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# Using an Essentiality & Proficiency Approach to Improve the Web Browsing Experience of Visually Impaired Users

by

Jatinder Dhiensa

A Doctoral Thesis

Submitted in partial fulfilment of the

requirements for the award of

Doctor of Philosophy

of

Loughborough University

May 2010

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# Abstract

Increased volumes of content exacerbate the Web accessibility issues faced by people with visual impairments. Essentiality & Proficiency is presented as one method of easing access to information in Websites by addressing the volume of content coupled with how it is presented. This research develops the concept of Essentiality for Web authors.

A preliminary survey was conducted to understand the accessibility issues faced by people with visual impairments. Structured interviews were conducted with twelve participants and a further 26 participants responded to online questionnaires. In total there were 38 participants (both sexes), aged 18 to 54 years. 68% had visual impairments, three had motor issues, one had a hearing impairment and two had cognitive impairments. The findings show that the overload of information on a page was the most prominent difficulty experienced when using the Web.

The findings from the preliminary survey fed into an empirical study. Four participants aged 21 to 54 years (both sexes) from the preliminary survey were presented with a technology demonstrator to check the feasibility of Essentiality & Proficiency in the real environment. It was found that participants were able to identify and appreciate the reduced volume of information. This initiated the iterative development of the prototype tool.

Microformatting is used in the development of the Essentiality & Proficiency prototype tool to allow the reformulated Web pages to remain standards compliant. There is a formative evaluation of the prototype tool using an experimental design methodology. A convenience sample of nine participants (both sexes) with a range of visual impairments, aged 18 to 52 performed tasks on a computer under three essentiality conditions. With an alpha level .05, the evaluation of the Essentiality & Proficiency tool has been shown to offer some improvement in accessing information.

## Acknowledgments

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I would also like to thank Tony Warren, the head of RNIB College Loughborough who helped me to access and experience at first hand a snippet of the world for people with visual impairments. The thanks also extend to DANS and the BCAB mailing list for allowing me to get in contact with people with visual impairments. A huge thanks to all the participants for their time and interest in this study; working with you was an experience that I will cherish.

I would like to thank my husband Bhin Gill and my baby Neehal Singh Gill for being my rocks, for showing me how to smile when things were bad and for showing me how to take small steps towards my goal. Special heartfelt thanks to my parents Harbans Singh Dhiensa & Balbir Kaur Dhiensa, my sisters Jasbir Bassi & Rajveen Sull and my brother Narinder Singh Dhiensa for keeping my spirits up and making me persist in my goal. I would like to thank my extended family for endlessly supporting me through the highs and lows of this research. A special thanks to my in-laws Gurdev Singh Gill & Sullinder Kaur for caring for my baby during my final year.

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# Chapter 1 – Introduction

## Chapter Preface

This thesis documents the investigation into the assertion that setting essentiality levels and applying personal preferences to how Web content is viewed increases the effectiveness of the Website for users with visual impairments. The research behind the thesis has been heavily based in the area of disabilities with particular interest in visual impairments and Web accessibility. This research has conceptualised the Essentiality & Proficiency theory leading to the development of the Essentiality & Proficiency Tool. The tool has been user-trialled to test the above thesis.

## 1.1 Motivation for the Research: Merging Two Domains

### 1.1.1 Web Accessibility

Having entered the domain of Web Accessibility through contract work, the inspiration for this research came from a (pre-workshop) departmental presentation that was given on "Proving the Validity and Accessibility of Dynamic Web Pages'' (Stone & Dhiensa 2004). The presentation looked at how it was simple for accessibility checkers to check static pages but when it came to checking dynamic pages a number of limitations came to light.

The main limitation highlighted was that, when checking dynamic Web pages for validity or accessibility, the checkers were able to assess only one instance of the page and that each page would have to be checked and rechecked for each possible output. The proposed solution was a method to obtain a generalised output of all possible instances from a dynamic Webpage script making the process more efficient. This was done through meta-tags based on notation in the form of regular expressions.

During the presentation Colin Machin drew parallels between the solution and work undertaken by his MComp student on Capability and Essentiality in Web Content (Hook 2003). The proposal was to take work that had been based in the area of

mobile communications and apply it to the area of Web accessibility for users with visual impairments.

Although this work has been inspired by Hook (2003) the work for this thesis has been conducted by the author. There was some collaboration with Francesca Smith during the course of the project but the research has been steered and conducted by the author. Roger Stone programmed some software for the research however the author was wholly responsible for design and testing of the software.

### 1.1.2 Essentiality and Capability

The basis of this work actually lies in the area of mobile communications devices and their Web capability. Limitations in display size and bandwidth have led to the slow uptake of Web applications through mobile devices. Furthermore as a variety of viewing devices/user agents are in use, Web authors find that they have to develop multiple versions of the Web content for the user agents. The solution sought was based on the idea that by assigning essentiality levels to Web content and by allowing the user to adjust the amount of info on view by changing the essentiality level the author would need to develop only one version of each Website that would be accessible to all user agents. This would also enable the user to access the information faster. The capability factor in this work looked at the amount of information that could be conveyed based on the size of the display on the mobile device and the bandwidth at its disposal. Hook (2003) defines essentiality and capability as "[w]here Essentiality can be thought of as a measure of 'what we would like to display', Capability is a measure of 'what we are *able* to display'."

### 1.1.3 The Mergence

The parallel found between Stone & Dhiensa (2004) and Hook (2003) was to enable the Web author to complete their task in one go. In the former, the solution offered the Web author the ability to check all possible outcomes of dynamic script in one sitting. Similarly in the latter, the solution offered the Web-author the ability to create one Web-site that would be accessible to all user agents. The rationale for this research was that by taking the Web accessibility factor from the former and applying it to elements taken from the second work, it would gradually evolve into the concept of Essentiality & Proficiency. The Essentiality & Proficiency concept is a solution

that would enable the author to have one version of Website for all no matter what visual impairment the user had.

## 1.2 Aims: The Overall Goal

The purpose of this PhD is to increase access to Web content for users with visual impairments by developing a system that allows Web authors to have one version of a Website that can be personalised for individual requirements of each user. This reduces the need to have a number of versions of a Website to meet different requirements. The aim of this PhD is to enable visually-impaired users to have access to essential Web content without them having to trawl through vast quantities of information and to do this without alienating them by having various versions of a Website. This will be done by taking the concept of Essentiality & Proficiency and developing it into a tool that allows:

1. The idea of essentiality to be developed for Web authors.
2. The user to state the level of information they can digest with regards to their impairment.
3. The user also stating the visual format of the content that they or their viewing device (in this case their assistive technology) can handle.

### 1.2.1 Objectives

A series of steps have been identified to achieve the aim. These are:

1. Background research into disability, visual impairment, assistive technology, the Internet and, more importantly, the research or projects that have been and are being carried out to make Web content more accessible.
2. Understand the users and their needs. What problems are being faced by the users and how would they like to view the content? Would the notion of being able to view just essential information appeal to them?
3. Develop a technical demonstrator.
4. Test the technical demonstrator on the same participants from whom user requirements were captured.
5. Analyse and present results to the academic community.
6. Develop a prototype tool using the results of the first set of user trials.
7. Run functionality tests on the tool. Does the tool present the Web page as required by user?

8. Run tests to see if the essential content is being picked out by the prototype
9. Evaluate the prototype tool. Test what happens when the Prototype tool is used to find information. How effective is the essentiality in finding information in essentiality marked-up pages?
10. Write up the outcomes of the research and relay findings to the research community.

## 1.3 Contribution to Knowledge

The concept of Essentiality & Proficiency has been developed to bridge the gap from inaccessible Web pages to fully accessible Web pages. Although numerous attempts have been made to bridge this gap, the Essentiality & Proficiency goes further to offer a solution that has dual purposes: to enable better access to Web content for people with visual impairments but also to offer more efficient access to Web content for people who use different viewing devices. Hence it is a concept that can be applied beyond the domain of Web accessibility for both the able-bodied and people with disabilities; this is what makes it unique.

The process of researching and developing the concept of Essentiality & Proficiency and the prototype tool has highlighted both positive and negative elements of research in terms of what did and did not work. The negative elements are issues which can be avoided in the future.

Parts of the research findings are joint work with Francesca Smith and have been published by the author in conference proceedings (Dhiensa, Machin, Smith & Stone 2005). The content of Dhiensa, Machin & Stone (2005) is the basis of Chapter 5 and the content of Atkinson & Dhiensa (2007) is based on Chapter 2. Dhiensa, Machin, & Stone (2006) is extended in Chapter 6. Parts of this research have informed Atkinson, Dhiensa & Machin. (2006) and Stone, Dhiensa & Machin (2006).

## 1.4 Thesis Outline

### Chapter 2 Literature Review

This chapter defines disability and introduces the Disability Discrimination Act 1995, which grants people with disabilities the same rights as able-bodied people. The

review then narrows in to the area of Web accessibility which has evolved from the enabling legislation and explores the underlying issues and proposed solutions such as the Web Accessibility Guidelines (WCAG) 1.0 and WCAG 2.0. The solutions presented are split into hardware and software solutions. The gap in knowledge is identified alongside the techniques that are being drawn together by this research to form a possible solution.

### Chapter 3 Essentiality & Proficiency

This chapter presents the concepts of Essentiality and Proficiency that form the basis of the techniques being developed and tested through this research. There are separate explanations of Essentiality and Proficiency and a discussion of how the components are used together.

### Chapter 4 Concept to Technology Demonstrator

This chapter reports the design and use of the preliminary survey to capture the Web accessibility issues of visually impaired students. The findings from the preliminary survey are presented and these have then gone on to feed into an empirical study. The aim of the empirical study was to develop an Essentiality & Proficiency technology demonstrator to see if the users' accessibility issues could be addressed. The empirical study conducted is then discussed with a close look at the benefits and limitations of the approach.

### Chapter 5 Developing the Prototype

This chapter presents the design and development of new software to handle Essentiality & Proficiency. The system design and system architecture for the Essentiality & Proficiency prototype tool are reported. A first attempt to mark up Web pages with essentiality is discussed, leading to a possible technical solution. There is then an explanation of the iterative development of the prototype tool in preparation for the formative evaluation.

### Chapter 6 Evaluating the Essentiality & Proficiency Tool

This chapter discusses in detail the formative evaluation of the prototype Essentiality & Proficiency tool. The experimental design methodology is presented, along with the results, the discussion and the conclusion.

### Chapter 7 Conclusion

Summaries of each chapter are presented and then final conclusions are drawn from the research leading to areas of further work.

## 1.5 Motivation for the Research (Author Interest)

The author's interest in the area of disabilities started during the summer of 2002 when the author met up with a family friend who suffered from cerebral palsy. The author had seen Ian when he was a young child and thought that it would be impossible to converse with him. However by 2002 he was using assistive technology to communicate. After fully conversing with the friend, the author found the concept of using assistive technology to communicate and to gain independence of fundamental importance.

The assistive technology used in this instance was a Vanguard communication device. The Vanguard was a speech-enabling device that was attached to the wheelchair. There were two switches embedded into the headrest which were linked to a screen located in front of him. Only one of the switches was in use. The Vanguard worked by highlighting the rows available for selection via tapping the switch once. Then the row selected would highlight each box column by column which again was selected. These boxes were either a link to another page or a phrase, word, letter or number that Ian wanted to say. There was structure to the layout of each page, which ensured that there was consistency with the pages so that Ian could use them. Seeing the assistive technology in practice led to the interest in this area of research.

Unfortunately Ian passed away in 2005. The author is very grateful to Vanguard for allowing the opportunity of sharing fun-filled conversations with Ian.

# Chapter 2 - Literature Review

## Chapter Preface

This chapter defines disability and introduces the Disability Discrimination Act 1995, which grants people with disabilities the same rights as able-bodied people. The review then narrows in to the area of Web accessibility which has evolved from the enabling legislation and explores the underlying issues and proposed solutions such as the Web Accessibility Guidelines (WCAG) 1.0 and WCAG 2.0. The solutions presented are split into hardware and software solutions. The gap in knowledge is identified alongside the techniques that are being drawn together by this research to form a possible solution.

## 2.1 Disability

> *n: A disadvantage or deficiency, especially a physical or mental impairment that interferes with or prevents normal achievement in a particular area.*
>
> (Heritage 2000)

The above is a dictionary definition of disability, the legal definition is given later in section 2.4.

### 2.1.1 Disability Defined

To understand the concept of disability it is of prime importance to first define the terminology used. Generally people are confused by the terms impairment, disability and handicap and have been known to use them to mean the same (Barnes & Mercer 1996). The World Health Organisation (WHO) originally produced a classification of the terms in the form of International Classification of Impairments, Disabilities and Handicaps (ICIDH) however these have since been replaced by Functioning, Disability and Health (World Health Organisation (WHO) 2001).

Impairment is a deviation from the generally accepted norm of the body function and structure as a result of a loss or abnormality (Barbotte, Guillemin, Chau, & the Lorhandicap Group 2001). The range of body function includes the physiological and

psychological functions of the body (WHO 2001). The body structure includes the limbs and organs. Disability describes the inability to perform daily tasks and activities as a result of impairment (WHO 2001). Finally handicap defines the social disadvantages to a person as a result of an impairment/disability (Barnes & Mercer 1996). The term handicap stems from the 'hostile social environment' suffered by a person with a disability. However it should be noted that the term handicap is not readily used as it is seen to be politically incorrect.

As this research concentrates specifically on Web accessibility for the visually impaired it is important to distinguish between the different terms used for visual impairment. WHO (2009) discusses four levels of visual acuity (the clearness of vision) from normal vision to blindness with two levels of impairment in between. The terms no vision, "severely sight impaired", "mild/moderate vision", "partially sighted", "sight impaired" and "low impairment" are also used when discussing visual impairment (World Wide Web Consortium (W3C) 2005).

Blindness is defined as a substantial loss of vision in both eyes which cannot be corrected (W3C 2005). Blindness can have many causes such as cataracts (clouding of the lens), glaucoma (damage of the optic nerve) and age-related macular degeneration (loss of central vision) (WHO 2009). In contrast low vision, mild to moderate vision and partially sighted defines vision which is restricted such as tunnel vision (only the centre of the field of vision is clear), poor acuity (vision which is not sharp) and central field loss (only allows the edges of the field of vision to be seen) (W3C 2005).

The terms which will be used within this research are low impairment, mild/moderate impairment and no vision. Low impairment in this research defines vision which can be corrected using glasses, contact lens and surgery. Mild to moderate impairment defines vision which is restricted (as defined above). The term no vision, will be used in place of blindness or severe impairment.

## 2.2 Visual Impairment: The Statistics

As this research specifically centres on Web accessibility issues for visual impairments it is important to understand the number of people who are affected by visual impairment. There were 152,000 people registered severely sight-impaired (no

vision) and 155,000 people registered sight impaired (mild/moderate vision) in England on 31st March 2006 (European Commission 2007). The registers are voluntary and therefore both Action for Blind People (AFBP) (2005/06) and the Royal National Institute of Blind People (RNIB) (2004b) believe that the total figure for the UK is two million (The Information Centre 2006). It therefore appears as though "less than 1%" (300 000 in 50 million) are *registered* with a visual impairment however "over 3%" (2 million in 60 million) are *believed* to have a visual impairment.

> *"There are two million blind and partially sighted people in the UK. One in 12 of us will become blind or partially sighted by the time we are 60. This rises to one in six by the time we reach 75."*
>
> (Douglas, Corcoran & Pavey 2006)

The total number of people with visual impairments is on the increase. The primary reason for this is an increase in the numbers of elderly and with advances in medicine, this is set to double by the next 50 years (RNIB 2004b; AFBP 2005/06). The RNIB (2004b) states that the ageing population is increasing by 50 000 every 5 years. As visual impairments are most prevalent amongst the elderly, the increase in the ageing population will also mean an increase in the number of visually impaired people (AFBP 2005/06). This argument is reinforced by the statistics in Table 2.1 which show that the greatest percentage of people registered blind and partially sighted during the last 12 years were 75 and over.

Table 2.1 Percentage of people on the register of blind and partially sighted people, by age group, England 1994-2006 (The Information Centre 2006)

England — Percentage

| as at 31 March | Percentage of people aged | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0-4 | 5-17 | 18-49 | 50-64 | 65-74 | 75 and over | All ages |
| **Blind** | | | | | | | |
| 1994 | 0 | 2 | 10 | 8 | 13 | 67 | 100 |
| 2000 | 0 | 2 | 10 | 8 | 10 | 69 | 100 |
| 2003 | 0 | 2 | 11 | 9 | 10 | 67 | 100 |
| 2006 | 0 | 2 | 12 | 10 | 10 | 66 | 100 |
| **Partially Sighted** | | | | | | | |
| 1994 | 0 | 2 | 11 | 8 | 14 | 65 | 100 |
| 2000 | 0 | 2 | 9 | 8 | 11 | 69 | 100 |
| 2003 | 0 | 3 | 10 | 8 | 11 | 68 | 100 |
| 2006 | 0 | 3 | 10 | 9 | 10 | 68 | 100 |

Table 2.1 also shows that the registered blind and partially sighted people do not fit into one age category. Similarly, Douglas et al. (2006) conducted an extensive study of 1007 people ("Network 1000") registered blind or partially sighted which evidences that the visually impaired population are not a "homogenous group". The sample has been used to represent the visually impaired population and findings highlight that the group differs greatly in terms of age, gender, ethnicity, onset and level of visual impairment (The Information Centre 2006). All these factors influence the needs and preferences of the individual and hence for this reason it is integral to the process of developing products of an adaptable nature that will enable the visually impaired population to live an independent lifestyle (RNIB 2004b; Douglas et al., 2006; Douglas, Corcoran & Pavey 2007).

