and Access Issues

This section will present the results that directly relate to issues concerning the Resource Discovery and Access, namely the direct interaction the user has with the system, and the different features of the RDT that are more grounded on the server-side.

4.2.1 Subselections

Being able to pre-filter results was considered a good idea, and most participants saw it as a big boon when using a larger database which would yield more results. But the participants wished to take it one step further, being able to pre-filter more accurately down to specific genres, subjects and more. This would allow users to further filter results to their liking, thus shortening

the amount of results they would have to browse through to find their intended resource. It also has a potential benefit for browsing, as it would reduce the unwanted resources shown to the user, thus making it easier for the user. Finally, it would make the site more accessible to users by allowing them to avoid unwanted results, shortening the time and effort required to find resources by a substantial amount.

The way this would work is that by selecting an option/preference, the option/preference would then expand, showing more specific subgenres of that option, further allowing the user to narrow down the search results. While this solution already exists in most library RDTs and search engines in general, being allowed to do this before searching would enable users to more directly find their desired resource. A participant explained it as such: "It would also be nice if you could get sub-settings when you choose a setting, such as by choosing genre, you would also get the possibility to choose one or more specific genres."

4.2.2 Options

One option that most of the participants felt were lacking was the option to filter away the title of the resource. This option would be easy to add, and the desire for it seems to stem from everything else being possible to filter away, so the participants wanted to be able to filter that as well.

Options for altering designs were considered by most participants to be beneficial. While the participants all agreed that being able to alter font type, size and color, along with background color and some method for enhancing text visibility would make the site more accessible to them, they all seemed to have different prioritization of these features. One found the option to alter font size and type to be the most efficient, another wanted the ability to embolden all text, another desired screen masking more than any of the other options, whilst the last felt that most of these options would not affect their experience, it would possibly be of great benefit to others. When asked about it, most participants agreed that being able to somehow highlight or alter the different headings would also be of great help when browsing the site.

While one participant said "An option to bold all the text, so it would be easier to read. Changing font size and font type would also be good." when asked about settings to make a website more accessible to them, another claimed that altering the font "doesn't seem too important."

4.2.3 Searchable results

Several users mentioned the ability to search within the results to further narrow down the search. This seems to point more towards a secondary search instead of a need for further filtering. If utilized, such a function would allow users to perform a second more narrow search in their already limited and filtered search results. This would be great for resource discovery when the user does not know exactly what they are looking for, yet know the general requirements. This could however create a potential problem in the navigation of the website, as it might become difficult for the user to be aware of which search it is currently performing (if the user is making a primary or a secondary search). "Being able to choose subgenres to filter and then to be able to search for words after that which will let you limit it a lot before you search. Or perhaps some sort of double search", as said by one participant regarding how they would want to handle an abundance of search results.

4.2.4 Vocabulary

The participants also reflected on the use of keywords and terminologies regarding the prototype. One of them said the word "format", for her, signifies dimensions rather than file types. She recommended finding another expression such as "file format" or "file type". She also said the word "description" is not as distinct as it should be. The word was meant to connote summaries, abstracts or more information about an item, yet did not seem to intuitively promote that connotation to the participant. Two participants commented on the use of the word "braille" and explained that "punkt" or "punktskrift" are the words used by Norwegian users. One of them said "lesepunkt" is the word used in the everyday speech. These feedbacks show the importance of a well-designed vocabulary to make search interfaces user friendly.

5 Discussion

The main purpose of improving accessibility is to identify and remove barriers that prevent users from accessing information, or give users the means to overcome the barriers. Based on the results gathered from the participants, it seems obvious that there is clear potential for improvement on existing RDTs. The concept of user-controlled adaptation also seem to be well received by the participants, and they acknowledge its potential usefulness. Using a set of options for the users to alter would be the easiest way to allow them control of the design, while also being the method that will have the lowest requirement of the user in terms of knowledge regarding website design. It is imperative to keep the terms used in the options as simplified as possible, to further lower the user's need for previous knowledge or experience, and every option that might be confusing should also be accompanied by a help-icon that further explains its function. It is crucial for the developers to bear in mind that the users of such a solution are not web designers or developers, and they should not be expected to have any measure of pre-existing knowledge before being able to use such a solution, unless that knowledge can be proved to them while using said solution. This could be achieved through the help-icons which all should contain information explaining the function, where the concept can and should be explained briefly.

"By considering users' preferences as well as the potential gap between the capabilities required by the content, device and situation and those possessed by the user, we can suggest appropriate adaptations" (Atkinson et. al., 2012). These are the kinds of considerations that must be taken when developing solutions with a large amount of user-controlled adaptation. To apply this theory towards allowing user-controlled adaptation, it is suggested to allow for as many possible adaptations as possible, while also limiting the options the users have. While seemingly contradictory, the intent is to allow users a multitude of options, so they feel they have the option to alter anything that would be directly affecting them, yet also to limit the amount of options they have so they are not overwhelmed, nor feel that some options will get lost amongst the multitude of other options.

One of the most common usability problems of search interfaces is poorly organized search results (English, et al., 2002, as cited in Beyene & Godwin, 2018).

Beyene & Godwin (2018) state that:

Research suggests that users with print disability could be better served if search results are presented with more information as that may help to ascertain the accessibility of a resource to a particular user (Beyene, 2017; Chapman, 2007). A potential problem, though, is that users might be turned off if the interfaces are overloaded with information (Beyene, 2016). Library search tools such as Primo, seem to have tried to handle that by displaying minimal set of metadata such as author, title, and material type and hiding the rest behind the "Details" link. Here, it might be important to note that information regarded as "less important" by some may be very important for others, which implies the need of understanding users' needs and preferences.

This promotes the idea of having all metadata accessible to the user, yet choosing to hide some of it from plain view, thus allowing the user to choose whether to see all the metadata or not. The prototype was based on allowing users to do just that, while also allowing them the option of choosing which information was to be shown to them and which information should be hidden unless the user wanted to see it.