Furthermore one very interesting finding from the Network 1000 study shows that even in 2006 visual impairment is generally perceived as a great individual barrier. Participants of retirement age (48%) and working age (30%) of the representative visually impaired population find visual impairment a barrier when using computers (Barthel 1995; Douglas et al. 2006, 2007). This is closely followed by social barriers such as the inaccessibility of the equipment itself, lack of confidence, financial costs of assistive technology and concerns relating to training (Vincent 1996).

What this suggests is that the barriers faced by visually impaired population to accessing Web-based information start even before they reach the Internet (Douglas et al., 2007). For this reason it is essential that once they reach the Internet and access Web pages they face 'as few' problems as possible and the way to do this is to research possible methods that will reduce Web inaccessibility.

## 2.3 Assistive Technology Used by Visually Impaired People to Access the Web

It is integral to understand how people with visual impairments access information that appears on the screen and also how they input information. Assistive technologies are used as a first measure to overcome accessibility problems such as not being able to see the screen or use the keyboard. At its simplest, people with

visual impairments adopt one of three alternative methods to access Web based information:

1. Enlarging text size using screen magnification software
2. Having text vocalised using screen reading software
3. Using refreshable Braille displays

The screen magnification software magnifies everything on the screen. Screen reading software works together with the operating platform and the software to render aurally all the information on the monitor (Royal National Institute of Blind People (RNIB) 2008). The refreshable Braille displays are Braille keyboard attachments which sit along the length of the keyboard. The refreshable Braille displays work with the screen reading software and output a line of text at a time in Braille using small pins.

Alternative text formats in terms of simpler wording are adopted by users with an additional cognitive disability, which to some extent takes difficult words and translates these into simpler words for people with conditions such as dyslexia (Disability Rights Commission (DRC) 2004). Furthermore accessibility features such as enlarging font size and changing text and background colour are readily available in operating systems for those who have milder visual impairments however very few people are aware of these functionalities (Hanson et al., 2005; LARS 2006; Apple 2007; Microsoft 2007). There are also specialist browsers such as WebbIE and the Web Adaptation Technology which will be discussed in more detail later (UMIST 2004; Hanson 2004).

The screen reader's aural output or synthesized speech will include everything from the start up screen, to toolbars and any software used. When browsing Web pages the screen reader reads the page left to right and outputs all the information in a linear top to bottom manner. The screen reader will read the title, the URL, and then the content.

The visually impaired user has to rely on the keyboard to control the screen reader as it is non-visual medium (RNIB 2008). Using the tab keys the user is able to navigate from one element to another such as links, form fields, buttons, objects and images.

The screen reader also allows the user to use commands for example to navigate page headings, frame headings, and links in a page. Once the element is identified it is read out, for example the link "Contact us" would be aurally outputted as "Link, Contact us" and the search icon that is used for "Search" will be outputted as "Button, Search".

Good navigation of a Web page using a screen reader is greatly dependent on the correct use of headings, link texts and alt texts (RNIB 2008). If these elements are not in place the user will not be able to navigate the Web page and will also miss out on important information. For example suppose a Web page for a health spa has a gallery which contains images of the facilities such as the salt water swimming pool, steam room and foot spa. If the images do not have the detailed alternative text descriptions (alt texts) which are attributed to graphical images and icons, then the visually impaired user will not be able to have the same access to the information about the spa facilities as a sighted user.

A limitation of the screen reader is that the output has to be listened to from beginning to end, there is no scope for scanning as can be done by a sighted reader (RNIB 2008). So if a Web page contains a vast amount of text, the user will have to listen to all the content before deciding whether the information is what they required. Based on this the research shows that there is currently a gap in terms of having a tool that will reduce this information quantity for the visually impaired user to sort through in order to get to the information that they require. This is discussed further in section 2.8.3.

### 2.3.1 Audio & Visual Renderings

Unfortunately as stated above the assistive technologies themselves present problems for the visually impaired users as different processes are required to break down the same information depending on which output format is chosen (McMillin & McMillin 1989; Yesilada 2005). Hence it is of prime importance to understand the differences between audio output and visual output when attempting to address the issue of Web inaccessibility as these lay the foundations for this research. Yesilada (2005) details the differences at length.

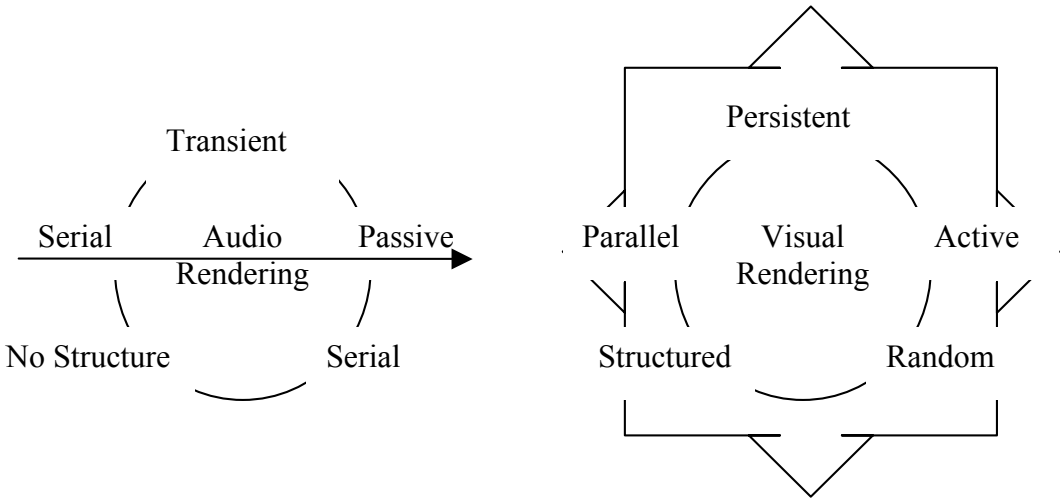



Figure 2.1 - Key differences between audio and visual rendering as identified by Yesilada (2005)

Figure 2.1 defines audio output to be more restricting than visual output due to its serial and passive nature (as shown by the single arrow flowing in one direction). The restriction in audio output means that the user would have to listen to all the output to get to the information that they require. Aural clues cannot be obtained in audio output. However visual clues can be found in a visual rendering, this is shown by the quad-arrow which flows in many directions (Zajicek 2001, Walshe & McMullin 2004; Harper & Bechhofer 2005). The effort taken to try to work out aural clues leads to disadvantages such as: increased cognitive effort, increased load on working memory and also increased task completion time (Kottapally et al., 2003).

In contrast it could be argued that visual output offers "concurrent accessibility of multiple actions" due its parallel and active nature (Monk 1994). In other words the user would be able to pick and choose from the information and carry out more actions due to the amount of information available in one instance. If one set of information is going to be rendered in both audio form and visual form, as displayed in figure 2.1, the original source needs to be both "statically coherent and dynamically coherent" as both output format are very different to each other (Weber 1998; Moehling, Smith, Stewart, & Swenson 1999).

## 2.4 Disability Discrimination Act 1995

The Disability Discrimination Act (DDA) was passed in 1995 with the intention of allowing people with disabilities to operate in the environment alongside able-bodied people (Moore 1995; DWP 2003). However in order to be able to use the act, the individuals needed to first prove that they fitted the definition of disability under the act. The DDA states that:

> *"a person has a disability for the purposes of this Act if he has a physical or mental impairment which has a substantial and long-term adverse effect on his ability to carry out normal day-to-day activities."*
>
> (United Kingdom, Parliament 1995)

The DDA identified two forms of discrimination (Gooding 2000). Firstly, discrimination may exist when a disabled person is treated less favourably due to their disability. The second form of discrimination takes place when adjustments have not been made to enable a disabled person to make full use of services or to participate in education and employment (RNIB 2004c; DRC 2006).

The DDA was not a robust piece of legislation as corners could be cut and furthermore many areas were found to have been missed out completely (Equality Challenge Unit (ECU) 2004; DRC 2006).

> "*In December 1997, the Government established the Disability Rights Task Force, an independent body comprising members from disability organisations, the private and public sectors and trade unions, to advise it on how best to meet its 1997 manifesto commitment to look at securing comprehensive and enforceable civil rights for disabled people. As a result of the Task Force's first recommendations, the Government established, in April 2000, the Disability Rights Commission. (The constitution and functions of the Commission are set out in the Disability Rights Commission Act 1999)"*
>
> (United Kingdom, Parliament 2004)

The Disability Rights Commission (DRC) ceased existence on the 28th September 2007 and the role of securing civil rights for the disabled had now been taken on by the Equality and Human Rights Commission which started on 1st October 2007 (Directgov 2009).

The DRC worked towards updating and amending the DDA. Three items of legislation: SENDA 2001, DDA Amendments Regulations 2003, Disability Discrimination Bill 2004 alongside a number of codes of practice have been developed in the process towards achieving Full Civil Rights in 2006 (Gooding 2000; DRC 2006). The Disability Discrimination Bill in particular extended the definition of disability by widening the scope, for example to include duties on public authorities and also on transport such as a revision of rail vehicle accessibility (United Kingdom, Parliament 2004).

However this research concentrates on the accessibility of Websites, which were not initially covered by the DDA. This was clarified in the Code of Practice (2002), which gave Websites the status of a service and therefore Website accessibility became a legal requirement from 1st October 1999 (Gooding 2000; Webcredible 2005; RNIB 2006):

> "*The Act makes it unlawful for a service provider to discriminate against a disabled person: by refusing to provide (or deliberately not providing) any service which it provides (or is prepared to provide) to members of the public; or in person."*
>
> Section 2.2 (pg 7) (Disability Rights Commission (DRC) 2002)

Furthermore the code detailed the obligations of services and service providers (section 2.13 - 2.17 in the Code of Practice 2002) and used the example of an airline company's online flight reservation and booking service as a Website accountable to the act (DRC 2002). However this example has since been omitted in sections 4.5 – 4.9 in the revised Code of Practice (2006) which came into force on 4th December 2006.

Through the DDA, the DRC (2006) aimed to achieve *"a society where all disabled people can participate fully as equal citizens."*

However Gooding (2000) and Hudson (2004) argue that the DDA on its own is not enough to make a great impact and there is a great need for social understanding of disability. Furthermore there has been a slow uptake of the DDA by service providers due to lack of awareness of the legislation (Gooding 2000; DRC 2002). In contrast it appears that social inclusion for people with disabilities is becoming more and more a mainstream concern. This is apparent from the European Commission's (EC) Policy on eInclusion, which aims to ensure that disadvantaged people have equal access to digital communication and are not digitally excluded (Sloan 2001). eInclusion goes beyond disabilities in terms of the disadvantaged groups and also includes the elderly and the less affluent.

It is evident that the DRC placed great importance on Web accessibility as their first formal investigation was to assess the accessibility of the Web (which will be discussed later in section 2.6.7) by measuring Website conformance to the Web Accessibility Guidelines 1.0 (WCAG 1.0) (Disability Rights Commission (DRC) 2004). The WCAG 1.0 guidelines which were developed by of the Web Accessibility Initiative (WAI) (see section 2.5.1), have had a great influence on the field of Web accessibility as they have been the accessibility standards used by a number of countries.

### 2.4.1 Section 508 of the Rehabilitation Act

The United States Congress addressed the problem of inaccessibility of information technology by amending the Rehabilitation Act with Section 508 in 1998 (IT Accessibility & Workforce Division (ITAW) 2008). The purpose of the amendment was to force Federal agencies (which is the equivalent to the Civil Service) to eliminate the factors that hindered the disabled accessing electronic and information technology and enable equality. More specifically it is the Web-based Intranet and Internet Information Applications (1194.22) standard in Section 508 which concentrates on the accessibility of Websites (ITAW 2008). This standard sets out 16 rules which are based on WCAG 1.0 and which need to be followed for Website compliance. The limitation of Section 508 is that compliance is limited to federal (government) Websites and therefore cannot be used against commercial Websites.

### 2.4.2 Legal Cases against Web Inaccessibility

As stated above although Section 508 cannot be used against commercials Websites two prominent Web accessibility court cases have however been brought in the United States under the Americans with Disabilities Act (ADA) (DBTAC National Network of ADA Centers 2009). Title III of the ADA of 1990:

> "*prohibits discrimination on the basis of disability by public accommodations and requires places of public accommodation and commercial facilities to be designed, constructed, and altered in compliance with the accessibility standards established by this part."*
>
> 36.101 (Purpose) (Department of Justice 2002)

In contrast to the DDA, where Websites are considered to be services, the two court cases have used title III of the ADA to consider Websites as "public spaces" (DBTAC National Network of ADA Centers 2009). The first court case was filed by Robert Gumson in October 2002 (DBTAC National Network of ADA Centers 2009). Robert Gumson who is blind, experienced extreme difficulty when trying to purchase airline tickets from Southwest.com.

The case filed against Southwest.com was an attempt to get the company to redesign the Website for greater accessibility. In particular Robert Gumson requested the provision of alternative text for the graphical navigation buttons on the Southwest Website as it was not possible for his screen reader, which translates text into audible output using a voice synthesizer, to translate the graphical images into text. However Gumson lost the lawsuit as ADA's criteria for "public spaces" was deemed too ambiguous and it was questioned whether the Internet should be included in the criteria.

The second court case was filed by the National Federation of the Blind (NFB) against Target.com (DBTAC National Network of ADA Centers 2009). In September 2006 the court ruled that a claim could be made against Target, based on the inaccessible nature of the Website hindered the level of enjoyment that would be experienced from the goods and services in the Target stores. This case was settled

out of court. The settlement included the continual monitoring of the Target Website for accessibility by the NFB. Other Web accessibility lawsuits have also been filed against companies such as Ramada, Priceline, American Airlines and AOL but these have been settled out of court (DBTAC National Network of ADA Centers 2009; Mason & Casserley 2000).

#### *2.4.2.1 Sydney Organizing Committee for the Olympic Games v Maguire*

The landmark Web accessibility court case of Sydney Organizing Committee for the Olympic Games (SOCOG) versus Maguire took place in Australia on 24th August 2000 (Mason & Casserley 2000). The Human Rights and Equal Opportunity Commission (HREOC) supported a complaint lodged by Bruce Maguire on 7th June 1999 against the Sydney Organizing Committee for the Olympic Games (SOCOG) under the Disability Discrimination Act 1992. Maguire, who is blind and is a Braille display user, lodged a complaint against the inaccessibility of the official SOCOG Website and in particular the failure to provide Braille copies of information to order tickets and Braille copies of the souvenir program. HREOC supported the complaint and ordered SOCOG to make their Website accessible. SOCOG ignored the court order and were subsequently fined A$20 000.

In conclusion, social inclusion has been made possible by the introduction of the Disability Discrimination Act (1995) and also more recently by the EC Policy on eInclusion. However the problem with the DDA is that although it identifies that service providers need to take necessary steps to eliminate any discrimination, there is slow take-up of service providers developing or amending their Websites to be accessible.

## 2.5 Accessibility Not Required

The World Wide Web was invented in 1989 and was initially a text-only interface and a monotype at that. It was developed using HTML (Hypertext Mark-up Language) to be a means of data sharing (Fairweather, Hanson, Detweiler & Schwerdtfeger 2002; Ross 2002). Surveys show that the initial proposed average user for the Web was seen as a white educated male IT worker (The World Wide Web Consortium (W3C)

2004a). Hence there was little need for accessibility compliance for users with visual impairments.

The inclusion of scripting languages and style sheets has enabled Web authors to state how they wish the browser to display the content of their Web pages in order to produce a visually-pleasing interface (Pitkow & Kehoe 1995). Furthermore, the introduction of extensions to HTML, upgraded the Web from text-only format into a rich source of information represented in a mixture of textual, visual and audio forms (Fairweather et al., 2002).

The Web now offers a huge array of services ranging from search engines, e-commerce, and entertainment which has now further been extended by Web 2.0 (Mason & Casserley 2000; W3C 2004a; Webcredible 2006). Even though the progression of the Web opens up positive experiences for users such as reducing isolation through social networking, the fundamental problem with this is that not all users are able to readily appreciate all the media used as there has also been a shift in the user base of the Web (Pitkow & Kehoe 1996; Busby & Whitehouse 1997; Lee 1999; Mason & Casserley 2000; Sloan 2001; Hackett, Parmanto and Zeng 2003; Douglas et al., 2007). Users are not solely white, male, able-bodied, middle-class technology experts, but range from people with disabilities, to the elderly, the less affluent and ethnically diverse. Additionally the exponential growth of the information age has seen vast amounts of information made available on the Web which are argued to be lacking in standards and structure which further impact accessibility (Bauwens, Evenepoel & Engelen 1995; Moehling et al., 1999; DRC 2004).

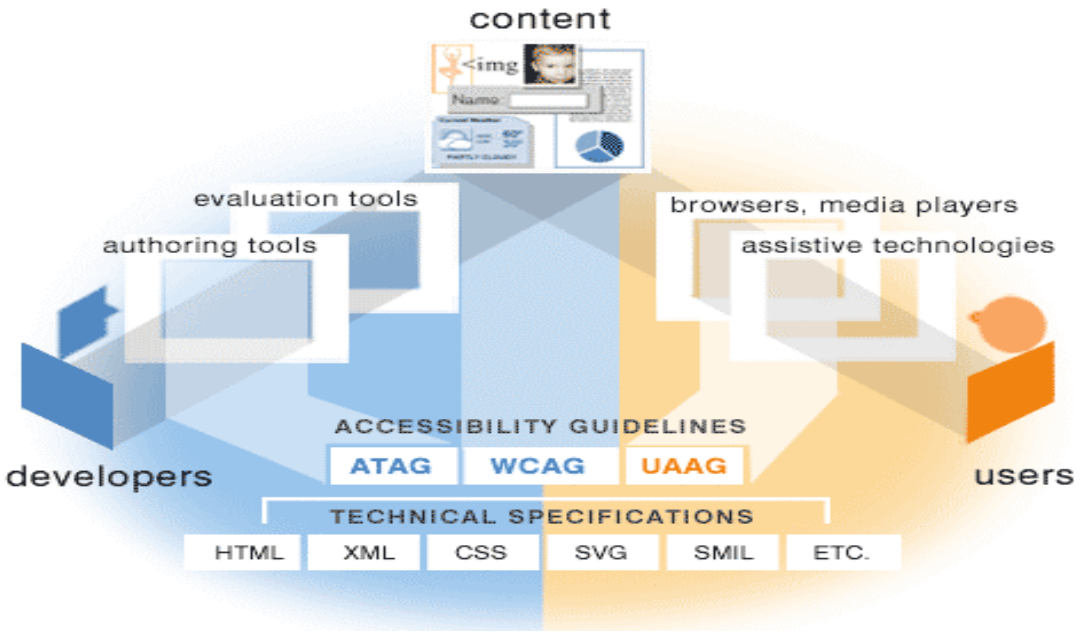
## 2.6 Addressing Web Inaccessibility

As suggested earlier, assistive technologies have their own limitations (see section 2.3) but accessibility problems are further exacerbated when the users are unable to interpret what is presented (the content of Web pages including for example navigation bars, body of text, images and inline links) due to inappropriate design (McMillin & McMillin 1989; Barthel 1995; Hale 2000; DRC 2004). For instance the increased use of audio-visuals has led to problems in the form of screen readers not being able to decipher the image if there is no additional text (Vincent 1996; Petrie,

Morley, McNally, O'Neill and Majoe 1997; Sloan, Gregor, Rowan and Booth 2000; DRC 2004). Similar problems were also initially experienced with electronic documents (Barthel 1995; Bauwens et al., 1995).

Hence the issue of inaccessible electronic documents preceded Web inaccessibility during the early 1990s and earlier attempts have been made to address the problems through the development of "content considerations" and "electronic text standardisation" (Barthel 1995; Bauwens et al., 1995; Busby & Whitehouse 1997). Although these solutions can be seen as shaping the area of Web accessibility, it was the World Wide Web Consortium (W3C) founded in 1994 that started to address issues of inaccessibility in 1997 through the Web Accessibility Initiative (WAI) (Brewer 1999; W3C 2004).

WAI developed Web Content Accessibility Guidelines (WCAG), User Agent Accessibility Guidelines (UAAG) and Author Tool Accessibility Guidelines (ATAG); WCAG 1.0 are the oldest of the guidelines (WAI 2006). As stated earlier, Web Content Accessibility Guidelines (WCAG) offer advice on how to make Web content accessible. User Agent Accessibility Guidelines (UAAG) are guidelines developed to advise on the design of accessible user agents (devices used to browse Web content) which will help lower accessibility issues faced by disabled Web users. Authoring Tool Accessibility Guidelines (ATAG) advise developers of authoring tools (such as HTML editors) on how to generate accessible Web content.




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Figure 2.2 - Web accessibility processes devised by (WAI 2006)

Figure 2.2 shows how WAI envisages the different components to fit together to achieve an accessible Web. Although very important, UAAG and ATAG play a lesser role in this research and have not been considered at great length as this will follow when work is continued on the development of the essentiality authoring tool for Web authors.

### 2.6.1 Web Content Accessibility Guidelines 1.0

The Web Content Accessibility Guidelines 1.0 (WCAG 1.0) were developed and recommended in May 1999 (Brewer 1999). The primary purpose of WCAG 1.0 is to promote the accessibility of Web content for users with disabilities. This is done by addressing two general themes which are ensuring graceful transformation and making the content understandable and navigable. WCAG 1.0 states that adherence to the guidelines by making small adjustments will ensure that Web content is accessible by all users and user agents (browsing devices such as PC, PDA, mobile phones etc). Although accessibility guidelines have been produced by a number of organisations such as RNIB and Macromedia, WCAG are seen to be the most comprehensive and most widely used (Sullivan & Matson 2000; Yesilada 2005; BSI 2006; EC 2007).

WCAG 1.0 is a set of 14 guidelines which are accompanied by a detailed set of checkpoints. The definitions of these checkpoints explain the practical application of each guideline. Each checkpoint has a priority level assigned to it based on the checkpoint's impact on accessibility.

Here is an example of a WCAG 1.0 guideline along with the checkpoints that accompany this guideline:

> *Guideline 4: Clarify natural language usage.*
>
> *Checkpoints:*
> *4.1 Clearly identify changes in the natural language of a document's text and any text equivalents (e.g., captions). [Priority 1]*
> *For example, in HTML use the "lang" attribute. In XML, use "xml:lang".*
>
> *4.2 Specify the expansion of each abbreviation or acronym in a document where it first occurs. [Priority 3]*
> *For example, in HTML, use the "title" attribute of the ABBR and ACRONYM elements. Providing the expansion in the main body of the document also helps document usability.*
>
> *4.3 Identify the primary natural language of a document. [Priority 3]*
> *For example, in HTML set the "lang" attribute on the HTML element. In XML, use "xml:lang". Server operators should configure servers to take advantage of HTTP content negotiation mechanisms so that clients can automatically retrieve documents of the preferred language.*
>
> (Web Content Accessibility Guidelines (WCAG) 1.0, Guideline 4)

#### *2.6.1.1 WCAG 1.0 Priority Levels*

There are three priority levels: Priority 1, Priority 2 and Priority 3. The example of WCAG 1.0 guideline 4 (as shown above in section 2.6.1) displays the priority levels associated with the checkpoint. For example checkpoint 4.1 is Priority 1 and checkpoint 4.2 is Priority 2.

If Priority 1 is not achieved then a number of user groups will not be able to access the Web content. If Priority 2 compliance is not achieved then a number of user groups will have difficulty in accessing the Web content. Without Priority 3 compliance, user groups may have some difficulty accessing the Web content.

If all of the checkpoints in Priority 1 are met then the Website can claim WAI conformance level A and display the corresponding symbol on the site. If all checkpoints in Priority 2 are met, then level double A can be claimed and if Priority 3 is met then level triple A can be claimed. These conformance levels are self-assigned.

#### *2.6.1.2 WCAG 1.0 and Essential Content*

As this thesis looks at accessibility of essential content found in Websites it is important to understand how WCAG 1.0 addresses this. Essential content is any text, images or audio (or a collection of these) used to convey important information. Although the WCAG 1.0 definition of essential content is similar to the definition of essentiality as proposed by this research it does not discuss it in the same context (see Chapter 3).

For instance, WCAG 1.0 states that all essential content should be conveyed to all users regardless of their disability and for this reason the guidelines propose the use of equivalents. The use of equivalents is the process of inaccessible content being replaced by a different format of the same content. A prime example of this process is the text equivalent which is used to replace an image with a textual description of the image. For instance the text “a roaring lion” may be equally informative to users with a visual disability as an image of a roaring lion. The guidelines state that the equivalent must contain enough detail to convey the essential content.

WCAG 1.0 presents a number of solutions in the form of text equivalents and non-text equivalents (such as auditory descriptions of complex visual presentations, or video of sign language for written text). WCAG 1.0 states accessibility of essential content to be of high importance and therefore assigns the use of accessible equivalents as advised by guideline 1, checkpoints 1.1 to 1.4 with a Priority 1.

#### *2.6.1.3 WCAG 1.0 Content, Structure and Rendering*

As discussed in section 2.6, inappropriate design of Web pages creates accessibility problems for users of assistive technology. WCAG 1.0 draws particular attention to document content, structure and presentation as contributing to the accessibility barriers faced by disabled users. Document content is defined as the text, images, animation and music that are used to relay information. Structure is the use of structural elements such as header, list, table etc used to organise the content. Presentation defines the different types of rendering such Braille, synthesized speech, text-only or graphical presentation and can be controlled by presentation elements such as colour, font, centre etc.

WCAG 1.0 identifies some of the accessibility issues as experienced by disabled users:

> *"Not all users can make use of visual clues such as image maps, proportional scroll bars, side-by-side frames, or graphics that guide sighted users of graphical desktop browsers. Users also lose contextual information when they can only view a portion of a page, either because they are accessing the page one word at a time (speech synthesis or Braille display), or one section at a time (small display, or a magnified display). Without orientation information, users may not be able to understand very large tables, lists, menus, etc."*
>
> (WCAG 1.0)

The following WCAG 1.0 guidelines are proposed to address the accessibility issues (as stated above) caused by document structure and rendering:

- *Guideline 2: Don't rely on colour alone*
- *Guideline 3: Use Markup and style sheets*
- *Guideline 4: Clarify natural language use*
- *Guideline 5: Create tables that transform gracefully*
- *Guideline 12: Provide context and orientation information*
- *Guideline 13: Provide clear navigation mechanisms*
- *Guideline 14: Ensure that documents are clear and simple*

Guidelines 2, 4, 5, 12 and 14 have at least one checkpoint assigned with Priority 1. The checkpoints of guideline 3 and 13 were assigned Priority 2. This suggests that content structure and rendering play a great importance in accessibility for WCAG 1.0. Web authors need to ensure that they pay particular attention to the content and structure when designing their Website otherwise some groups of users will not be able to access the Website.

Furthermore the importance of essential content, as discussed in section 2.6.1.2, is also mentioned by WCAG 1.0 when advising on document structure. Guideline 13, checkpoint 13.8 advises Web authors to:

> *Place distinguishing information at the beginning of headings, paragraphs, lists, etc. [Priority 3]*

Distinguishing information is important as it aids the users' understanding of the essential content. WCAG 1.0 states that placing such information at the beginning of structuring elements such as heading and lists, is called 'front loading' and has great benefit for users of screen readers. (The accessibility issue caused by the serial output of screen readers is discussed in section 2.3.1) The benefit of checkpoint 13.8 is reinforced by its assigned level of Priority 3 (as discussed in section 2.6.1.1) which suggests that by satisfying this checkpoint, there will be improved access to the Web document.

### 2.6.2 Limitations of WCAG 1.0

Smith, S.R (2005) believes the problem with guidelines such as WCAG 1.0 is that they are produced with the stance of moral objectivism. In other words it was a grand idea developed for the good of disabled people. However, WCAG 1.0 had been criticised for being too technical and difficult to apply (Kirchner 2002; Webcredible 2006). Hence the Web Accessibility Initiative (WAI) developed Web Content Accessibility Guidelines (WCAG) 2.0, which became a W3C recommendation on the 11 December 2008.

The primary purpose of WCAG 2.0 is to address accessibility issues for a greater range of disabilities such as blindness and low vision, photosensitivity, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement and speech

disabilities. It was felt that the modifications suggested by WCAG 1.0 placed greater importance on visual impairments and that the other disabilities were less favoured (Boldyreff, Burd, Donkin & Marshall 2001; Milne et al., 2005; Bohman & Anderson 2005). WCAG 2.0 also attempts to be less technical and in line with the latest technologies.

### 2.6.3 Web Content Accessibility Guidelines 2.0

WCAG 2.0 differs from WCAG 1.0 as it is based on 4 principles, 12 guidelines and their Success Criteria. The 4 principles are: perceivable, operable, understandable and robust. WCAG 2.0 defines the principles as:

1. *Perceivable - Information and user interface components must be presentable to users in ways they can perceive.*
    - *This means that users must be able to perceive the information being presented (it can't be invisible to all of their senses)*
2. *Operable - User interface components and navigation must be operable.*
    - *This means that users must be able to operate the interface (the interface cannot require interaction that a user cannot perform)*
3. *Understandable - Information and the operation of user interface must be understandable.*
    - *This means that users must be able to understand the information as well as the operation of the user interface (the content or operation cannot be beyond their understanding)*
4. *Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.*
    - *This means that users must be able to access the content as technologies advance (as technologies and user agents evolve, the content should remain accessible)*

(Web Content Accessibility Guidelines (WCAG) 2.0)

WCAG 2.0 states that the principles are integral to developing accessible and usable Web content. Hence if the principles are not true for a Website then it will be inaccessible for users with disabilities.

Each principle is divided into guidelines. The main purpose of the guidelines is to ensure that Web content is accessible and therefore can fit the needs of a wide range of users with cognitive, sensory and physical disabilities. The guidelines are accompanied by Success Criteria which specify what needs to be achieved for conformance.

#### *2.6.3.1 WCAG 2.0 Success Criteria*

The Success Criteria are testable statements which will either be true or false. The following is guideline 1.1 with its Success Criteria:

> *Guideline 1.1: Text Alternatives: Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, Braille, speech, symbols or simpler language.*

Success Criteria for guideline 1.1:

> *1.1.1 Non-text Content: All non-text content that is presented to the user has a text alternative that serves the equivalent purpose, except for the situations listed below. (Level A)*
>
> - *Controls, Input: If non-text content is a control or accepts user input, then it has a name that describes its purpose. (Refer to Guideline 4.1 for additional requirements for controls and content that accepts user input.)*
> - *Time-Based Media: If non-text content is time-based media, then text alternatives at least provide descriptive identification of the non-text content. (Refer to Guideline 1.2 for additional requirements for media.)*
> - *Test: If non-text content is a test or exercise that would be invalid if presented in text, then text alternatives at least provide descriptive identification of the non-text content.*

- *Sensory: If non-text content is primarily intended to create a specific sensory experience, then text alternatives at least provide descriptive identification of the non-text content.*
- *CAPTCHA: If the purpose of non-text content is to confirm that content is being accessed by a person rather than a computer, then text alternatives that identify and describe the purpose of the non-text content are provided, and alternative forms of CAPTCHA using output modes for different types of sensory perception are provided to accommodate different disabilities.*
- *Decoration, Formatting, Invisible: If non-text content is pure decoration, is used only for visual formatting, or is not presented to users, then it is implemented in a way that it can be ignored by assistive technology.*

(WCAG 2.0, Guideline 1.1, Success Criteria 1.1)

The Success Criteria are similar to the checkpoints in WCAG 1.0, as they accompany the guideline when testing for accessibility. Like the checkpoints and their assigned priority levels in WCAG 1.0, the Success Criteria in WGAC 2.0 are divided into levels of conformance in terms of Level A Success Criteria (lowest level of conformance), Level AA and Level AAA (highest level of conformance). The difference between WCAG 1.0 and WCAG 2.0 is that, where WCAG 1.0 guidelines and checkpoints were criticised for being too technology specific, the Success Criteria attempts to be more 'technology neutral' by presenting sufficient techniques, advisory techniques and common failures to aid the understanding of what is accessible and what is not (Webcredible 2006, W3C 2008).

Sufficient techniques advise on what is sufficient to pass the Success Criteria. Advisory techniques advise on what will enhance accessibility. Advisory techniques are just advisory and are not sufficient to pass the Success Criteria. Common failures are known practices in Web development which do not conform to WCAG 2.0.

#### *2.6.3.2 WCAG 2.0 and Essential Content*

WCAG 2.0 separates the definitions of essential and content. WCAG 2.0 defines essential as:

> "*if removed, would fundamentally change the information or functionality of the content, and information and functionality cannot be achieved in another way that would conform."*

Content is defined as:

> *"information and sensory experience to be communicated to the user by means of a user agent, including code or markup that defines the content's structure, presentation, and interactions."*

This differs to WCAG 1.0, which coupled essential and content together as defined in section 2.6.1.2.

Even though the term essential appears a number of times throughout WCAG 2.0, for instance guideline 1.4, Success Criteria 1.4.5 and Success Criteria 1.4.9 and guideline 2.2, Success Criteria 2.2.1 and Success Criteria 2.2.2, it is very specific to images of text in the former guideline and time limitation in the later. So although WCAG 2.0 does discuss the term essential it is not in the same context as will be used in this research. The issue of essentiality as defined in this research (see Chapter 3) is not addressed by either WCAG 1.0 or WCAG 2.0.

### 2.6.4 Limitations of WCAG 2.0

Even though WCAG 2.0 highlights how improvements should be made in line with the specified disabilities in a design-for-all manner, this does not necessarily lead to accessibility optimisation (Hudson 2004; Web Accessibility Initiative (WAI) 2007). For instance, how do the adjustments made for users with visual impairments such as in guideline 1.2 of WCAG 2.0 apply to users with cognitive impairments such as dyslexia? One suggestion is that guidelines should be more context-aware in terms of factors such as the purpose of the Website and how the user will view it (Sloan et al., 2006).

Another argument against the guidelines is that they are the product of retrofitting. The domain of accessibility up until recently has been a game of catch-up. However

the development of technologies, such as the evolution of Asynchronous JavaScript and XML (AJAX), and the ability of the user to generate their own content produces more accessibility issues (Webcredible 2006). A prime example of the difficulties for the visually impaired user is that they require sight to be able to appreciate the ability of AJAX to change the content of a part of the page without refreshing the whole of it.