As mentioned earlier in pt. 1.1, the main purpose of this project was to establish a baseline for the preferences desired by the users of RDTs. While this was achieved to some extent, it is clear that more research is needed. The current data gathered, analyzed and reported in pt. 4 have given suggestions on how to improve the prototype, yet it is also possible to use the same suggestions as a baseline for what preferences users should be able to choose between.

5.1 Options

The main objective of the prototype, and one of the major objectives of this study was to examine whether giving users control over the search results presentation would make the search interface easier or more efficient to use, or more accessible to low-vision impaired people. The study by Beyene (2016) showed that users with print disabilities do not want to flip

through a large amount of pages with search results. The different options examined in this study, and the functionality provided by the options would allow more results to be compressed into a shorter list, yet it would still give the user the information they wanted. An additional benefit of this compressed results list is that it can reduce the possibility of a navigation overload, as well as making the search interfaces more mobile-friendly.

While many library search interfaces already provide the view more/less option, it is important to note that they do not allow the users to determine which information they are shown under the "view less" option. In this study, we tested giving users that control, and while the users understood the intent of the study, their reactions were mixed. As one participant stated, "It would probably have more of a benefit for frequent use than a one-time use."

The participants all agreed that the usage of preferences/options in a tab was a good idea, but they could just as easily have been placed underneath the search bar, according to some of them. This shows that the placement, while important, is not crucial to the functionality. Due to spatial constraints on the search page, however, it is suggested that they are kept to a separate page, so the search page will not be "crowded" with functionality, which will make it harder to navigate. If sub-filters are to be added, it becomes increasingly important to ensure enough space for the filtering options.

It is not advisable to place the options for altering the design on the same page as the filtering options, as it might be confusing for the user if two different categories of options are presented on the same page, especially because the filtering options themselves might be enough to fill the whole page by themselves.

As for what options should be offered to the participants, being allowed to filter out most metadata seemed to be preferable, including things such as title and author. It is worth noting that all the metadata available should be presented to the user, though they should be "hidden" behind either a "details"-link, as mentioned by Beyene & Godwin (2018), or behind a "Show more"-link, so as to not confuse the user with an overwhelming amount of metadata that might be irrelevant at the time.

Even when the user has specified what metadata they wish to be shown, it is important to allow them to go back on their choices and see all the data available on any given resource, should they wish to, as they might not consider that when they choose their desired filters. This approach is based on the "multi-layer design" theory, where the data is hidden from the user until they decide they are ready to use it (Shneiderman, 2002). This theory could also be further incorporated into the design of the solution by granting the user options for what degree of control they want, or to what extent they want to be able to alter the design.

As for the design in itself, being allowed to alter this might be the most crucial step towards increased accessibility. Granting the user simplified options regarding the design, such as being allowed to choose the font type, size and color, being able to alter the background color or being allowed to make all text italicized or bold, should they want it. Likewise, it is important that they are allowed to remove italicized, underlined, or bold text if they find it harder to read, or prefer it not to be there for other reasons. This presents a potential problem though, as content providers often use italics, bolds and underlines to emphasize content. One possible solution to this would be to give the user their own option on how the site should handle emphasis. Another would be to add specific tags if any text is meant to be emphasized to the user.

Other helpful implementations that have been suggested by the participants are the inclusion of a screen reader software similar to the "BrowseAloud"-solution that Funka.com has integrated, as well as a form of screen masking which is a part of the same solution. Integrated tools are a welcome addition to most sites as it removes the need for the user to bring/utilize their own tools. But as one of the participants stated, it is not necessary for every site to have its own solution, or to provide its own tools. There should be a standard, or there should be options for the user to choose from. The main problem regarding this is that there is no single universal standard regarding screen readers. While possible to implement, it might be advisable to let the users use their own AT, and instead just follow existing guidelines (such as the WAI-ARIA and WCAG 2.0) to accommodate these tools. Should it still be decided to implement the tools directly in the site, it is suggested that it is made both as intuitive and as user-friendly as

possible, and that the controls are simplistic and similar to other, existing software, or customizable for the user.

5.2 Presenting the search results

The search results is the main feature of a library RDT. It is the reason users visit the site and it is the product that the RDT provides. Therefore, it is of the utmost importance to present it properly. The participants felt that the most convenient way to have the results presented was for them to be clearly referred to as results, as the prototype did not provide a clear distinction between what was the search area and what were the search results. They also felt that being able to select what they wanted presented to them would be important. Yet it is possible to take this one step further and give the users the option of how they want the results to be presented; if they want the information on a single line, such as one participant wanted, or if they want it spread out with increased line spacing, or if they want the resource presented as an object with different tabs giving different information about the resource.

Beyene & Ferati (2017) have also mentioned search results presentation with a "details" link, as well as visual cues to indicate the availability of the resource in the library.

The participants generally said they do not like excessive information to be shown on search interfaces. However, they didn't discuss what type of information they don't want to see. However, during the experiments, they were observed selecting fields from the preferences settings to experiment the view more/less options. From this simple experiments, it might be possible to say that it is important to leave the choice to the user in the manner demonstrated in the experiment.

Granting the users options for adapting the search results to fit their own preferences would be a step towards increased accessibility, yet there is a risk for giving the user too many features or options for altering the design, at least for irregular users. While regular users could "save" their options for every time they visit, irregular and new users might not want to do this. One possible way to prevent confusing or annoying irregular and new users with all these functions could be to hide them in another "layer", as suggested above.

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5.3 Shortcuts

The shortcuts in the prototype yielded some interesting feedback. Most of the participants did not seem interested in them at first glance, but they all expressed positive interest in them when it was suggested that they could be customizable to the users own needs and wants. Some stated that having certain formats would be nice, they also agreed that being able to store searches or specific filtering options would be a good idea. Others wanted some of the shortcuts to automatically adapt to the user, yet still have the option to customize how many would do that, and be able to customize the remaining shortcuts into what they themselves wanted. This feedback indicates a desire for customizable shortcuts. What these shortcuts should be used for, or what the users should be able to customize them into is not clear at this point. The prototype utilized the shortcuts as a method to filter out different formats of the resources, such as video, audiobooks or e-books, yet most participants did not necessarily want them as filters for formats, as they considered that to be covered by the options instead, especially if the subgenres were to be added to the filtering options.

5.4 Participants and Limitations

One of the main limitations of this project is the number of participants. Lazar et.al. (2017) state that the minimum number of participants in a user test depends on the type of test and how much time and money one has to conduct said test. While Nielsen (2000) has suggested that usability tests require at most 5 users per test, and instead suggest a larger amount of tests, this project had only 4 participants and one user test. The participants were 3 women and 1 man with 1 person in the 18-30 age group, and the other three in the 50+ age group. The participants were varied in age and occupation, as well as the frequency of which they used library RDTs, with one rarely using it, one using it on occasion and two using it often. As this study used qualitative methods for data gathering, the data gathered have provided insight into what the participants preferences were, and what they would like to see in future versions of RDTs, the sample size is simply too small to make any conclusive statements. The ideas presented in this paper is therefore to be considered suggestions that warrant further research, yet results thus far are promising and show that there are many ways of improvement.

Due to the arguments made above, one can also question the significance of the results, yet most of the results presented were agreed upon as a positive adjustment towards accessibility by all four participants, and due to the large variation of the participants, one could attribute some significance to the results of this project.

Another limitation for this project was the prototype in itself. It was simplistic and generalised, and was, as noted in some of the transcripts (See Appendix A), incomplete. It had several shortcomings, yet the features that were to be tested were functional. Thus the prototype and the user tests related to it can be considered a success, albeit one with potential for improvements.

5.5 Other suggestions

Library search tools and search engines in general often provide users with different options for setting their preferences related to language, region etc. While this study has not examined how often these functionalities are used, the settings still exist. Based on this, a suggestion is made to augmenting these existing functionalities to include varying options related to accessibility. This would make accessibility a matter of choice, which would ultimately only prove to make search tools more usable and accessible to everyone.

Another suggestion is to include a form of label for different information resources based on their accessibility features (Rothberg, 2013). This experiment included a metadata field for accessibility that two of the participants tested. However, it would be necessary for a study with a larger group to assess the usability of such a metadata field in general library search tools.

6 Conclusion

Search interfaces are what stands between the user and multitude of information resources stored in information systems such as libraries and massive databases. Their design affects not only the accessibility of these interfaces, but also the accessibility of the books, journals, etc stored in these systems. Therefore, past studies recommended not only adherence to the well-

known accessibility guidelines of W3C, namely the WAI-ARIA and WCAG 2.0, while designing the search interfaces, but also examining of the role of library metadata for making the search process itself accessible. This paper aimed at following the recommendations of those studies to test how those recommendations could be applicable to users with low vision impairments. Thus it aimed at answering two research questions:

Would giving users control over the presentation level contribute to improve the usability and accessibility of RDTs for users with print disabilities?

How can developers facilitate for users controlling the presentation level of a Search interface?

To answer the questions, a hi-fi prototype was created to be tested by participants with low vision impairments. The prototype was developed with the focus on allowing users to control what metadata that would be presented in the search results, in an attempt to test if doing so can improve the accessibility and usability of RDTs. The participants of this study were all positive regarding this, and it seems to promote the possibility that this method works.

For the second question, examples of existing websites that incorporated tools that aimed at allowing the user some control of user interfaces were presented to the users. The idea was to see whether users would find such solutions helpful if applied to library search tools.

Based on the results gathered from this test, the answer to the second question seems to be to enable the users themselves to choose which options and preferences they prefer, and then allow them to select these options which in turn is used by the interface to perform an automatic adaptation based on these options and preferences. The result should be a site that is tailored to the users preferences and is easy to use, regardless of the disability the user has.

The main purpose of this study is about making search interfaces accessible for people with disabilities. Based on the literature, and the testing performed in this study, it is becoming clear that this is not achieved solely by designing interfaces while following the accessibility guidelines, but instead doing a combined approach. If the method of user-controlled adaptation tested in this study becomes the main method of creating RDTs, it would mean simplifying the whole process of resource discovery and access.

7. Recommendations

For anyone wanting to design a library search interface, it is important to be mindful of several things. The most important of which is to know that your users are diverse, and any designer should take this into account. Therefore, it would be advisable to consider the following recommendations: have different accessibility features implemented, allow users to filter their results without having to browse them first, present the information in a compact way that is still easily readable, and if possible, allow users to configure certain elements, such as the search results presentation, by themselves. The higher the degree of user-controlled adaptation is, the more likely it becomes that a user will be able to utilize it to a greater extent. Just make sure to not go too far in allowing users to control the adaptation, as they will not be as knowledgeable as a designer, and should not be expected to be. Give them help whenever needed, and explain every functionality as simply as possible.

A final suggestion is the possibility of adding a form of label or icon to represent the accessibility of a resource, as mentioned in pt. 5.5. This would allow users to easily identify if the resource is accessible for them or not. While metadata could do this as well, an icon takes up less space, yet can give as much, if not more information as a written sentence regarding the accessibility of a resource.

8 Future work

Should there be a future attempt at improving the accessibility of library RDTs through user-controlled adaptation, it is suggested that the study gathers more participants, and follows a qualitative guideline to create a functional prototype that can be tested quantitatively to provide enough empirical data to properly conclude whether user-controlled adaptation improves the accessibility and usability or if it creates additional confusion for the users. It is also suggested to review the findings in this paper and base the new study on this paper, as a continuation of the study.

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Appendices

Appendix A (Consent Form)

Consent form

Hello participant,

Thank you so much for agreeing to participate in this user study! The purpose of this study is to show whether granting users control of the presentation level will improve accessibility of search interfaces. What this means is that we wish to give you, the participant, the possibility to alter settings on the prototype website that will allow you to choose what sort of filters you would like to use on the site. In future iterations of this prototype, it is also possible that we will include settings that will allow you to alter colors (such as text and background colors, to create the contrast you want) and what kind of text, or how big it is, you would want. This is to test if this is an approach that would make search interfaces in general more accessible to users without the need for assistive technology.