Although WCAG 2.0 is envisaged to be "technology independent" and applicable to both current and future technologies, experts feel that these guidelines are too vague and require a more technology-focused approach. Hence there is need for guidelines to be produced alongside the development of the technology in order to allow the disabled user to reap simultaneous benefits alongside able-bodied users (Lee 1999; Sloan, Gregor, Rowan and Booth 2000; Sullivan & Matson 2000; Petrie, Hamilton & King 2004).

### 2.6.5 Web Accessibility Tools

The effort to ensure accessibility does not stop with the adoption of the WCAG 1.0 and WCAG 2.0 guidelines is enhanced with a range of evaluation tools which test using these guidelines (Sloan, Gregor, Rowan and Booth 2000; Assistive Technology Resource Center 2004; Stone & Dhiensa 2004; WAI 2006). The automated checkers can be categorised into *accessibility evaluators* which allow the author to check each page for compliance with the guidelines and *accessibility repair tools,* which allow the authors the further functionality of pin-pointing and repairing each problem (Assistive Technology Resource Center 2004). A comprehensive list of the range of accessibility checkers has been compiled by the Assistive Technology Resource Center (2004) and Yesilada (2005) and an evaluation of the tools has been conducted by Kirchner (2002).

### 2.6.6 Limitations of the Accessibility Checkers

Evidence suggests that even with the ready availability of accessibility checkers Websites are failing to meet the compliance levels (Sullivan & Matson 2000; Disability Rights Commission (DRC) 2004). One reason is that automated checkers are limited as they cannot check for all conformance points as some are left to human judgement (Moehling et al., 1999; Sloan, Gregor, Rowan and Booth 2000; Petrie,

Hamilton & King 2004; Stone & Dhiensa 2004). Hence it is strongly advised that accessibility testing should not be left solely to automated tools and that it should incorporate testing with proposed users (Chisholm & Henry 2005; Milne et al., 2005; British Standards (BSI) 2006). Compliance assessed by automated checkers may also provide a false sense of security.

One possible solution to overcome the above failing of accessibility checkers is to manually check for accessibility problems (WCAG 2.0; Web Accessibility Benchmarking Cluster 2007). The Web Accessibility Benchmarking Cluster (WAB) (2007) proposes the Unified Web Evaluation Methodology (UWEM). The UWEM is a methodology to evaluate conformance to WCAG 1.0 by endorsing both manual and automated testing. It advises experts on how to carry out manual checks, in a step by step process, on single Web pages and on complete Websites. The aim is to ensure that there is consistency in the manual checks. So if two experts were to carry out manual checks on the same Web page they would achieve the same results.

Another limitation of accessibility checkers is that they are based on one set of guidelines such as WCAG 1.0 and are more likely to test HTML than other languages (Takata, Nakamura and Seki 2004). Hence the accessibility checkers can be seen as restricting accessibility to certain formats. Could this be another reason why certain sites fail the tests?

On the other hand, even if a page is 100% WCAG accessible it can still be useless to some users due to sheer volume of content (Hiltz & Turoff 1985; Asakawa 2005; Sloan et al., 2006). Users who access Web pages using screen magnification software are hindered by large amounts of text (Moehling et al., 1999). Due to the magnification, users find that they have to work extra hard to pin-point the information that they require. So if Websites are developed to be very pleasing for able-bodied people and this is coupled with perfectly accessible pages there will still be the issue about the volume of content which causes the problems highlighted in section 2.3.1 concerning the two different renderings.

### 2.6.7 Investigations into Web Accessibility

As discussed earlier, the DDA (1995) highlights the importance of Websites being accessible to the disabled users. We have seen the development of Web accessibility guidelines and evaluation tools to address the inaccessibility (Ross 2002; RNIB 2004a). However investigations have been carried out showing that Web inaccessibility continues to exist (Kuriawan 2002, Ross 2002, DRC 2004; Bailey & Burd 2005).

For example, Sullivan & Matson (2000) tested 50 of the most popular Web sites such as such as AOL, CNN and ZDNet. They found that up to "82% of the 50" Websites tested were inaccessible. Another investigation found that "71% of 100 Fortune 500 company Websites" were inaccessible (Nicholas & Romano 2002). Furthermore the DRC conducted a formal investigation into Web accessibility and found that "81% of the Websites surveyed failed to meet the basic requirements" of WCAG 1.0 (DRC 2004).

So why are they failing? Petrie, Hamilton & King (2004) conducted an evaluation of 100 Web sites for accessibility. The evaluation found that the blind participants had the greatest difficulty in using the sites. Visual clutter, complex page layouts, difficult navigation systems and poor colour contrast were the most recurring faults in the Websites. Furthermore incompatibility between assistive technologies and navigational links were found to be cumbersome for the users (Sloan, Gregor, Rowan and Booth 2000; Petrie, Hamilton & King 2004).

The causes of these failings are that: Web authors have little understanding of the guidelines, they find the guidelines too restrictive and the process too time-consuming (Petrie, Hamilton & King 2004). But above all it is evident that Web authors are simply ignoring accessibility issues (Sullivan & Matson 2000).

Issues of Web accessibility are being voiced not only in academia but, more importantly, by the people experiencing the problems. Here are some examples taken from a Web accessibility email thread published by the British Computer Association of the Blind (BCAB) (2007) of how people with visual impairments view Web accessibility and suggest possible ways of improving matters for themselves:

*"I've just come across a Website that claims to have WAI – AA and WCAG 1.0 having a symbol in the corner of the screen. The thing I don't agree with is the colour contrast – white text on a light blue background."*

This shows that even though Web authors are trying to make their Websites accessible, users still experience accessibility problems and want the ability to change the visual presentation.

*"I only need Lunar for one reason that is to invert the screen to high contrast black so I can use white font. I am experimenting with the magnification at times."*

*"I do like to see pictures as well, if only through a glass darkly. I often shut Lunar off for this. If the photographs are not in too much detail and if I know what they are I can after a while see them. I think this is due to the brain filling in what it knows should be there. Some days I am good at getting a fix on a picture other days not…"*

(BCAB 2007)

These statements reinforce the argument for some form of personalisation (explained in detail in section 2.8) which will address the users' requirements.

*"I don't think there's ever going to be a solution that can meet everyone. I suppose that the other option would be to change colour preferences within your magnification software, but I don't know about others but sometimes this can be very confusing as it changes the whole screen and sometimes makes it difficult to differentiate between the menu bars and other screen content."*

*"Surely the Web designer needs to allow for the possibility of change by the end-user though? Some Web-pages are hard-coded with text, colour combinations etc. And in this case the browser doesn't over-ride them. Starting with a good colour combination is a good idea, but we also need the possibility of change coded in as well."*

*"Web developers should indeed be thinking about separating presentation from structure in their Websites and creating the possibility for change by the user."*

(BCAB 2007)

The BCAB list members that contributed to the email thread have clearly identified a need for a solution that will allow the users to obtain alternative presentations of Websites which fit their needs. However developing alternative interfaces such as text-only is not the answer, as this type of solution will only address a specific disability (Hanson 2001; Jay, Stevens, Glencross & Chalmers 2006). The answer lies in improving the existing interface to a level that it can be used by a range of able-bodied, disabled, young and old users through universal access (Kline & Glinert 1995; Stephanidis 2001; Mankoff, Dey, Batra & Moore 2002; Hoffman, Grivel & Battle 2005).

## 2.7 Universal Access v Contextual Accessibility

Stephanidis (2001) defines universal access as a method of meeting the needs of all possible users. A comprehensive discourse on the topic of universal access is presented by Stephanidis (2001). As Web technology has evolved, the userbase has broadened significantly in terms of: ethnicity, abilities and skills as was discussed in section 2.5. For all possible users to access the same Web page there needs to be solution in place that can personalise the page to each user. Web personalisation is one method of enabling universal access within the Web domain. Even though this research concentrates on users with visual impairments, the overall goal is to present a Web personalisation approach which can be used by a range of users with other limitations such as device capability as well (discussed in section 2.8.3).

More recently experts have begun arguing that universal accessibility is not possible and that we should actually aim for contextual accessibility (Petrie, Weber & Fisher 2005; Sloan et al., 2006). Contextual accessibility is achieved when a Website or product is developed with the awareness of the context in which it will be used, coupled with optimising the use of alternative methods to provide accessible information (Sloan et al., 2006).

Contextual awareness is integral to the Web personalisation approach presented by this research. The approach enables the information contained in Websites to be personalised to the user and present it in the most appropriate format. The information is rated by its level of importance in order to deliver the core message of the Website to the user. The user is then able to select a level of importance and

receive it in their preferred format. Rating the importance of information is only possible by understanding the context within which the user will use the Website. Therefore it can be argued that this research takes elements of both universal access and contextual accessibility. Chapter 3 presents the approach in more detail.

## 2.8 Web Personalisation

Web personalisation is where a Web page or Web service can be personalised or adapted to fit user requirements. The advantages of Web personalisation lie in its ability to ease information overload as is addressed by this research and also create customer loyalty (Pierrakos, Paliouras, Papatheodorou, & Spyropoulos 2003).

### 2.8.1 User Modelling

Web personalisation stems from the domain of user modeling (Kobsa 2001; Stephanidis 2001; Pierrakos et al., 2003). User modeling is the process of gathering user data in terms of characteristics for example skill level or preferences and creating a cognitive model of the user. User modelling has been used in the development of software systems in order to achieve better information retrieval, task completion and for other purposes (Kobsa 2001). For an extensive review of the development of user modelling over 20 years see Kobsa (2001).

#### *2.8.1.1 User Profiles*

Better task completion and information retrieval is achieved when a system can cooperate with the user (Korfhage 1984; Stephanidis 2001; Anand, Kearney & Shapcott 2007). The system can only do this if it has an understanding of the user requirements and needs (Bhatia 1992; Kobsa 2001). Part of the approach being considered for this research is to generate user profiles which will allow users to access Web content based on their strength of visual impairment. The findings presented by Gunderson (2004) are a prime example of why user profiles are being considered for this research.

Gunderson (2004) has shown how the severity of a user's visual impairment effects the time taken to complete simple tasks on the Web. Users were split into three groups (Gunderson 2004). In the allocated time the control group of non-disabled users completed 75% of the tasks, the low vision group completed 25% and the blind

group completed 12.5%. This study identifies how users with different levels of visual disability have different needs and abilities. Creating profiles for categories of these conditions is one possible method to address the different needs and abilities of users with visual impairments when using Web content. These user profiles will allow the Web content to be mapped to the user needs based on their visual impairment.

By generating a range of user profiles there is a greater ability for a product to be accessible to a range of users rather than one specific group (Sugiyama, Hatano & Yoshikawa 2004). Hence, although this research is concentrating on the Web accessibility needs of users with visual impairments, the overall goal is to make Web content more accessible to users with a wider range of limitations such as device capability, restriction on time etc. Macias & Sanchez (2001), Carreira, Crato Goncalves & Jorge. (2004) and Anand et al. (2007) provide evidence of user profiles being successfully used in a range of Web personalisation approaches.

### 2.8.2 Web Adaptation

Web adaptation is the first personalisation approach considered for this research. Web adaptation defines a system's ability to adapt the visual output to the user requirements. Specialist browsers such as Web Adaptation Technology and WebbIE are a form of Web adaptation as they offer users with varying disabilities the ability to customise the visual interface to meet their needs (Hanson 2004; UMIST 2004). The specialist browsers have been developed to provide users with the ability to navigate around complex Web pages (Zajicek, Powell & Reeves 1998; Kottapally et al., 2003; Yesilada, Stevens & Goble 2003; UMIST 2004; Yesilada 2005).

For example Web Adaptation Technology browser gives users various options by which they can alter the interface 'on the fly' (Hanson 2004). The visual contents of the page can be enlarged and the font adjusted, for example, in order to reduce the distractions on the page. The key to this technology is that it adapts content returned from HTTP requests and thus the visual adaptation appears exclusively for the user and the page source is left unchanged. Although Hanson's (2004) Web Adaptation Technology transforms Web content to the user needs it does not enable the user the ability to view only the essential information.

In contrast UMIST (2004) developed the WebbIE text browser for Blind and visually impaired user. WebbIE allows the user to browse the Web in text format. The browser displays the pages in text format and the user is able to navigate the page and go to different links by using the arrow keys. UMIST (2004) believe that the WebbIE browser enables the user to fill in forms with ease. The browser can work in conjunction with a screen reader, or the user with some good sight may simply adjust font size and colour to suit their requirements.

The limitation with specialist browsers such as WebbIE, is that they are developed for one specific disabled group and do not address the needs of others (Boldyreff et al., 2001; Hanson 2001). Another limitation with specialist browsers is that they solely adapt one presentation format into another which may create further problems. For example one dyslexic user may appreciate the simple text format produced by WebbIE. However as the WebbIE produces the whole Web page in a textual format, another user may find that there is too much text for them to comprehend and this could be the source of confusion for them. Hence this exemplifies the need for a Web personalisation approach which places an emphasis on accessing the right volume of information and to present it in the format required for the user.

Some users simply desire the ability to make small adaptations such as enlarging text and changing the font style whereas other users want more functionality such as being able to control the volume of information they view (Petrie, Morley, McNally, O'Neill & Majoe 1997; Huang & Sundaresan 2000; Hanson 2004; Lee 2004). Reducing the amount of information leads to better information processing (McMillin & McMillin 1989; Zajicek 2001; Kottapally et al., 2003). This is done by removing extra information and retaining the core information.

The aim of this research is to present a method to control the volume of information delivered to the user by extracting the important information contained in a Website. The ability to control the volume of information and to deliver it in a presentation format suitable to the user will increase accessibility to the Website. In this research the volume of information will be controlled through content adaptation whereas Web adaptation will be used to change the presentation formats to the user needs.

It may not be sufficient for a user to have a single profile. Some users' requirements change during the day. Zajicek (2001) believes that the variation in user requirements, apparent through the life-course and also throughout a single day benefits from Web adaptation and content adaptation.

### 2.8.3 Content Adaptation

It has already been identified that accessibility barriers are created for the visually impaired when different media are used (Oppenheim & Selby 1999; Davis, Kendall & Meeks 2002). This is also the case for different user agents, for example, as most Websites are developed for large displays and therefore difficulties occur when viewing the same content on a smaller device as it is argued that this is a disability in itself (Lee 1999; Huang & Sundaresan 2000; Davis et al., 2002; Mankoff et al., 2002; Jay et al., 2006). So a system is required that enables the user to state how much content their user agent can accept (Carreira et al., 2004).

The development of methods and systems for content adaptation that allow the content to be presented according to device requirements is not a novel idea (Nakano, Harumoto, Shimojo & Nishio 2002, Chen, Ma & Zhang 2003; Berhe, Brunie & Pierson 2004; WaSP 2004; Mohomed, Cai & Eyal de Lara 2006; Forte, Claudino, Lopez de Souza, Francisco do Prado & Santana 2007). Similar content adaptation is required for example for visually impaired users because as, stated in section 2.3.1 difficulties are experienced when trying to obtain information that is of most interest (Yoshida & Kindo 1999; Sloan, Gregor, Rowan and Booth 2000; Walshe & McMullin 2004). When content is made adaptable for more than one person there is nothing to stop it meeting the requirements of the elderly, the novice or even the time constrained as is the intention of this research (Hanson 2001; Stephanidis 2001; Zajicek 2001).

#### *2.8.3.1 Semantic Mark-up*

One method of content adaptation being utilised is semantic mark-up and the use of Resource Description Framework (RDF), which initially allowed information to be represented in a machine-readable and understandable format across a range of user agents. Content adaptation using semantic mark-up has been extended towards solutions for the visually impaired (Pontelli, Xiong, Gupta & Karshmer 2000; Huang

& Sundaresan 2000; Mukherjee, Ramakrishnan & Kifer 2004; Quan & Karger 2004; Brunet et al., 2005). Some of these solutions are discussed in section 2.8.5.

### 2.8.4 Web Personalisation Techniques

Content-based filtering techniques are machine learning methods. The machine learning methods are used to examine Web content, predominantly text, in order to understand what the users want (Pierrakos et al., 2003). For example WebClipping2 as proposed by Carreira et al. (2004) incorporates content-based filtering coupled with a user profile strategy to extract news articles that are of interest to the user according to their profile. The proposed use of user profiles in this research differs from WebClipping2. The profiles in WebClipping2 are based on the system monitoring reading behaviours whereas the profiles in this research will be based on the user manually selecting how they would like to view the Web page. Furthermore similar technologies are available under the banner of Really Simple Syndication (RSS) to enable Web sites to receive and relay up-to-the-minute news in real time.

Social or Collaborative filtering is used to personalise a service without having to examine Web content. The personalisation is achieved by understanding the common features in the preferences of a range of users. Social and Collaborative filtering relies heavily on user feedback for example when users rate an item, this is recorded by a system (Anand et al., 2007; Pierrakos et al., 2003). Anand et al. (2007) present a prime example of Social and Collaborative filtering.

Manual decision rule systems are where the Web author personalises a Web service with the cooperation of the user. Pierrakos et al. (2003) state that user registration procedures are used to obtain static user models. The static user models define the rules for how the Web content is to be presented to the users. Content-based filtering, social or collaborative filtering and manual decision rule systems are just some of the approaches used for Web personalisation (Stephanidis 2001; Pierrakos et al., 2003; Sugiyama et al., 2004).