What we need from you:

We will gather some basic personal information (age, occupation and information about any impairments you might have). We will also ask you about your experience with the user test, and about your other experiences with some sites. You should feel free to respond in any way you wish, as everything you say and mean is of importance, and there are no "wrong answers" to any of the questions. The data gathered will be anonymized if it is not already anonymous, and it will also be encrypted. When the data is successfully analyzed and the project has been completed, the data will be safely and securely deleted. We will not share this data, or your

personal information, nor contact information or participation in this subject with any other party.

You can of course choose whether you wish to answer these questions or not, and should you at any point regret your decision to answer, you can withdraw your consent at a moment's notice by informing us. We will then proceed to delete any data gathered from you, and you will be thanked for your participation. There will be no repercussions towards you as a result of this.

We would also like to record the audio of the user test, purely for transcribing it later, thus allowing the researcher to focus entirely on the user test.

I consent to the following:

Gathering of information ☐

The recording of audio during the user test ☐

I have fully read and understood this form ☐

I am aware that I can at any time retract my ☐

consent and that there will be no repercussion

for doing so.

Date   Sign. participant   Sign. researcher

Appendix B 1 (Interview Guide - Original)

Information about the user

1. What age group do you belong to between 18-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80+
2. What is your profession?
3. Are you visually impaired or suffering from Dyslexia
a. To what extent are you impaired?
b. Do you use any assistive technology when you browse websites?

The User Test

1. How did you feel the user test went?
2. Did you get to test the settings to adapt the search results?
    1. a. Did the settings help make the site more accessible or easier to use for you?
    1. i. Were there any settings you preferred?
       ii. Were the settings easy to understand?
       iii. Were there any settings you felt were missing?
3. Did you use any assistive technology during the user test?

Feedback regarding the comparison

1. What settings do you think would be nice for you to choose from to make websites more accessible to you?
2. Are there any improvements you want to see in the prototype website?
3. Would it be preferable if these changes were done automatically based on your settings on every website you visit?

Appendix C (Full transcripts of the user tests)

User test 1:

Researcher: [welcoming speech, explaining the general concept of the prototype and the user test]. So, any thoughts before we begin?

Participant: Well, the design seems a bit boring, if I'm honest.

R: Yeah, we know. Due to time constraints, we had to keep it simple and a little boring, sadly. But that'll be fixed later!

R: Could you start by testing the settings? Just spend some time and familiarize yourself with them.

P: Sure! [lists the settings] Ah, these are sort of filtering options?

R: Yeah, they're there so you can attempt to filter the results and the information given to you before you search, so you don't have to try to find it in the midst of all the results that would normally come when you search. Now, what I want you to find is a video by a person named "Matthew Mercer".

P: So he would be considered the author?

R: Yeah, for this case he would be considered the author.

P: Right… but where's the search field?

R: As it is right now, you set up the settings for the filtering before making the search, so the search field is actually back at the main page.

P: Right, so there's the button to go back.

R: And over here is the button to go back without making any changes.

P: And where's the button to use the settings… [searches] Ah, there it is.

R: Now that you've spent some time searching for the button, I thought I'd just ask you what you thought about it's placement. Was it where you expected to find it?

P: Well, I kind of expected it to be right above the other button where you could go back without making any changes. It would kind of be nice to have it be more of a button, because where it is now, it kind of mingles with the other options here.

R: Right, so back to the task at hand. Could you scroll through the results and find the video I was asking for?

P: [scrolls through the results] Hmm… I can't really find the results… Or maybe I misunderstood the task?

R: No, you're actually scrolling through the results now, which is interesting. But that's good feedback as well, as it will let us know to make them more distinguished! They probably should have been centered or something.

P: No, they didn't really need to be centered, I just didn't quite see them.

R: Right. Maybe we just need to make them easier to spot then.

P: Ah, right. Yes.

R: If you'll look here, between these two lines, you might see the search results. Seeing as you only checked the author box, you only get the author and the title, so that might be why it was hard to spot.

P: Ah, right! Well, I thought that was just some general information, and not the search results themselves.

R: Then we definitely need to make them more obvious!

P: Maybe there should be a heading called "search results" or something?

R: That sounds like a good idea, would you prefer that heading to be centered?

P: No, that doesn't really matter, you could just as well keep it above the search results on the same side. I know that people using screen masking or screen readers have their own preferences. [proceeds to complete the task]

R: Did you think it was okay to be able to filter it to only see the author or would you prefer it if some more information was "standard"?

P: I think it was okay, but it would be nice to be able to select title.

R: Maybe you'd like it to be a bit more clear about what's a title?

P: No, not really. It was obvious enough for the title, and the author is presented as an author and then the name, so that works just fine.

R: But you think it'd be nice to be able to choose whether or not to show the title?

P: Yes.

R: Alright, we'll look into that! Now, you can just browse a bit more, maybe try to press the show more/less button, to see how that works.

P: [tests the button]

P: That was a lot of information.

R: Interestingly enough, that amount of information is actually quite limited when comparing what normal libraries have.

P: Well, I still thought it was a bit overwhelming.

R: That is kind of what we're testing here, to see how much information is too much, and if it helps to allow the user themselves to choose what information is shown. Now, for the next task you can try to search for "De tre bukkene bruse" (A children's book).

P:Okay. [inputs search word]. Ah, it's in Braille?

R: Yes. But I was wondering whether you preferred the term "Braille" or if you preferred "punkt" or "punktskrift" (norwegian words for Braille).

P: Well, I don't really care either way, and I don't think there's any difference, so I guess it's up to preference. [finds the book and browses the information.]

P: But if this had been a completed product, would I have been able to choose genre? As in, could I have chosen whether to get it in normal text or Braille, audio book or something?

R: That should be possible, if the library had it, yes. The finished product would possibly let you see each version of it. Now, there's one final aspect of the prototype for us to test, which is the shortcuts.

P: Right, so do I have to go back to the start page then?

R: You are actually still on the start page, so you just need to find the shortcuts.

P: [navigates to the shortcuts]

R: So what we're thinking is to test how well the shortcuts are working, and what you would normally want to use them for. For this user test we've chosen to use the different formats as shortcuts, but the idea is that you can customize them yourself to whatever you want to use them for, like commonly searched terms, saved settings and whatnot. So I was wondering if you like the shortcuts being the formats, or if you wanted them to be something else.

P: Formats work just fine.

R: Right, and how would you like them to work? As a form of filtering device, so you could quickly filter searches by their format, or would you want to be able to click it and then be shown everything with those formats?

P: Both maybe, but that might not be possible?

R: Well, it is, and it could be a setting that you yourself can choose.

P: Right, because sometimes you know exactly what you're looking for and then it'd be nice to filter, but other times it would be nice to just browse a format.

R: Would you like the ability to customize the shortcuts by yourself? Maybe choosing something like filtering on if it's adapted to screen reader? Or if you could customize the shortcuts yourself, how would you like to customize them?

P: Can I choose any thing?

R: Anything!

P: Well, I think it's nice to be able to choose formats, but it would also be nice to choose genre and possibly last search or common searches.

R: Now, the next part of the user test is related to letting the user customize the color choices and such for websites, do you think this would be useful for people such as yourself?

P: Yes, definitely.

R: Now I'll show you two different websites so you can see how existing solutions handle this. Here's a site called ATbar, which stands for Accessibility Toolbar. [explains the functionalities of the ATbar]

P: [tests the text size increase button] Oh, this only increases a little bit each click. [clicks rapidly] Wow, this would drive me mad [laughs].

R: Well, we actually tested this function ourselves a bit, but when we tested it, we had a dropdown menu instead, to make it easier to make larger changes at once.

P: Ah, like Microsoft Word? Yes, I think that'd be much better than this clicking.

R: So, are there any of these settings you'd be interested in customizing?

P: Not if I have to download that bar and use it on every site independently. Then it'd be easier to just use the native windows functionality. This isn't something I'd want to use my time or energy on. If it had been easy and user-friendly, I would've used it.

R: Now then, I'll show you Funka's solution to accessibility. [explaining the functionalities of "Browsealoud" on Funka.com]

R: Alright, now for the interview. What age group do you belong to?

P: 18-30.

R: And what's your profession?

P: I'm an Advisor.

R: And you're visually impaired, right? To what extent are you impaired?

P: I'm visually impaired yes, I'm strongly impaired and will eventually turn blind.

R: Do you use any assistive technology when browsing websites?

P: None, except for the normal zoom that is in the browser.

R: And how did you feel the user test went?

P: Good, it was simple and very user friendly.

R: And did you get to test the settings to adapt the search result (referred to as preferences in the following user tests)?

P: Yes, I got to test some of them.

R: Did the settings help make the site more accessible or easier to use for you?

P: Yes, but they didn't change the experience from being able to alter it at a later time. It would probably have more of a benefit for frequent use than a one-time use. so yes and no.

R: Were there any settings you preferred?

P: None in particular.

R: Were they easy to understand?

P: Yes, they were.

R: Were there any settings you felt were missing?

P: Title would be nice to change. Also, the more the better, up until there's "too many".

R: Did you use any assistive technology during the user test?

P: No.

R: What settings do you think would be nice for you to choose from to make websites more accessible to you?

P: An option to bold all the text, so it would be easier to read. Changing font size and font type would also be good.

R: Are there any improvements you want to see in the prototype website?

P: Making it a bit more similar to the toolbar on funka.com, making it easier to know where the search results are on the site (namely using search results as a header for that part of the site), and putting the buttons for the settings on the same side.

R: Would it be preferable if these changes were done automatically based on your settings on every website you visit?

P: Yes, it would be desirable, but it would depend on the website. Local changes only, if possible.

--- End of user test---

User test 2:

Researcher: There, let's get started. You can make any changes to the setup that'll help you use the laptop.

Participant: This should work [sets up the browser zoom].

R: Okay, the first thing for you to do is to make yourself acquainted with the website itself. There's not a whole lot of interesting things on it, it is a relatively simple concept for now. If you'll look down here [points to shortcuts] we have something that's called shortcuts, that when pressed will show every available result of the formats that are named there. They will be shown further down on the site, but the site doesn't automatically scroll down by itself yet, that'll happen in a later iteration of the prototype.

P: Right, I understand.

R: And then all the information we have on the results will also be shown.

P: Like a standard library setup.

R: Yes, very standard. That's what we're trying to imitate with this, but it's very simply made("Hjemmesnekra"), as none of us are developers. (Us refers to the researcher and the project supervisor.)

P: Right, I understand. You do know that blind people call it "punkt" or "punktskrift" (The norwegian term for Braille - the prototype used the english term Braille).

R: Yes, I know, I asked the last participant that we had here about which term is the most used, but we weren't sure whether the term "Braille", "punkt" or "punktskrift" should be used. she said they were interchangeable, but we weren't sure if the term commonly used was "punkskrift" or not.

P: In normal speech, blind people refer to it as "punkt" or "lesepunkt".

R: Right, that's something we can easily change.

P: Do you know how many objects (actual term used by participant) you will test this on?

R: There's three in total, there's one more after you, that's all the participants we managed to gather. But this is very good information to get. We'll be making another version of this prototype based on the feedback gathered from this user test, so it's great with any information you can bring. So, this user test will be pretty standard: If there's anything you see or notice, feel free to say it, as any feedback is good feedback.

P: Yes, then I'd like to say: "Settings", is that something for me?

R: That it is! That's actually the first place we'll go to take a look. We'll see if you intuitively understand what's happening here or not.

P: I would assume these are terms used for filtering, there is filtering on things like author… [lists terms used for filtering]. Should I click anything?

R: You can click anything you want. As of right now you can test whatever you feel like.

P: Now I clicked on settings… Adapted to screen reader, yes [checks box]. Doesn't really look like a lot happened. Oh right, there came the short description. That's not entirely intuitive. Here it says show more/less, but on the previous place we were at - does this button work [refers to show more/less]?

R: Yes.

P: Okay, now it shows all the information and then back to the limited information again, but nothing about being adapted to screen readers, which I didn't find to be that logical.