The Web personalisation approach put forward by this research can be defined as a content-based filter combined with the characteristics of a manual decision rule system. The approach looks at the level of importance of Web content and filters the

content based on decisions made by the user. The user is asked to manually create a user profile which will set out the rules by which the content is to be filtered and presented to their requirements.

### 2.8.5 Web Personalisation for the Visually Impaired

A number of Web personalisation based applications have been developed to allow better access to Web content and present it in the most suitable format (Huang & Sundaresan 2000; Sloan, Gregor, Rowan and Booth 2000; Hanson 2004; Lee 2004; Loney & Festa 2004). Specific attempts at Web personalisation have also been made for people with visual impairments (Macias & Sanchez 2001; Santiago, Martinez, Leija & Hernandez. 2001; Takagi, Asakawa, Fukuda & Maeda 2002; Carreira et al., 2004; Walshe & McMullin 2004; Parmanto et al., 2005; Gupta & Kaiser 2005). To some degree the examples of Web personalisation can be divided into the two groups: one which is totally an automated process and one which has manual inputs.

#### *2.8.5.1 Manual Web Personalisation*

The AVANTI browser is one of the earliest examples of a Web personalisation that incorporated Web adaptation techniques to match content and presentation to user requirements (Stephanidis 2001). The AVANTI browser was based on the User Modelling Server (UMS) which enabled user-orientated adaptations and the Hyperstructure Adaptor (HSA) which enabled content adaptations. The adaptations were based on user characteristics, such as, type of disability, skill and interests.

A profile of the user was initially compiled through a questionnaire which was completed during initial interaction with AVANTI browser or the information was obtained using a smart card. An understanding of the user in terms of user selections and navigation was acquired dynamically during their live interactions with the AVANTI browser. Stephanidis (2001) states that the resulting adaptations from the AVANTI browser were mostly alternative presentations, additional functionality for example shortcuts, and conditional presentation of technical details. The AVANTI Browser can be seen as the starting point of Web adaptation and content adaptation being considered as an approach to address the issue of Web inaccessibility for people with disabilities.

In contrast Pontelli et al. (2000) present a framework approach based on the semantic structure to ease the non-visual navigation of tables, frames and forms. Their approach is to parse and analyse the HTML code that makes up the Web page in order to produce a structural representation. The structural representation is a synthesis of the syntactic structure (in terms of whether the HTML element is a table or frame) and the semantic structure (how it semantically fits into the Web page).

The semantic structure is captured by an automated analysis of the HTML code. The purpose of the automated analysis is to find HTML tags that form the tables or frames. This is followed by a manual annotation of the document which specifies how the table or frame form should semantically be represented and how it should be navigated. The navigation is specified by commands written in a Domain Specific Language (DSL). The tool designed by Pontelli et al., (2000) then navigates the structural representation to produce an output as defined by the DSL commands.

Pontelli et al. (2000) is a prime example of semantic mark-up used as a Web personalisation solution (as introduced in section 2.8.3.1) for the visually impaired. Where Pontelli et al. (2000) has concentrated on the non-visual navigation of tables, frames and forms, Huang & Sundaresan (2000) and Mukherjee et al. (2004) have extended the use of semantic mark-up into more encompassing automated Web personalisation solutions.

#### *2.8.5.2 Automated Web personalisation*

Huang & Sundaresan (2000) present Aurora which transcodes Web content semantically rather than syntactically. Huang & Sundaresan (2000) define media-type and encoding components of the Web page as syntactic constructs. Semantic constructs are defined as meaning of the Web content. For example the context in which a search box is used for a search engine will not be obvious from the HTML form element (Huang & Sundaresan 2000).

Aurora undertakes this task by mapping the content into a schema-defined XML, which it then returns to the user in their appropriate rendering for example a speech output for a portable device. Aurora is presented as an alternative Web interface that

is able to reduce the Web page into the consistent style required by the user. It is a three-step process:

1) User enters a hyperlink in a system-generated Web page.
2) Aurora downloads the external Web page and gets the assigned XML – transformation rule. Using the rule Aurora extracts the appropriate data and maps it into a XML fragment in the original XML document.
3) Aurora then generates a new Web page

Mukherjee et al. (2004) offer a semantic bookmarking approach to accessing the Web. The semantic bookmarking approach is based on structural analysis and semantic labelling based on an ontology specific to a domain. The process is to assign segments of a page with semantic labels based on the logical structure of the page. Mukherjee et al. (2004) present an example of the news Website and suggest semantic labels such as "Major Headline News" and "Taxonomy News". These semantic labels will be read out by an assistive browser. The user can then select those segments of interest and bookmark them. When the user selects a bookmark, the Web page is retrieved and the content is automatically restructured and semantically labelled. If the content labels match the bookmark, then it is read out to the user.

The downfall of these approaches is that good interoperability depends on an agreement about the language used and its associated meanings (Yesilada 2005). This is because without such an agreement there will inevitably be a number of systems with their own meanings that will not be able to understand or work with each other. Mukherjee et al. (2004) and Huang & Sundaresan (2000) reduce the volume of information by allowing the user to select sections of interest from the whole Web page. The approach put forward by this research reduces the volume of information by filtering the important information from all the sections the whole Web page and presents that to the user. Therefore the approach presented by this research differs from the work of Mukherjee et al. (2004) and Huang & Sundaresan (2000).

#### *2.8.5.3 Parallel Web Personalisation Solutions*

The following Web personalisation solutions have been grouped as having parallel features to the approach offered by this research. The parallel features identified in Macias & Sanchez (2001), Paramanto et al. (2005) and Iaccarino, Malandrino & Scarano (2006) are that they offer a Web personalisation approach using content-based filtering which attempt to increase accessibility to Websites. However the approaches differ from the work of this research.

For example Macias & Sanchez (2001) present KAI which they call a transformation tool. KAI, which is a Kit of Accessibility to the Internet, classifies different parts of the page and presents them according to user needs. KAI uses the Blind Markup Language (BML) which is based on XML. Macias & Sanchez (2001) state that BML has been designed to build Web pages that are not restricted by presentation or technology.

KAI performs a number of processes on a Web page. Firstly it transforms the HTML/XML into BML, then it filters, repairs, restructures and presents the output according to the requirements which the user has defined. An audio/touch browser is also offered to further enable the visually impaired user better access to the Web content.

In contrast Paramanto et al. (2005) present AcceSS which is Accessibility through Simplification and Summarisation. Simplification defines the process of removing clutter and retaining important Web content. Summarisation provides the visually impaired user with a preview of the Web page.

Paramanto et al. (2005) believe that the simplification process is similar to the role of a “guide dog”. The simplification is done through genre-based templates and pattern matching algorithms. A genre-based template is an object containing a rule system. The rule system is used to locate landmarks in a Web page, for example a navigation menu landmark is located near the top of the page.

The process of simplification and summarisation is:

- User requests Web page
- URL is analysed in order to detect the genre
- Once the genre has been detected then a matching process is performed to identify the main landmarks of the Web page and parts of the page that are not important.
- The genre of the Web page dictates the structure of the output and the summarisation of the Web page. The Web page is therefore presented accordingly.

Iaccarino et al. (2006) present PAN (Personalisable Accessible Navigation) which is an intermediary service designed to increase Web accessibility. PAN is a set of edge services built upon a Scalable Intermediary Software Infrastructure (SISI). Initially the user has to install the SISI framework on their device. The user can then access the PAN services through an access page. PAN incorporates a manual decision rule system where the user tells the system what they want and this forms their profile. PAN offers four main edge services, these are text-based, link-based, FilterImages and easy and smooth navigation.

There are limitations to these attempts. Even though Paramanto et al. (2005) have gone to great lengths to develop genre-based templates there is a chance that some of the important information is missed out during the matching process especially if the Web author changes their website. Furthermore although Macias & Sanchez (2001), Paramanto et al. (2005) and Iaccarino et al. (2006) suggest parallel solutions, they tamper with the integrity of the page and it can be argued that removing the content 'changes the feel of the page' and also infringes on the Web author's copyrighted material (Lee 2004; Brajnik, Cancila, Nicoli & Pignatelli 2005).

The approach proposed by this research allows the Web author to mark up the content, so if some of the content is removed; the author is still able to deliver the core message. The argument against this may be that it produces more work for the author (WaSP 2004). However the counter argument is that this may enable the user to perform better as they will not have to sift through unnecessary content (Hiltz & Turoff 1985; Lee 2004; Brajnik et al., 2005).

Evidence shows that many attempts have been made to allow the user to personalise the content of Websites to meet their requirements; this research will further the attempts by combining user requirements and device requirements whilst sustaining author intentions in order to deliver user-specific output. To achieve full Web accessibility there has to be complete cooperation between the guidelines, Web authors, tool developers and the users; with requirements for the whole process to be more context-aware (Miesenberger & Puhretmair 2005; Chisholm & Henry 2005; Sloan et al., 2006). However until this happens there will be development of solutions to bridge the current gap between inaccessibility and a fully accessible Web (Brajnik et al., 2005).

## 2.9 Conclusion

The number of people with visual impairments in the United Kingdom is growing. People with visual impairments face a number of obstacles even before they reach the Web. Development of civil rights such as the DDA 1995 and Section 508 of the Rehabilitation Act has enforced the fact that that the disabled should not be treated less favourably. Although Web technologies are a great method of social inclusion this has been hampered by the emergence of inaccessible, media-intensive Websites.

The inadvertent, less favourable treatment has led to the intervention of Web accessibility guidelines and evaluation tools. Both the guidelines and tools have limitations. Studies have shown that full Web accessibility does not exist. Furthermore even if 100% accessibility is achieved, there is still the issue of content size which affects the effective use of visual and audio rendering.

The fact is that although great strides have been taken to achieve a fully accessible Web, this is a long way off. Hence this research is important in trying to address two core issues (a) to make inaccessible Websites become accessible and (b) control the volume of content in order to achieve effective rendering of information. As the Web has evolved with new technologies and various presentation formats, content requires clear structure and mark-up. This will allow it to be received by users according to their needs.

### Chapter Summary

The literature review has defined disability and reported how people with visual impairments are affected by the inaccessibility of IT before they even attempt to surf the Web. The DDA 1995 and Section 508 of the Rehabilitation Act have been reported along with landmark cases showing how legal attempts are being made to tackle Web accessibility issues. The WCAG guidelines and accessibility tools have also been reviewed to understand how W3C has tried to regulate Web accessibility. Investigations into Web accessibility of Websites have been presented and a case has been made for the need to develop a personalisation solution which not only adapts the visual presentation but also adapts the content. Current research into Web personalisation, Web adaptation and content adaptation has been explored as a baseline for the Essentiality & Proficiency concept which is reported in Chapter 3.

# Chapter 3 - Essentiality & Proficiency

## Chapter Preface

This chapter details the concepts of Essentiality and Proficiency that form the basis of the techniques being developed and tested through this research. There are separate explanations of Essentiality and Proficiency and a discussion of how the components are used together.

## 3.1 Essentiality

On any given Web page, there will be some sections of information that are of more use than others. Web sites are often found to contain very little information that is absolutely essential. In other words, the meaning of the site could easily be conveyed in a much smaller volume of information than is actually present. Some elements of the page may have a high degree of information content making it essential for these to be displayed. At the same time, other elements are purely aesthetic (such as most of the images on a page) and can be cumbersome for those who have a disability (for example a visual impairment) and those who have little time and/or bandwidth.

Therefore, at its simplest Essentiality is a contextually-defined concept used to enable the author to divide up the content into passages and to identify how important each passage is in conveying the intent of the page. As a concept Essentiality is a means by which Web authors are able to make their Web content more digestible for both users and user agents. This will be explored further on section 3.4.

Take an example of a user organising a conference trip and needing to identify a hotel in which to stay. At this stage the user requires only the most essential information, such as location and room rates, to be displayed. The author can identify this information by setting a high essentiality level on this information, and this could allow the user to retrieve the selected information much faster and more easily. In contrast, if the very same Website was being used by holidaymakers, they may wish to retrieve further information, such as details of attractions local to the hotel as well as the information on location and room rates. Whilst this information is important to

the hotel it is not as important as a list of the hotel's facilities. Recognising this, the author might assign lower essentiality levels to the information on local attractions.

Having established the concept of essentiality it is possible to develop a method of delivering a volume of information that the user can handle. By rating the content based upon how essential it is to the process of conveying the meaning of the site, a method is evolved that will restrict the volume of content that is delivered and subsequently displayed from a given Web page. As highlighted earlier the author is required to perform this rating, as it is only the author who will know which part or parts of a given page are the most 'essential'. The technical details of how this is done are discussed in chapter 5.

### 3.1.1 Essentiality: Author Appeal

The question that arises is why would a Web author wish to increase their workload by trying to assign levels of essentiality? Essentiality would appeal to Web authors for two reasons. The first reason is that it will help make the page more accessible and therefore potentially increasing the user base, as accessibility enables a wider range of users to access the site. The second reason is that as the authors have to define the importance of the content, this provides them with an impetus to develop a concise site. The site would benefit from the partitioning of the content as this would separate out noise, making the site more information-rich and more usable at the same time.

## 3.2 Proficiency

Section 3.2 is split into three sections covering: Capability, Rendering and Proficiency.

### 3.2.1 Capability

Originally Web content was designed to be displayed on the relatively large screens of PCs and work stations with fast processors and network connections. However with the advancement in mobile and communication technology Web content is now also displayed on mobile phones and other highly-portable devices as well. However the capability of mobile phones to display content varies depending on factors such as display size and connection bandwidth. The problem that then occurs is that Web

pages in general contain large amounts of information in an assortment of formats which may not all be suitable for the displays of various mobile phones and other devices.

Some Web authors have been persuaded to produce alternative page s or even whole Websites for delivery of such devices. However an alternative solution to this problem would be to retrieve only the essential content and displaying it in relation to the capability of the device. Therefore the essence of capability defines the limitations of devices with small displays and/or low bandwidth to display information. The fact is that not all user agents or viewing devices can display the same content. In order to be able to allow devices to display a given Web page in a meaningful manner, we seek a method for removing the unnecessary content and reducing the content to what is essential for them.

Hook T.E, (2003) recognised the limitations and developed a mark-up scheme, which he called CEML to deal with Capability and Essentiality together (see figure 3.1). CEML stands for Capability and Essentiality Mark-up Language. The Web author assigns essentiality levels to the content as already described taking note of the profile of the information content that it is intended to deliver. This, clearly, is done at the stage of authoring the content by the Web author. When a request is made for the Web page, the Web server elicits information about the user's agent in order to identify limitations on display size and/or bandwidth. This is a measure of the capability of the device and assists in determining the volume of information that should be delivered in order to satisfy such limitations.

Thus, the setting of essentiality levels has implications for the author in terms of what the author would like to display, whereas capability is a measure of what the user agent can display.

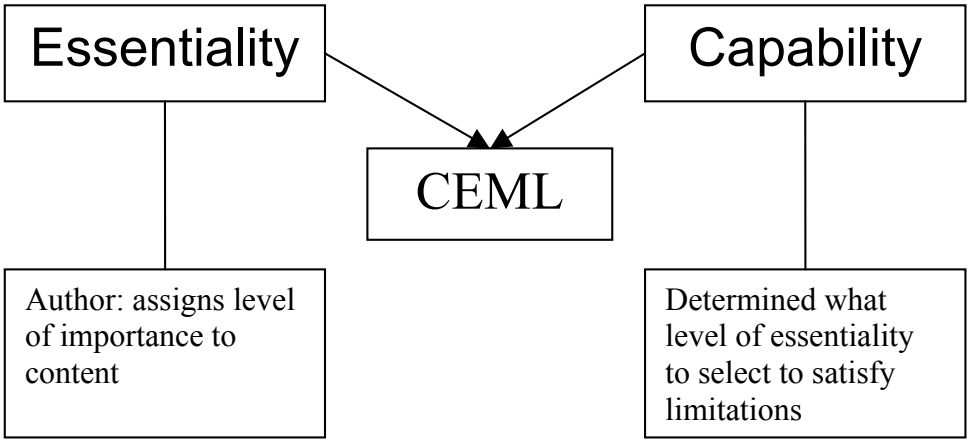



Figure 3.1 Essentiality and Capability: As Proposed by Hook

Capability, then, is a measure of the volume rendering ability of the user agent. The same logic can be applied to the ability of a given visually-impaired user to accept or perceive particular content or formats. Different forms of visual impairment impact users in very different ways. For example, cataracts produce low-contrast vision, with associated loss of resolving power and sharpness. People suffering from glaucoma will see an image only in the central field of vision. The opposite is true of those with macular degeneration, where only the area surrounding the axis is visible. Those with symptoms of diabetic retinopathy have blotchy vision. As a result, it is possible to identify particular solutions to many of these forms of visual impairment. In doing so, we have come up with a near-parallel solution to that of display or bandwidth limitations.

Abilities in reading and navigating a Web page vary significantly between users with different levels of vision. Furthermore the technology used to view the page imposes different requirements upon its presentation. Screen readers, for example, will move sequentially down the source text of a Web page reading as it goes. Users of screen magnifiers will have to scroll around the screen in search of the required content. Instead of seeing the content as a whole, as is intended by the author, the user has to work through the content sequentially or randomly, hoping to eventually stumble across what is sought. Even users with some useful vision will find few visual clues such as colour contrast, font size or position which would help identify what is important and what can be skimmed.