R: No, but that's very good feedback. As things are, we have this information text here [refers to headline of settings page] that states filtering the information when you're searching. With this, you can filter before you search, so you don't have to look for the filtering options after you've searched.

P: Ah, okay. Another thing that disturbs me a bit is that down in the right corner it says "go back without making any changes", and that's something I would normally not notice unless I scanned the entire page. So I'd prefer all the information in the same place, meaning I'd like it under the "Use changes" button as that's where I'm looking when using the settings page, and it's so stupid to have to look separate places for information.

R: Right, well that's very good information. This is the kind of information that helps us a lot. What I now want you to do is that by merely filtering information, i want you to find the book "The Life of Mercer", by author "Matthew Mercer" (false book made for this prototype).

P: [Navigates to the search field] It would probably be enough to just search for Mercer. I'm not entirely certain how it's spelled though.

R: Well, you spelled it correctly, I can tell you that much. But are you able to find the same book if you only filter through settings?

P: I wouldn't be certain about that, because not every book is in every format.

R: No, but that's the shortcuts, we were referring to the settings up in the corner over there. But it's still very good feedback.

P: So if I search for everything, what do I get then?

R: Then you'll get everything shown.

P: I didn't think it was intuitive when the results aren't shown immediately after searching or filtering, as you have to look over to the scrollbar and see if it becomes smaller or not. It would be nice with some sort of auto-scroll or at least a preview window or something that informs you that more text will be shown.

P: So that leads me to believe that no, it's not possible through only the settings. But you said author, so if I select author then search for Mercer, all his books should show up... But they didn't.

R: No, but to be completely honest, that's a fault in the prototype, not a fault you've done. You're doing everything right.

P: [laughs] Okay.

R: The problem is that for some reason, the prototype doesn't get the information. I think I know what the problem is, but I can't tell why it's a problem. Oh well, we can move on, as we've completed the task, as you found the book. Your next task is to use the shortcuts to find all the books of a desired format.

P: Right, so say I choose audio books, then all audiobooks will be shown, right. Hmm, Peter Gryffin hasn't written the book "The snowman", has he? [laughs]

R: No, he didn't, but I thought that it'd be safer to say he did in case Jo Nesbø took offense to us using his name. [chuckle]

P: So if I search for Jo Nesbø, then that book won't show?

R: No, I can guarantee that, as we haven't been allowed to use a proper existing library for this test, so we've kind of just made a simplified version of it.

P: So it's more of the design and the layout/setup that we're here to test?

R: Yes, that's right, that's the information we're looking for, as well as how you interact with said design and the site in general, as well as how you interpret the different things. And this brings us to the next part of the user test, as we'll be comparing two existing solutions. But before that, I have a couple of questions regarding what's been done.

R: What age group do you belong to between 18-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80+

P: 50-60

R: What is your profession?

P: Part time marketing, part-time student

R: Are you visually impaired or suffering from Dyslexia

P: Visually Impaired

R: To what extent are you impaired?

P: 50%

R: Do you use any assistive technology when you browse websites?

P: None, besides a large screen and a reading TV.

R: How did you feel the user test went?

P: I did not quite understand what the purpose of the test was. I liked the big search field and the big search button, but would've preferred a different color on the background to show that they were different from each other.

R: Did you get to test the settings to adapt the search results?

P: Yes

R: Did the settings help make the site more accessible or easier to use for you?

P: Not really, but they would have helped with a larger set of results, and would have made browsing through them faster.

R: Were there any settings you preferred?

P: Not really

R: Were the settings easy to understand?

P: Yes, except for the "formats", as that to me means dimensions more so than file types. Possible solution could be to rename it to file format or file type.

R: Were there any settings you felt were missing?

P:Title.

R: Did you use any assistive technology during the user test?

P: No.

R: Okay, so now we'll change from the library page to a different concept, namely altering the design of a website. Due to the limitations of the task, this will not be anything beyond a search interface, but the examples that you will be shown will be outside of search interfaces. We'll start with ATbar. Are you familiar with it?

P: No.

R:It stands for Accessibility Toolbar, and it's based on allowing the user to make some changes. [tests the demo on the site] It doesn't look like the demo is working. Well, the thing is that the different icons there are for different functions. [explains the functions on the ATbar]. Now the reason as to why I'm telling you this is because we'd like to hear your thoughts on the matter. Are there any of the settings mentioned here now that you would like to use or have available to you?

P: Well… enlarging text is nice, but it often results in the information being spread out a bit and makes it harder to find. Color choices aren't anything I struggle with, but here I would choose black text, not gray text. As for the lighting, it would be nice with a colour overlay or a sort of filter to dampen any outside lighting on the screen. What I struggle more with is finding where I'm supposed to do something. Like here [ATbar's demo website] there's a logo here [points to

screen] but also here, so does this mean I go back or what? I don't like unnecessary information.

R: It's interesting to know this as well, as we've already discussed some of what you mentioned earlier in the project, but we decided that we didn't have the time to look into it at the time, but if we receive feedback that we need to handle it, then we'll add it to the prototype as soon as we can. The next one is Funka.com. Have you heard of them?

P: Yes, I've actually been to a user test with them. [proceeds to elaborate]

P: But there was one function they had where you had a picture of a speaker and if you click it, it will read that section of the text for you. This was very comfortable, as you didn't have to wonder how much of the text would be read, since it was clear it was only that one section. Something to check out!

R: [explains the functionality of Funka's "Browsealoud"].

P: The screen masking function is actually very comfortable to use.

R: [tests the different functions to display their functionality]

R: [explains the settings]

P: I would like to be notified when the text is a hyperlink [referring to a setting]. Kind of weird that that isn't on automatically.

R: What settings do you think would be nice for you to choose from to make websites more accessible to you?

P: I would like everything I needed to find and interact with to be on the same side, so I didn't have to look for it, it's irrelevant whether it's horizontally or vertically. Screen masking is also nice, and it would be nice to be able to choose the font size and the colors of the text and background. It would be nice to have the option for having the text read back to me. But when there are large sections of text, I find it hard to know what's a header and what's part of the text. I don't know if this will show up a new image of the text when it reads past what's shown on screen, so it's imperative that the screen moves along with the text being read. It also needs

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to be easy to stop or start the reading, either by informing me that pressing enter or start or something else.