Our chosen solution to this problem begins by allowing the user to create a user profile, which describes the user's "viewing" requirements. The profile may, for example, define the fact that the user can see content only when high contrast is used or might define that as the user has no useful sight, in which case a screen reader will need to be used in order to vocalise the content. These differing requirements will, of course, have a profound effect on the way in which the content is rendered.

### 3.2.2 User Profiles: Rendering Content to Meet Requirements

The first step to creating a user profile is to allow the user to apply personal formatting preferences. By way of a rather crudely-defined example, table 3.1 divides visual impairments into three categories with generic user profiles based on the two characteristics, namely strength of vision and assistive technology used. The categories of vision used are rather crude, but are used as metaphors for a range of conditions in order to illustrate a point.

Table 3.1 Base user profiles for various degrees of visual impairment

| User Profile | Strength of Visual Impairment | Adaptation |
|---|---|---|
| 1 | Low impairment | ▪ Large font<br>▪ Different background |
| 2 | Mild/ Moderate impairment | ▪ Screen magnification software |
| 3 | No vision | ▪ Screen readers<br>▪ Refreshable Braille displays |

In reality, of course, there is a huge variety of eye conditions of varying severity. Both cataracts and nystagmus limit sight, but in different ways. Additionally, the effect of each may be rather limited or may have led to almost complete depletion of sight. Each of these conditions has a different set of presentation requirements when it comes to using the Web and will, therefore, call for a different profile.

In any event, a profile can be defined through a collection of parameters such as font size, font colour, background colour and text style. These parameters are chosen to allow the results to be displayed in a form suitable for users across a wide range of

conditions. Profiles will differ substantially across a range of visual conditions, and so base profiles for each condition can be created in advance. These default profiles will prevent the user having to complete a form, which may be time consuming and stressful. The values contained in the selected default profile can be manipulated subsequently by the user to tune the results.

Some conditions may require much more complex profiles. A user with macular degeneration will need a profile that steers the system away from placing important content in the centre of the screen. This kind of adaptation is rather more complex and is outside the scope of the current work.

A substantial volume of literature exists on the question of user profiles and it is not the intent that this thesis should extend that work. Rather, we seek to use the idea of user profiles alongside other techniques. Different visual impairments require different rendering schemes and user profiles. However this is only the first step in meeting the accessibility requirements of users with visual impairments. The next step is to address the problem of sheer volume of information that is apparent not just for the visually-impaired user but also for novice computer users.

### 3.2.3 Proficiency

As the Internet is almost entirely a visual experience, it is important that visually-impaired users are able to access the same information easily and in the most suitable format for their needs just as it is displayed for all others. One major obstacle to easy navigation and usability for the visually impaired user is the sheer volume of information on the page in front of them (as stated in the Chapter 2 section 2.3.1).

A sighted user can scan a Web page looking for cues as to the likely location of key passages that would be useful in answering a question, for example. A user with poor sight, who is relying upon a screen reader, would not have this luxury. Instead, the page would laboriously be read out to the user and the user would be expected to take extra notice of the audio stream when information that sounds as though it could be relevant is encountered.

Someone relying upon a screen magnifier would face a similarly tricky task, being required to scroll around the magnified screen in the hope of stumbling across the

target passage. In this situation, the key to easier navigation is the ability to control the amount of content provided and this could be achieved by the user selecting only the content above a certain level of essentiality and this is in turn made possible by the author selecting varying levels of essentiality for various passages. Clearly the user is in the hands of the author, the latter having rated the content passage by passage. However the result of this is that visually-impaired users can limit the textual information or images displayed on the page according to their needs.

In order to achieve the goal of limiting the volume of information presented, we define Proficiency in terms of the of user's ability to accept the information with respect to their impairment. The definition can be widened to encapsulate not only the element of user capabilities, but also any limitations imposed by the assistive technology in use and rendering schemes. In the case of assistive technology limitations, we think here of a user's ability to concentrate on the synthetic voice of a screen reader for only a limited amount of time; this will have an impact on the amount of text that can be presented. Rendering a Web page in a larger font will mean that a somewhat smaller amount of information can be presented in a given screen area, making the need for scrolling much more likely. In both cases, a reduction in the volume of text would be of benefit to the user. Where the user is unable to view or assimilate diagrams, there will be a need to remove those from what is presented.

Proficiency is not limited to users with disabilities but extends to a number of different scenarios for sighted users. For example users could also be given the ability to limit the amount of information to be presented based on how much time they have to surf the Web.

Proficiency, then, is a development of Hook's (2003) view of capability. Instead of simply regarding the capacity of communication channel to transmit data and the ability of the display to render it, we consider the impact of reductions in the user's ability to receive the information within a given rendering environment. So, proficiency, like capability, is a measure of the volume of information that can be accepted. In the case of proficiency, this measure applies to the user's capability and in particular is in regard to their visual impairment. The word “proficiency” has been

selected as it does not have the somewhat negative connotations for users with visual impairments that could be conveyed by the word “capability”.

As we are considering the user's ability to accept information, we are obliged to also consider the format of the information's presentation: the rendering. So, we also include this in the definition of proficiency. We have now, a measure of how much information a user can receive and assimilate in a given format: large text, high-contrast text, zoomed screen, voice or whatever; it is the user's selected profile that determines the rendering in use.

## 3.3 Essentiality & Proficiency

Having discussed both Essentiality and Proficiency as separate ideas, we can now consider how they might be used together to great effect. Our aim is to limit the amount of information that is presented to a given user, but this must be done intelligently. By asking the author to rate the information in terms of its importance, we have a good starting-point for this exercise. The author has been asked to assist by ranking each passage with an essentiality value. The user's profile defines the ability to deal with information. It specifies the manner in which the information is to be rendered, for example, the background colour along with the size and colour of the text or, indeed, if a visual rendering should be replaced by speech. It also specifies the volume of information that can be tolerated within the current rendering regime. Thus, as well as specifying, how to render the content, it also has implications for how much is displayed.

A simple view of combining Essentiality & Proficiency would involve the Web server starting at the highest level of essentiality and pulling out the content. If the volume of content retrieved is less than the amount deemed to be suitable for the current situation defined by the proficiency, the essentiality level is reduced and the same test is applied. This continues until the volume exceeds that with which the user can cope and the server reverts to the previous level, delivering the content revealed.

The operation of Essentiality & Proficiency has been encapsulated in figure 3.2. Firstly it refers to the author’s intention in accordance with what is identified as most

essential for users, when conveying information through the Website: the essentiality measures. Secondly, proficiency encapsulates the information needs of the user through the use of profiles, specifying user capability and rendering requirements. In other words, proficiency allows the user to state the format in which they wish the information to appear (as shown by user profile in figure 3.2) and to define the volume of information that is acceptable (essentiality level).

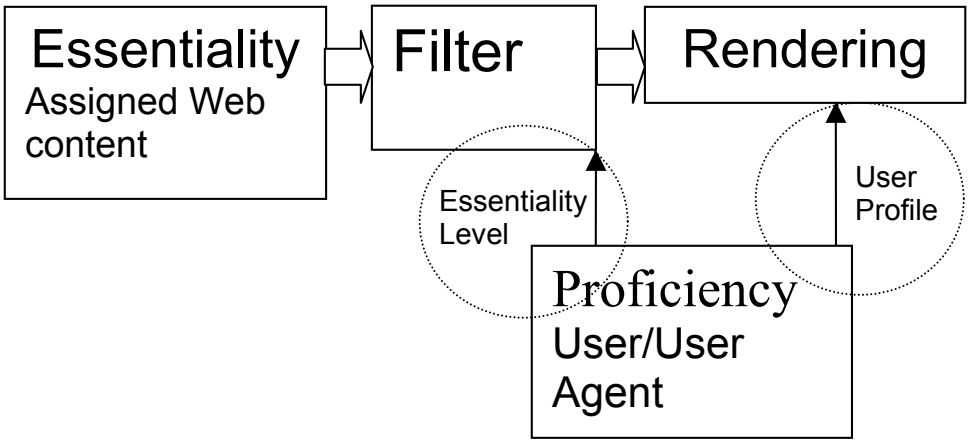



Figure 3.2 Essentiality & Proficiency in Action

## 3.4 The Perceived Benefits

One key advantage of Essentiality & Proficiency is that it is useful for all user types, not just those with a visual disability. The concept could be used by, for example, a user browsing the Web using a PDA or by a manager who needs to become acquainted with a given topic in a short space of time. The requirements are the same: the user needs to be selective about the volume of information and may need to manipulate its appearance. The result is that visually-impaired users will be making use of a technique created for all, as opposed to one created just for their needs. Perhaps this will make them feel included rather than excluded; the latter arises when companies overtly create alternative versions of their sites (usually text only) for those tacitly deemed less able. In the case of Essentiality & Proficiency, all users utilise the same URL for each site, however the content of the page is manipulated on its way to the users to suit their individual informational and presentational needs.

Of course, in a given situation, the user is relying upon the author's view of what is important and this may not coincide with the user's view. Work is continuing on this and the concept of essentiality tracks (Atkinson, Dhiensa, et al. (2006)) is being developed. Here, the information is rated not for its overall importance based upon the needs of some arbitrary and nebulous user, but on a group of users, each from different domains and with different roles with respect to the information.

## Chapter Summary

This chapter has presented the concepts of Essentiality and Proficiency and has shown how they have developed into the concept of Essentiality & Proficiency. Essentiality has been defined as a means of restricting the volume of information within a Website. Proficiency has been defined as the user's ability to accept information along with their formatting preferences. The next chapter details the preliminary survey which informs the development of Essentiality & Proficiency into technology demonstrator. The Essentiality & Proficiency technology demonstrator is then tested in the empirical study.

# Chapter 4 - Concept to Technology Demonstrator

## Chapter Preface

This chapter reports the design and use of the preliminary survey to capture the Web accessibility issues of visually impaired students. The findings from the preliminary survey are reported and these have then gone on to feed into an empirical study. The aim of the empirical study was to develop an Essentiality & Proficiency technology demonstrator (which will be referred to as the demonstrator) to see if the users' accessibility issues could be addressed. The empirical study conducted is then discussed with a close look at the benefits and limitations of the approach.

## 4.1 Essentiality & Proficiency: Developing the Idea

A preliminary survey was conducted to assess the assumption that the Essentiality & Proficiency concept would work in a real environment with the target users. The preliminary survey was collaboratively undertaken by the author and Francesca Smith who was studying for an undergraduate degree under the joint supervision of Colin Machin and the author (Smith 2005). Frequent project meetings were held between the author, Colin Machin and Francesca Smith. Although Colin Machin, as the student's supervisor responsible for assessment, oversaw the meetings in keeping with departmental procedures, the meetings were steered by the author. The author directed and also conducted the work to ascertain whether the concept of Essentiality & Proficiency could be transferred into to a practical solution: a usable tool for a real environment.

### 4.1.1 Design Rationale

The preliminary survey was designed to evaluate whether the concept of Essentiality & Proficiency was a viable solution and whether it could be developed into a usable tool. A User-Centred Design approach was used for the research. The preliminary survey was the first step in following the User-Centred Design principles as stated by Preece, Rogers et al. (1994). The principles are:

- Focusing on the users early in the design process, trying to understand their cognitive, social and attitudinal characteristics and accommodating them
- Measuring user reactions by presenting them with interfaces and simulations of the system such as technology demonstrators
- Designing iteratively

A number of steps were drafted in order to facilitate the study.

- Design and carry out a preliminary survey to capture the Web accessibility issues.
- Analyse the results.
- Feed the results into the design of an empirical study of the concept demonstrator.
- Conduct the empirical study.
- Analyse the results of the empirical study

### 4.1.2 Preliminary Survey

Structured interviews were arranged with students at the Royal National Institute of the Blind (RNIB) College based in Loughborough, UK, to understand the problems associated with various conditions when using Web pages. The RNIB College educates blind and partially-sighted students in vocational skills and this enabled people of different ages with a broad range of visual impairments to be surveyed. Furthermore the students attend courses at both Loughborough College and the RNIB College itself. The turnover of students is very high and hence this research as a whole has had the input of a number of different students during the four years.

Surveys help to gain an understanding of the current situation of the phenomenon being studied. Structured interviews and questionnaires are the most common form of data collection. When using questionnaires, the researcher should ensure that they extract as much as possible from this data collecting method. The limitations of questionnaires exist in the form of effort, response, bias, the area of the topic and the focus of the questions (Kuniavsky 2003). Limitations with this research style stem from the need for a large number of participants for statistical validity (Cornford and Smithson 1996). However surveys have the advantage of gaining core information

from target populations and are therefore representative of the real world. This research method was adopted for the preliminary survey as it provided real data for analysis and laid the foundations for research.

The underlying purpose for the preliminary survey was to gather user requirements from visually impaired users for the technology demonstrator of the Essentiality & Proficiency concept. The aim was to find out what difficulties were being experienced and what measures could be taken to make navigation and assimilation of Web pages easier. The data was required from different visual impairments to build up profiles through the collection of formatting preferences such as font styles, colour schemes etc. It was also of fundamental importance to understand whether the assertion that reducing the volume of content would increase accessibility to users with visual impairments. Both the formatting preferences and reduction in volume of content would carry through into the testing parameters in the empirical study.

The interview was based on a standard set of questions that can be found in Appendix A. The initial questions (one to three) were aimed at understanding the population interviewed. Questions include; Name, Age and Ethnic Origin. Questions four and five established if the participant had any other disability other than sight. The questions then go on to understand the computer programs used by the participants and the frequency of this use. After this the questions focused directly on the Internet establishing issues linked to using the Internet. The questions were devised by the author based on the findings of the literature review (section 2.6.7) and formulated themselves around the current issues faced, with using the Internet. The author aimed to see if these 'real' issues reported in the literature actually existed.

To ensure the questions used within the structured interview made sense, two pilot interviews were run: one with a visually impaired student and the other with a sighted student. These were used to test the questions could be understood by both sighted and visually impaired participants. There were no issues found when the pilot sessions were run and therefore the questions used in the interview were not changed.

### 4.1.3 Preliminary Survey: Capturing User Requirements

The preliminary survey consisted of one-to-one structured interviews with twelve participants from the RNIB College Loughborough. The author contacted the principal of the college to see if he would support the research by allowing the author access to visually impaired students to use as participants. After meeting with the principal and describing the research aims, the author obtained permission to distribute a request for volunteers to be participants in the preliminary survey interviews.

As the interviews were structured, the author created a list of standard questions that were used with each of the twelve participants. These can be found in Appendix A. After the initial interviews were conducted the author developed the interview questions further based on the participants feedback. The developed interview questionnaire can be found in Appendix B. To try and increase the sample size, the second questionnaire (Appendix B) was sent out to online computer technology based forums for people with visual impairments such as the BCAB (British Computer Association for the Blind) mailing list and Blindtech (a Yahoo group mailing list based on similar interests), along with groups for able-bodied people. As the members of the mailing lists were technology-oriented, this enabled us to gather information from users with a variety of user experiences.

### 4.1.4 Survey Results: Sample

From the initial request that went out to the students of the collage, twelve students volunteered to take part in the interviews. The interviews were set-up with the participants individually and these were held in the collage library, so the students did not have far to travel. The interviews lasted approximately 15 minutes and there were nine men and three women, with the ages ranging from 18 to 54.

As the questions asked in the online questionnaire (Appendix B) and interview (Appendix A) were the same, the decision was made to join the results and assess them together. The questionnaires went out to two online computer technology based forums for people with visual impairments (BCAB and Blindtech) and the author was unable to establish the total number of people who had received the questionnaire as the mailing address for the questionnaire was hidden.

This equalled a total sample size of 38, with a split of 22 males and 16 females. The age range for this sample was 18 to 57. The Internet experience of the sample was vast as 79% of the sample were experienced (30), five had intermediate experience and three had occasional use, so everyone within the group had used the Internet.

68% of the sample had a visual impairment and therefore the sample represented the target audience of this research. Three of the participants had mobility issues and one had a hearing impairment. There were also two participants with cognitive impairment.

It can be assumed that to some extent the reliability and validity of results are beyond the author's control. Two factors in particular may affect the results:

- The questionnaire and even the interview questions may be answered with goodwill towards the success of the project. For example the participant may answer the questions in the way they believe the author would want them to answer.
- When emailing questionnaires, the recipients may not have much time to fully read and answer the questions. They may simply select answers almost at random.

However the author took necessary measures to control as many variables as possible that would affect the reliability of the results. For example the interview questions were sent for approval by the principal of RNIB College Loughborough and Loughborough University's Ethical Advisory Committee. This was to ensure that the language was as simple and concise as possible and would not offend the participants.

Steps were taken to ensure that the participants were fully informed of the project and why the survey was taking place. The author had to ensure that the explanations were un-biased and that no personal feelings were being conveyed to the participants as their true reflections and opinions were required. Furthermore the author reiterated throughout the interviews the importance of the participant giving their true and honest opinions even though they may feel that it would offend the concept of the proposed work. In this context, the participants were assured that all opinions, positive or negative, informed the work.

### 4.1.5 Analysis of Results from the Preliminary Survey

As described in section 4.1.4 the sample size consisted of 38 participants. This included both those that had been interviewed and had completed and returned the questionnaire. This section will review the results. The data used to analyse the results can be found in Appendix C.

1. 73% of all the participants stated that the overload of information on a page was the most prominent difficulty experienced when using the Web. In fact this figure was even higher at 75% for the respondents with visual impairments. Interestingly 57% of the respondents that were able-bodied yet wore contact lenses also stated the overload of information to be the most significant difficulty experienced when using the Internet. These figures suggest that there are a significant number of visually impaired Internet users who find it difficult to navigate the Web due to there being too much content on a page and therefore the information becomes hard to digest.
2. 62% of the survey participants said it would be useful or very useful to be able to manipulate the volume of information on a Web page, and 73% agreed that reducing the amount of information displayed on a page according to the essentiality would ease their use of the Internet. This verifies the importance of the essentiality factor of the Essentiality & Proficiency demonstrator.
3. The most recurring user responses to how Web pages can be made more accessible were: better accessibility and conformance to design standards. This was closely followed by;
    a. To remove irrelevant information from the pages
    b. To simplify the pages
    c. To create a better layout

    Again this substantiates the need for the Essentiality & Proficiency technology demonstrator.
4. 77% of the total participants desired the ability to manipulate the volume of images. There was a further breakdown of how the 77% of the

participants would achieve the manipulation. Participants were allowed to tick more than one option. The results showed:

a. 80% would manipulate the volume of images based on how important they are to the page in terms of conveying a message.
b. 30% would manipulate the images by their dimensions so that they would appear small, medium or large.
c. 40% of the total participants would remove the images altogether, from this percentage, 75% represented the users with severe visual impairments i.e. minimal sight to no vision. These users would rather have the text descriptions. The survey also illustrated that screen magnification users did not appreciate images as the images were rendered meaningless at such magnification and increased the amount of scrolling required.

5. A fundamental point identified was that users with severe impairment to no vision did not find formatting style preferences of any great importance. The key importance for 75% of visually impaired participants lay in reducing the volume of content. The only formatting changes required would be a simple machine-readable format for their assistive technology (screen reading software in most cases).

Therefore, the questionnaire and interview results from the preliminary survey support the demonstrator and hence Essentiality & Proficiency concept. As the interviews held at the college were one-to-one with the participants, the author has been able to create two case studies to interrogate the results further. Although case studies are not seen as valid statistically, the results can lead to interesting insights. Moreover the interpretations are used to gain a better understanding of the phenomenon being studied.

**Case Study 1**

Mick is a 54 year-old Web developer with no useful sight. Until 1995 he was unemployed and housebound. His daily lifestyle included doing household chores and once a week he attended a drop-in centre for the disabled. During 1995 Mick was introduced to IT with the aid of assistive technology in the

form of a screen reader (Jaws). Mick learned new skills and gained an independence that he thought was not possible.

With the aid of the screen reading software, Mick has gained vast experience in IT. Mick now develops Web sites, checks other sites for accessibility and also teaches other visually impaired students. Although Mick has made these strides forward, it does not mean that he is being served as best he could with his assistive technology. For example, the inaccessibility of some Web sites leads to the screen reader vocalising all the link information.

A second case study reviewed from the questionnaire results highlighted limitations that deter some users from using the Web.

**Case Study 2**

Alice (49) is a secretary and has no useful sight. Alice is proficient in the use of IT. Using a screen reader Alice creates spreadsheets, word documents and regularly checks and sends emails as part of her work. However Alice avoids using the Internet due to the confusion and the aural clutter she experiences. Alice dislikes having to read vast amounts of information as she feels overwhelmed before she even reaches the part that she needs.

Case Study 2 reveals that even though online technologies have been developed to increase social inclusion, they are often failing due to their inaccessible nature. Moreover Case Study 2 is a prime example of how the sheer volume of content deters Alice from using the Web.

The questionnaires provided evidence to the differing user requirements. Case Study 3 is a prime example of the benefit that the user and his assistive technology would experience from setting his own formatting parameters and from reducing the volume of content. This example is taken from one of the responses that came from the online forum groups.

**Case Study 3**

> This unemployed white male, aged between 26 and 33 years has severe photophobia. His eyes are extremely sensitive to light and therefore he is unable to view his monitor. For this reason he relies heavily on screen-reading software to access the Internet. However the difficulties that he experiences include too many links on a page and information overload. His screen reading software is unable to detect inaccessible images (i.e. those without ALT text) and thus he often finds that he is unaware of images that exist on the page.
>
> This participant has difficulties understanding what information a link will lead to, due to the lack of a description. This participant has little use for the formatting parameters as he cannot use the monitor. However he attributes great importance to being able to reduce the volume of content and to manipulate the number of images on a page based on their essentiality.

The preliminary survey substantiated the improvements the Internet had brought to the lives of users with visual impairments and underlined their reliance upon both assistive technologies and self-discovered adaptations. In conclusion, the preliminary survey confirmed that there was great demand for the Essentiality & Proficiency demonstrator whether it is to modify the format or reduce the volume of content or both. Analysis of the survey results led to the foundation of a further study, called the empirical study.

To support the preliminary survey the decision was made to create three generic user profiles for the Essentiality & Proficiency technology demonstrator. This was done as the preliminary survey results highlighted that people with different levels of visual impairment could be grouped into three user profiles;

1. Those who have a low impairment
2. Those with a mild/moderate impairment
3. Those with no vision

## 4.2 Designing the Empirical Study

The empirical study is based on the preliminary survey results and develops further the theory that a tool can be developed to aid people with visual impairment to access the Web by providing the users with generic profiles. The understanding is that the user logs onto the tool under a generic profile that is tailored to their visual impairment. These profiles will allow the users to go to a Website, select a profile and have the information adapted to their individual requirements rather than be bombarded with reams of information. The empirical study establishes this by developing a technology demonstrator that consists of modified Web pages and tests them with students from the RNIB College.

### 4.2.1 Creation of User Profiles for the Conditions

Table 4.1 shows an example of the different user groups within the field of visual impairment. Taking these as a first approximation to a set of profiles we narrowed down the requirements from the survey to create more specific profiles (table 4.2) for the technology demonstrator. These were strongly believed to be the solutions for each of the conditions.

Table 4.1 - Visually impaired user profiles

| User Profile | Strength of Visual Impairment | Assistive Technology in Use |
|---|---|---|
| 1 | Low impairment | Large font<br>Contrasting background |
| 2 | Mild to Moderate impairment | Screen magnification software |
| 3 | No vision | Screen readers<br>Refreshable Braille displays |

Table 4.2 - User profiles from real users

| User Profile 1 | Profile parameters |
|---|---|
| User has a low visual impairment | Black text on a pastel background |
| Changes formatting preferences in the browser | Font size 14, font style Arial |
| | 1-2 images can be meaningful |
| Frequent user of the Internet | *Essentiality level 4, providing a reduced level of content compared with the full page |
| Finds that there is too much information on a page | |
| User Profile 2 | |
| Mild visual impairment | White text on black |
| Has difficulties with font size | Large font size, say 20 point |
| Screen magnification user | Only essential images |
| Uses Internet once a week | Font style Arial |
| Difficulty understanding images when using desired setting of screen magnification | *Essentiality level 5, limiting the volume to a 'need-to-know' level |
| User Profile 3 | |
| No useful vision | Black text on white |
| Screen reading software user | Font size 14 compatible with JAWS |
| Frequent user of the Internet | No images |
| Would prefer no images, as incorrectly/ unlabelled images are useless | *Essentiality level 7, providing only near-vital information |
| Flash incompatible with JAWS | |

*The numerical values 4, 5 and 7 are used for the essentiality levels in table 4.2; these represent the volume of information (rating 1-10) which would be appropriate for each profile. Section 4.2.4 explains the essentiality levels in greater detail.

### 4.2.2 Selection of Website

The next step was to select a Website that would enable testing of the Essentiality & Proficiency concept. The choice of Website would be based on two conditions: inaccessibility and universal appeal. The Quaglino's Web site promoted a restaurant in the heart of London and was representative of a mixture of graphics and text in different styles.

The site was checked using the Bobby Checker (which has since been renamed WEBXACT) and was found to be inaccessible (see Appendix D for full report). The site did not comply with the W3C Web Content Accessibility Guidelines 1.0; for example the site contains 14 images and these do not have ALT texts. The site met the second selection condition as it offered a food service and that was deemed as having universal appeal.

It was seen reasonable to use one Website as this test was to establish, if as a concept, the demonstrator would work. It was also felt that because the site contained both text and visuals it was representative of general Websites available on the Web and it was seen as a very inaccessible Website, so other sites developed which do not comply to the WCAG 1.0 standards would be easily processed by the demonstrator.

### 4.2.3 Applying Essentiality: The Decisions

Once the selection of Website had taken place the decision had to be made on how Essentiality & Proficiency would be applied to the site. The application of user proficiency was a straightforward process. The refined formatting parameters would be used to render different versions of the same page. Shifting the assessment of what is 'essential' from the user to the author still leaves the problem of exactly how to model the essentiality. Hence applying essentiality was not as straightforward as had been envisaged because decisions had to be made on how to assign levels of importance to the Web content.

One method was to give a higher level of essentiality to all content that was emphasized i.e. headers and text formatted in bold and/or italicised. The theory was that if Web-authors had emphasized the content, it must be of great importance as they wish to draw particular attention to that content. (This, of course gives a possible approach to future automatic or assisted marking-up of text.) Contact details for the restaurant would be given a high essentiality rating. A rating schema started to evolve from the process of attempting to assign levels of importance to the Web content.

### 4.2.4 Essentiality Mark-Up Schema

As the sample Website had to be rendered in terms of font face/size and colour and the volume of information had to be reduced to fit the requirements, an essentiality mapping guidance table was produced. The function of this table was to ensure that each of Quaglino's Web pages was allocated essentiality consistently. The solution proposed was a simple method of ranking sections of content with percentages. Table 4.3 demonstrates how Quaglino's Website was modified to present a technology demonstration of essentiality allocation.

Table 4.3 Essentiality mapping

| Essentiality Level | | Description of Content | Domain Example |
|---|---|---|---|
| **1** | 0 – 10% | Purely aesthetic content | Aesthetic images/icons |
| **2** | 11% - 20% | Content that is mostly aesthetic, and of little or no information value | Photographs that are textually explained |
| **3** | 21% - 30% | Content that has little information value | Images of the restaurant building |
| **4** | 31% - 40% | General information 'take it or leave it' content | Other services offered by the venue |
| **5** | 41% - 50% | Information that could be of importance to minorities | Private dining facilities |
| **6** | 51% - 60% | Information important to some people | Music played at the venue |
| **7** | 61% - 70% | Information important to most people | Bar facilities |
| **8** | 71% - 80% | Information beyond the basics | Menus |
| **9** | 81% - 90% | Important information for all | Opening times |
| **10** | 91% - 100% | Vital information on the page; the raison d'être for the page, if not the site | Address and contact details |

The ten level rating scheme was devised based on collaboration between the author, Francesca Smith and Colin Machin. It was decided that a scoring percentage scheme familiar to people was required and therefore as the general population are familiar with having things scored out of one hundred (see table 4.3), this was seen as an appropriate method. However on application it was found inappropriate, as percentages were difficult to apply when studying the content of the page. It was difficult to distinguish between the margins for example '70%' and '71%' importance, as they fit into levels 7 and 8 respectively (circled in table 4.3). The confusion was omitted by using a rating score of ten levels. Of course, any purely numerical representation is going to be arbitrary and so further consideration was given to classification.

The use of a smaller number of categories was assessed, but did not allow for the level of detail required when assessing pages. For example if three were used e.g. high, medium or low, taking the example of 'Bar facilities' in a restaurant, it would be difficult to group as it may be viewed as any of the three e.g. "low" – because it is a restaurant and people are more interested in food, "medium" – because people may be interested in the wine list or "high" – as people may want to meet for drinks in the bar first or be looking to book the venue for a party.

Therefore the ten levels (bold numbers 1 to 10 in table 4.3) allow the Web author to be more precise when categorising their information and, in any event, the textual descriptions of the levels and the example are what really count. It was necessary to have some form of selection criteria to enable the current stage of the research to progress. It is acknowledged, though, that as this research is based on the end users and their understanding of essentiality, further work is needed to test the essentiality levels with the Web authors to find what number of levels best fit their needs and what descriptors can be attributed to them.

### 4.2.5 Technology Demonstrator

As the purpose of the technology demonstrator was to demonstrate the concept of the tool and to gain feedback about the user profiles, the essentiality levels were initially applied to screen shots of the pages and then transferred to the code. The technology

demonstration in practice consisted of taking generic user profiles and manufacturing static pages fitting the requirements captured in the interviews.

The technology demonstrator's user interface was made up of an accessible User Preference Web form that the participants could use to select their formatting preferences. Three essentiality renderings of the Quaglino's homepage were created from the parameters captured at the interviews, from three participants. The table of essentiality was used to rate the information on the page in preference of what is 'essential' to the end user and this then fed into the creation of the three user profiles.

The participants represented each level of visual impairment from the earlier categorisation. The renderings were assigned the generic user profile titles that represented the level of visual impairment (see table 4.4) and were set as default profiles. These profiles were linked to the Web form and the participant would be asked to view the rendering designed to best fit their level of impairment.

Table 4.4 User profiles defaulted in technology demonstrator

| Profile | Level of Visual Impairment |
|---|---|
| User 1 | Low impairment |
| User 2 | Mild to Moderate impairment |
| User 3 | No vision |

### 4.2.6 Technology Used

The User Preference Web form (see figure 4.1) was developed using HTML and CSS. The code was verified using the Bobby checker and also checked using HTML and CSS validation tools. The technology demonstrator was partially functional in that the participant could apply their preferences to the Web page (participant choices can be seen in table 4.5 (section 4.3.2). This was made possible by embedding JavaScript into the HTML code. Although JavaScript is known for creating accessibility problems by limiting navigation, guidelines were followed to overcome this problem (W3C 2000). CSS was chosen for presentation purposes, as it aids accessibility of Web pages by separating the presentation from the structure.

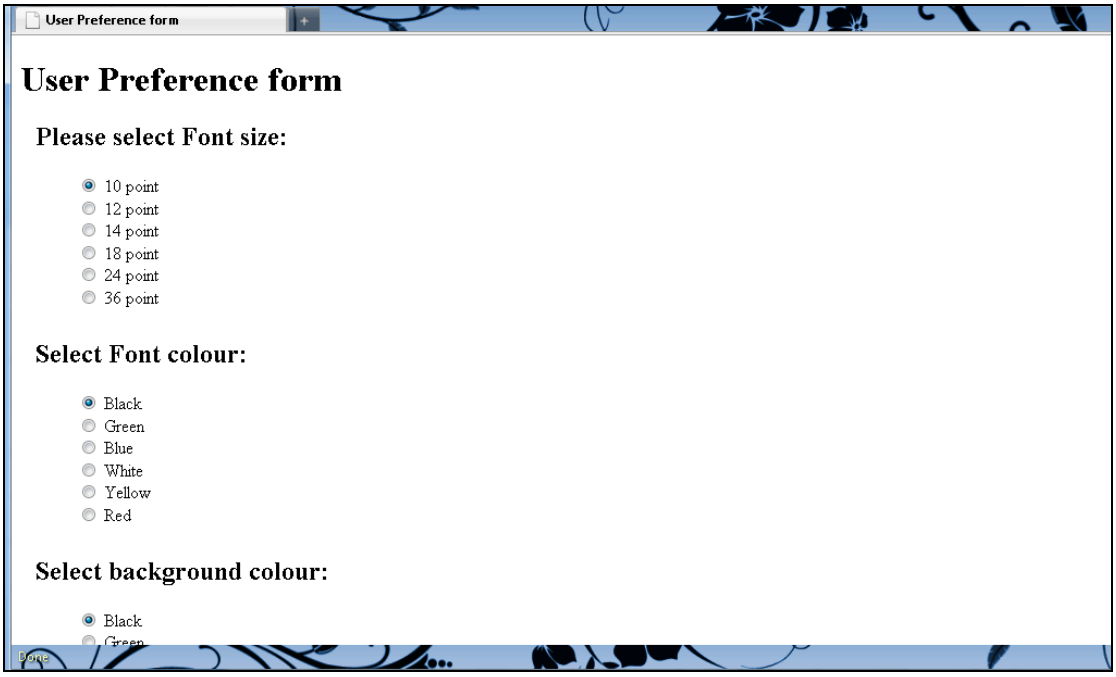



Figure 4.1 User Preference Web form

As stated above, the partial functionality of the User Preference Web form allowed the participants to try out their preferences on any URL of their choice. However the Web pages used for testing of the three profiles had been pre-modified to the requirements as set out in section 4.2.1.

The technology demonstrator was developed and tested jointly by the author and Francesca Smith. To ensure the system was platform independent, the technology demonstrator was tested in Internet Explorer and Mozilla. The outcome of this test was that the User Preference form was fully functional in both browsers. However, due to differing browser interpretation of CSS, the requested content was displayed slightly differently but was sufficient for testing the concept.

## 4.3 Conducting the Empirical Study: User Trials

User testing of the technology demonstrator was limited to four participants. We requested a sample of participants from the initial user requirements survey to test the tool as it would better validate the work. Ideally the author would have preferred to have two participants per profile but only four participants volunteered to participate in this study. It was therefore seen as appropriate to use all of the participants that had volunteered to take part in the study.

The group's age ranged between 21 and 54 years and a mixture of two women and two men. The participants all had visual impairments and they had all been participants who had been involved in the preliminary survey. The prime purpose of this testing was to present the users with the three different profiles and see if they would choose the user profile that had been created to suite them, based on the level of visual impairment they had. They were presented with the three different profiles and the original site.