R: Would it be of interest to be able to choose what sort of way the screen reader would handle things like titles, headings and so on?

P: Definitely, it's like the way you design a document. But when you have a screen reader reading a title, it announces it by saying "title" and then reading the title, so something like that would be nice.

R: Would color choices or changing the size be desirable to mark the different types then?

P: Well, ideally it would be possible, so everyone could specialize it to themselves.

R: Are these settings something you would like to customize yourself?

P: Yes, definitely. But I understand that during a development stage it would be necessary to choose things from a menu.

R: Are there any improvements you want to see for the first prototype?

P: I would've liked it to be more clear that something happened when I clicked something, beyond the scrollbar at the side changing size. Also something that indicated how much information was going to be shown.

R: Were there any of the other settings that you've just watched was interesting?

P: I liked the different color choices, the possibility to get it read for me and the screen masking from Funka.

R: Final question: If you could have all these settings to customize things as you wanted to, would you want this to happen automatically every time you visit a website?

P: I thought about this, but seeing as websites are so different, it wouldn't be plausible, as the different websites probably wouldn't react well to it.

--- End of user test ---

User test 3:

Researcher: [explains the prototype and helps setting up the laptop]

Participant: [browses through the settings]

R: Usually, I'd give you a task to find a specific book, but as you seem to know what you're looking for, I'm just gonna let you search using the settings.

P: Right… [checks several boxes]. What's the difference between "use these settings" and "Go back without making any changes"?

R: Well, when you choose "use these settings", it will save the settings you chose, but if you choose the other one then

P: It will go back without any of the settings?

R: Exactly.

P: [clicks "use these settings"] Ah, right, so now it only shows genre and subject?

R: Yeah, because that's what you selected.

P: Right. And there's a button for show more/less information… Will it go back then or how will this work?

R: Feel free to click it to see how it works.

P: Right… What if I try to see less? Oh, there it showed more information.

R: Yes, that's because it's not been programmed to do two things, but that's my mistake. But feel free to press it again.

P: Oh, there it showed less information again.

R: [explains the functionality of the show more/less button]

P: [browses all the existing results]

R: Right. And now we can move onto the next task, which is regarding the shortcuts I showed you earlier. If I tell you that the book "de tre bukkene bruse" is in "punktskrift" or "Braille", would you be able to find that by just using the shortcuts?

P: Well, there it is. That wasn't challenging.

R: No, but this user test hasn't been made to be challenging [chuckles]. But it's for testing the functionalities, which you've now done! Now we'll get to some questions and then we can look at a couple of other things.

R: What age group do you belong to between 18-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80+

P: 70-80

R: What is your profession?

P: Retired engineer

R: Are you visually impaired or suffering from Dyslexia

P: Visual Impairment (Naion, partially destroyed eye nerve)

R: To what extent?

P: Visus 0.2, or 80% sight loss.

R: Do you use any assistive technology when you browse websites?

P: Yes, the text to speech program called Supernova, and a large screen roughly 32". Also a magnifying glass with lights.

R: How did you feel the user test went?

P: It was pretty okay

R: Did you get to test the settings to adapt the search results?

P: Yes, but it didn't do much due to the low amount of results.

R: Did the settings help make the site more accessible or easier to use for you?

P: Not really, as the result set was quite limited.

R:Were there any settings you preferred?

P:Author and subject were nice to have

R: Were the settings easy to understand?

P:Yes, except for the "formats" and "description" part of it.

R: Were there any settings you felt were missing?

P: Title, reviews of the book from other readers. It would also be nice if you could get sub-settings when you choose a setting, such as by choosing genre, you would also get the possibility to choose one or more specific genres.

R: Did you use any assistive technology during the user test?

P: no

P: [referencing another library] And they have like 20 000 results for "crime" novels, and I find that to be ridiculous, because that doesn't help me at all. So I would like to be able to sort on subgenres again. Being able to choose subgenres to filter and then to be able to search for words after that which will let you limit it a lot before you search. Or perhaps some sort of double search.

R: Like being able to perform a search within your search results?

P: Yes, that would help a lot.

R: Are there any settings you feel were missing or that you would like to be able to get?

P: Well, a form of user reviews would actually be quite nice. I mean, the description is nice and all, but that's usually written by the publisher, which wants to sell the book, so it's often presented in the best way possible, but if I could read actual readers' feedback, it would help me decide on whether I should get this book or not.

R: Well, now it's time for us to move onto the comparison part of the user test. I will show you two websites that promote their own solutions to making the internet more accessible, namely Funka and ATbar. We will start with ATbar. [explains ATbar's functionalities]

R: And now, we'll look at Funkas "Browsealoud". [testing the screen reader functionality]

P: Oh, this one seems very usable. How does it work?

R: Well, if you mark this, then it will read that text. But unfortunately it also continues to read beyond what you've marked, sadly.

P: Oh, well that seems very usable. I especially like when it reads what you've marked and then stops, because that's something SuperNova doesn't do when I use it, it just keeps reading until I stop it.

R: Well, this one does too, unfortunately, but it would be nice if it stopped when it had read the marked area.

R: [continues to explain the functions and settings on "Browsealoud"]

R: Now we've reached the last part of the user test. There'll be a couple of more questions, before we're done. Now, the question is if you'd like all these functions as settings so you could browse websites without the use of accessibility tools.

P: The answer is: Yes please! [chuckles]

R: [chuckles] But is there any functions you'd prefer?

P: Well, I really liked Funka, but I can't really remember everything that was on ATbar.

R: That's not a problem, we can just look up that again. [brings up ATbar again] [goes through the functions one by one]

R: What do you think about the possibility to change the font?

P: That doesn't seem too important.

R: Fair enough, how about having a screen reader there?

P: That seems important, yes.

R: Okay, how about color choices and a color filter on top of the screen?

P: Both seem important, it's not something for me, but I'm sure it's useful for other people.

R: Okay then! Now, let's go over Funka's functions. What did you feel about the screen reader and the text magnifier that shows what text is read?

P: I liked it a lot, but I would like it to be easier to stop it or pause it, maybe even rewind it a bit, as some texts could be hard to catch at once, but other than that it would be fine just as it is.

--- End of user test ---

User test 4:

Researcher: [explains the prototype and helps setting up the laptop]

Participant: [browses through the settings]

P: So, what do you want me to choose here?

R: Just look through it first, and then you can see if you can find anything by using those settings.

P: I'll pick Language.

R: Alright, now you'll see the search results. There's also a button there that shows more or less information when you press it.

P: [clicks the button twice].

R: Okay, now try that again, and scroll down and see what happened.

P: So I can then search for Braille? [points towards shortcuts]

R: Yeah, that's correct.

P: But will that then filter out everything that's not Braille?

R: No, as things are now, when you click Braille, you'll automatically be shown all the resources which are in Braille.

R: Now that you're familiar with the settings and you've tested the search function, I'd like you to go into the preferences and select author and subject, and then find the book you found earlier by "Matthew Mercer".

P: So the idea is that I'm only going to get what I asked for in the results list?

R: Yes, that is the idea.

P: I would actually like it if you compressed the information more, as I have magnified the page so much that it would be nice to not have to scroll down for each result and instead get all the information on one line.

R: Well, that's certainly something that would be possible to do.

P: That would also make it easier to compare books.

R: While we're on the subject of comparison, is that an option you would like to have? The possibility of comparing several books at once?

P: It would be a bit too much text on a screen, and that gets difficult. Especially when you've magnified the site. It's easy for the information to get lost then. It's better if it's compact with the possibility of expanding, so the information spreads vertically, rather than horizontally.

R: Moving onto the shortcuts. If you could use them for anything, what would you use them for? Is there anything in particular you'd want to use them for?

P: Well, I would want them as checkboxes instead of buttons for the purpose they serve now.

R: Yes, that was the original idea, but we changed it for the prototype.

P: So, would it be used for stuff like scientific genres? Because some of the other library sites I've visited have many items where it is hard to see what's for adults and what's for children, so it would be nice to sort that more easily.

R: Alright. But if you imagine yourself as a frequent user of this site, would you want to use the shortcuts for something like common searches, previously searched or perhaps new releases?

P: Oh yes, that'd be great. Especially if you could combine some of them, to see new releases within previous searches.

R: Would it also be good to have several of the options?

P: Yes, that would be nice, especially things like new releases and if I could save earlier searches and such.

R: And back to what you mentioned about subjects, we've looked into having the option of choosing to pre-filter based on, say, genre and when you choose that more options expand out of it so you can further filter based on specific genres. Would that be something you'd want to see?

P: Definitely, that would help immensely, especially if that search could be saved.

R: Alright, now it's time for the second part of the user test, but before that I'd like to ask you a couple of general questions.

R: Which age group do you belong to between 18-30, 30-40, 40-50 or 50+?

P: That would be the latter, 50+.

R: Alright, and what's your occupation?

P: I'm currently on disability welfare.

R: As well as a student?

P: Yes, that's right.

R: And to what degree are you visually impaired?

P: Depending on the definition you go by, I'm strongly impaired. I'm the step beneath blind.

R: Do you use any assistive technology when you browse websites?

P: I use a screen reader and a magnification program.

R: And how did you feel the user test went?

P: I think it was funny and interesting.

R: Did you get to test the different preferences?

P: I'd say I did.

R: Did you find it helpful?

P: If I could get the information more compact, then yes.

R: Any of the preferences you preferred over others?

P: Not really.

R: Did you find the preferences easy enough to understand?

P: Well, I didn't read the long sentence explaining it, but I didn't have any problem understanding it, it was quite intuitive.

R: Were there any preferences you felt were missing?

P: Well, I would like to be able to just filter out Braille at once, as it's not relevant for me.

R: Did you use any assistive technology during the user test?

P: Nothing beyond standard magnification through the browser.

R: Okay. Now, for the second part of the user test, we'll be looking at two existing solutions which have different approaches towards making a site accessible. The main point here is to have you imagine which of these features you would like to be incorporated in a site, for instance the prototype. Just imagine the different features and any other that might not be shown, and see if any of them would be usable for you.

R: Now, the first solution I'll show you is the ATBar, or the Accessibility ToolBar. The solution is based around this toolbar here.

P: There were several buttons here that I don't need.

R: Yes, the idea behind it is to be a solution for many different impairments.

P: Well, there's several good things. What does the dictionary do?

R: Not quite sure, as it doesn't seem to work on their demo-site, but I would guess that it would either be a search/definition of a specific word.

P: Well, some general thoughts; If you use any accessibility tools then you already have most of these features, and even if you don't, yet need them, you would use the browser's innate features, and I feel that this is kind of a third layer on top of that, so I don't quite see the point of it. Another thing is that all these different solutions have different designs and UI, so the features are often in different places, making it more difficult to use.

R: Right, but the idea behind it seems to be that if you were away from your normal computer and just wanted to use a computer to check something online, this would enable you to use the features you're used to on any computer.

P: Ah, yes.

R: And now we'll go over to Funka's solution: "BrowseAloud". It is pretty much a screen reader. [demonstrates "BrowseAloud"]. So, what do you think?

P: Well, the idea is good, but unfortunately the problem is still that there's too many different solutions.

R: Yes, that is indeed a problem, as there's no universal standard.

R: So, last question: Are there any of the functions now seen that you would like to see on the prototype?

P: No, not really. If anything I'd just like what I mentioned earlier, about it remembering preferences, searches and reducing the number of search results. While I admit that "BrowseAloud" is excellent, and I would like to see it everywhere, it's currently only on that

site. I also like the ctrl +/- function for zooming in the browser, and would like something like that, if possible.

R: Right, and would it be desirable with a way to change font size?

P: No, not really, as I'd rather use the magnification that's in the browser.

R: Alright, well thanks for coming and participating in the user test!

--- End of user test ---