### 4.3.1 Testing Process

The testing process is detailed in the following steps;

1. The participants were greeted in the RNIB College foyer and escorted to a PC in the Learning Resource Centre. This environment was selected as it was the participant's normal working environment and it did not require them to travel.
2. Each participant was given an introduction to the empirical study. This included the ethical and confidentiality statement and the aims of the research.
3. They were then told that they would be asked to view four different Web pages. Each participant was given five minutes to view each page.
4. The monitor to the PC was then switched on and the participants were shown the User Preference Web form, which was a very basic form with drop down menus presenting a range of different formatting options for the participant to select. This is what a user would see if they were to use the tool, but as this is a demonstrator the participant was asked to complete the page but it did not link directly to a profile. This work had to be completed separately.
5. The participants were then shown how they could access each page by selecting different user profile levels.
6. They were left to browse the pages (Fig 4.2 and 4.3) and allowed to ask questions during this time.
7. Once the participant had finished browsing all four pages the monitor was switched off and the participant was asked post task questions (see Appendix E).

The User Preferences Web form was used as the interface to the Web pages that had been developed, based on their particular requirements. The participants were not made aware of this as the premise of the test was to see if the profile that had been generated for them fitted their requirements. Hence the participants were given four quite different renderings of Quaglino's Web page (the original and the three profiled pages can be found at figure 4.2 and figure 4.3 respectively) for them to browse through using their respective assistive technologies. Once the participants had seen all four pages they were questioned.

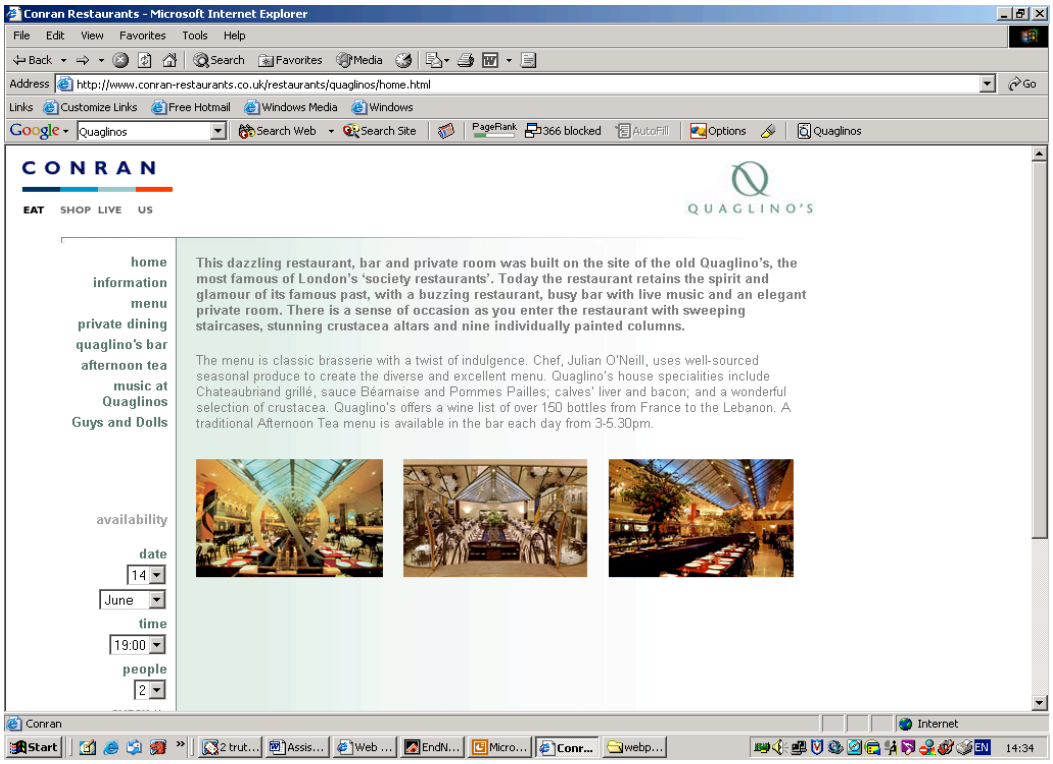



Figure 4.2 Quaglino's original Web page




(b) User Profile 1 (c) User Profile 2 (d) User Profile 3

Figure 4.3 Quaglino's pages altered to each of the three sample profiles

### 4.3.2 Results: User Profiles in Practice

Table 4.5 shows the results that were gained from the participants trials. The participants are listed along the top of the table and the information directly below in each column refers to that participant. The intended profile is what the author had selected as their preferred user profile based on the User preferences Web form filled out by the participant at the beginning of the study. The second row is the preferred profile, which is what the participant selected as their preferred profile based on the three viewed during the study. It is evident that participant 1 and participant 4 selected the intended profiles but participant 2 and 3 selected different ones. Their reasoning is described in the row named 'Reasons for preferred site'. The actual differences between the profiles can be seen in the row above.

Table 4.5 has been highlighted in italic text to show reasons for participant 2 and participant 3 preferring the different profiles that they have chosen. For participant 2 it is both essentiality and proficiency as they found the page to be clear and concise (essentiality) and comfortable to read (proficiency). Participant 2 said the text is easy to read (essentiality) and that Profile 3 would strain eyes and text not bold enough (proficiency).

All four participants were able to distinguish the reduced amount of content as highlighted (with underline) in table 4.5. The participants appreciated the reduced amount of text they all stated it to be the reason for preferring the profile that they had selected. For example participant 1 liked the amount of text and participant 4found the content to be of suitable amount.

The results show that each user had very different requirements, which may change over a period of time. Participants 2, 3 and 4 wanted to be able to enlarge images and text. Participant 2 explained how they needed to change the font size after looking at the screen for a short period, as their eyes became tired and it becomes harder to view the content. Furthermore, the preferences identified by the participants at the interviews had changed at the testing stage. Hence it appears that the participants would like the option to manipulate the format as different factors affect the user requirements.

Table 4.5 Test results

| | Participant 1 | Participant 2 | Participant 3 | Participant 4 |
|---|---|---|---|---|
| Intended profile | Profile 3 | Profile 1 | Profile 2 | Profile 1 |
| Preferred profile | Profile 3 | Profile 3 | Profile 1 | Profile 1 |
| Assistive technology used | Screen reader | Enlarging the text in operating systems settings | Screen magnification | Screen magnification |
| Differences apparent between the pages | Less text<br><br>Information easily found | Less information displayed<br><br>Colour change<br><br>Fewer images | Less information<br><br>Change in colour scheme | Less content<br><br>Greater colour-contrast on Profile 2<br>Profile 3 is text only |
| Reasons for preferred site | Likes the amount of text on the Profile 3 but would also like images that could be enlarged as has some available sight | *Very clear and concise*<br><br>*Comfortable to read* | *Text is easy to read*<br><br>*Profile 3 would strain eyes and text not bold enough* | Good contrast balance<br><br>Suitable amount of information |
| Other comments | As long as the text is read by the screen reader have no text size preferences | As time elapses, text size has to be increased as eyes become tired | Would like the ability to enlarge the images | Would like to enlarge both the images and text |

## 4.4 Important Findings

The empirical study showed that the generic profiles were valuable but only as a starting point as it was critical that the users had the ability to manipulate them and thus personalise them. This was less apparent for users operating screen reading software as colour and size of text was less important as long as it was accessible to the software. Users with a mild to moderate visual impairment are less likely to be content with generic user profiles based on their level of impairment. A personal profile does not need to be regarded as fixed but can be edited to take account of the user requirements which may alter within a day. A prime example would be where the user starts off using a set profile and then when their vision starts to become fuzzier after several hours of continuous work, they are able to set a stronger colour contrast.

The most important lesson learnt is that each user has individual needs when viewing Web pages. No two people would view the Web page in the same manner as ability and personal preferences require different renderings. Preferences can also alter with time. This was evident in the study as each candidate had different preferences in the test to their description in the interviews.

## 4.5 Conclusion: The Benefits

The empirical study has shown that the user profiles are useful, however the participants would prefer having the option to change the format if and when required. For example if their sight deteriorates throughout the day or even if they simply feel a need for something more cheerful, having the ability to change the settings will make the tool more useful.

A highly positive outcome from the test was that the participants all commented that the differences in amount of content were apparent and that they would appreciate having the option to reduce the volume of content. This is especially true for those who were hindered by the sheer amount of text and therefore avoided such Websites that were content-drowned.

### 4.5.1 Empirical Study Limitations

A small number of limitations were acknowledged during the development of the empirical study. The most apparent constraint was that the number of participants was limited to four and therefore some may argue that the test would not provide sufficient evidence for the importance of user profiles for the visually impaired population. However, the results provided very useful and insightful feedback.

The second most apparent limitation was that the technology demonstrator consisted of pages that had already been manipulated to the user requirements and did not perform a live rendering. Again this aspect of the tool highlighted important factors such as the user wanting to further tweak the pages and that the requirements captured during the preliminary survey phase might not be suitable for the user during the following session. What was found was that the user had many variations in their requirements during a day and that one profile may not achieve the goal of accessibility that is aimed for. This had not been thought of or even taken into consideration during the creation of user profiles.

Limitations were also made apparent during the testing process. The reiterative process of having to read each page was making the participant lose interest in the task. However this process was a must as the test was a comparison task between the manipulated pages or rather the user profiles. This loss of patience was also seen with another participant who had a cognitive impairment as well as a visual impairment, this caused them to lose interest quickly. However the feedback from their test in terms of their likes and dislikes again proved to be very insightful.

#### Chapter Summary

This chapter has reported how the preliminary survey (which captured the Web accessibility issues of visually impaired students) informed the empirical study. The aim of the empirical study was to develop an Essentiality & Proficiency technology demonstrator to see if the users' accessibility issues could be addressed. The findings from the empirical study highlighted both the benefits and the limitations of the study. The findings informed the development of the prototype Essentiality & Proficiency tool which is reported in the next chapter.

# Chapter 5 - Developing the Prototype

## Chapter Preface

In this chapter we present the design and development of new software to handle Essentiality & Proficiency, which we will refer to as the Essentiality & Proficiency tool or just the tool. This chapter details the system design and system architecture for the Essentiality & Proficiency tool. A first attempt to mark up Web pages with essentiality is discussed, leading to a possible technical solution. There is then an explanation of how the tool was tested prior to user trails.

## 5.1 System Design

We wanted to develop an Essentiality & Proficiency tool and test it with end users. The design process commenced with the premise that the tool was being developed to address the issue of inaccessibility for the visually impaired due to the overwhelming amount of information contained in many Web pages. The tool (see see figure 5.1) was designed so that the user could tackle the overwhelming volume of information by choosing an essentiality level, then the system filtered out all content which is marked with a lower level of essentiality. The design used the feedback from the empirical study. Furthermore the design was an iterative process and proceeded through a number of versions of the tool.

The empirical study led the development team to believe that the user profiles played an important part to the extent that the user could personalise the parameters to their requirements. This is visualised in figure 5.1 by the user creating their user profile and the desired output being returned as blue text on a yellow background. Furthermore the user may need to have a number of profiles as the empirical study showed that the requirements may change throughout the day. Based on this knowledge, the development team agreed that the tool should offer the user the functionality to store a number of profiles (illustrated as the database containing multiple profiles for user 1 and user 2 in figure 5.1) to meet their changing requirements. The author designed and tested the iterations whilst Dr Roger Stone was responsible for the programming.

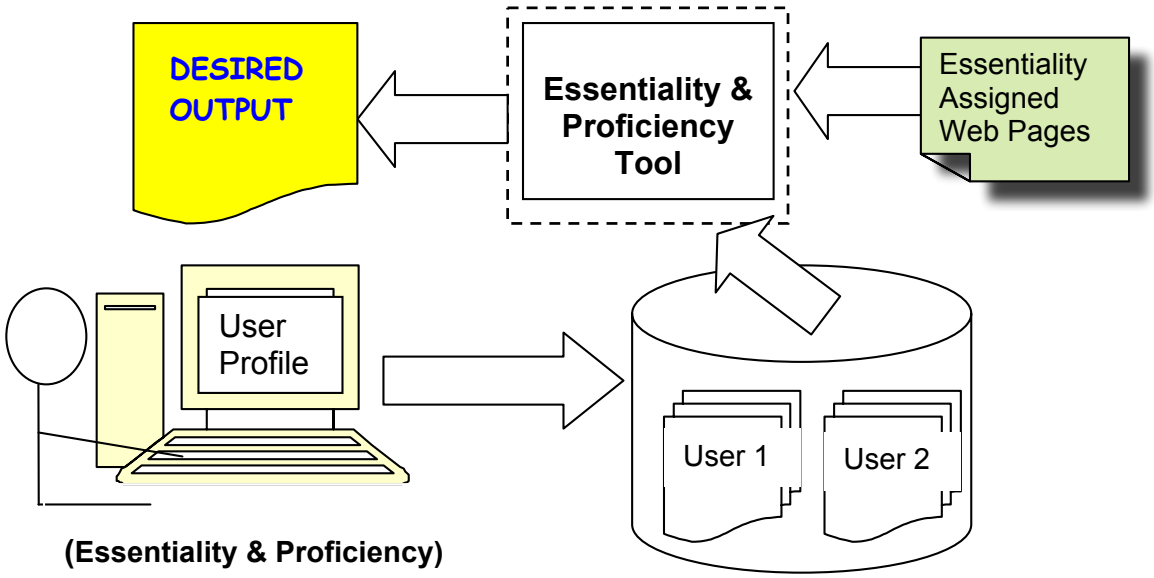



Figure 5.1 Essentiality & Proficiency in action

It was important to identify the key components for the tool. Web sites were the most obvious component and the need to create essentiality marked up pages was identified. In order to do this it was necessary to:

1. Finalise the essentiality levels.
2. Decide how to do the essentiality mark-up.
3. Iterations to the front end (Web form which will allow the users to input their preferences) of the tool.
4. Iterations to the design of the back end (main body of the tool in terms of how the information will be processed).

Consideration must be given to the server that would host the tool.

## 5.2 Essentiality Levels

As explained earlier, in any collection of information some pieces of information are more important than others. By allowing the author to rate Web content based upon how essential it is to the process of conveying the meaning of the site, what evolves is a means for restricting the volume of content that is fed through and displayed on to a given Web page. As the author performs this rating and as various sentences or passages are rated according to the essentiality scheme, an essentiality framework of the whole page evolves.

The empirical study enabled a more thorough understanding of how the essentiality levels work and is presented here. Figure 5.2 represents an example of a passage (see part (a) assigned with essentiality (see part (b), along with the key to show how the essentiality levels will be processed (see part (c) and the outputs that will be delivered to the user based on the essentiality level (see parts (d), (e) and (f). There are only 4 levels of essentiality in figure 5.2, as this is purely an example of how essentiality works and is not representative of the number of levels that are used in the tool.

Levels 1 to 4 in square brackets (for example [Level 1] [/Level 1]) are being used here to help explain the application of essentiality (see later for the actual method involving the real application of essentiality through microformating). The output for essentiality level 1 has been omitted as it is exactly the same as the original passage as shown in part (a) figure 5.2. The outputs for essentiality levels 2, 3 and 4 are presented in the parts (d), (e) and (f) of figure 5.2.

A point to note in this example is that essentiality has been based upon the importance of the sentence relaying the most essential information. In this instance the most important information lies in the last sentence and is therefore assigned with level 4 essentiality. However this is not necessarily the case in real Web content. It is just as feasible to find the first sentence to contain the most important information or even a sentence somewhere in the middle.

The Internet is almost entirely a visual experience therefore it is important that visually-impaired users are able to access the same information easily and in the most suitable format for their needs just as it is displayed for all others. The obstacle to easy navigation and usability for the visually-impaired user is the sheer volume of information on the page in front of them. The key to easier navigation is the ability to control the amount of content provided. The Essentiality and Proficiency Tool offers the user the choice of selecting the level of essentiality of the information required.

(a) Original passage

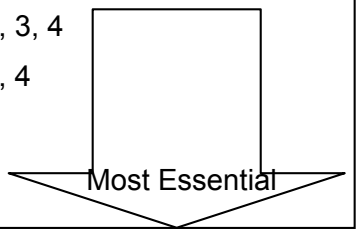
**[Level 1]** The Internet is almost entirely a visual experience therefore it is important that visually-impaired users are able to access the same information easily and in the most suitable format for their needs just as it is displayed for all others. **[/Level 1]**
**[Level 2]** The obstacle to easy navigation and usability for the visually-impaired user is the sheer volume of information on the page in front of them. **[/Level 2]**
**[Level 3]** The the key to easier navigation is the ability to control the amount of content provided. **[/Level 3]**
**[Level 4]** The Essentiality and Proficiency Tool offers the user the choice of selecting the level of essentiality of the information required. **[/Level 4]**

(b) Passage marked-up with essentiality levels

Key

Essentiality Levels

**Level 1** When displaying show all content in Levels 1, 2, 3, 4
**Level 2** When displaying show all content in Levels 2, 3, 4
**Level 3** When displaying show all content in Levels 3, 4
**Level 4** When displaying show all content in Levels 4




(c) Key showing how the essentiality levels will be processed

The obstacle to easy navigation and usability for the visually-impaired user is the sheer volume of information on the page in front of them. The key to easier navigation is the ability to control the amount of content provided. The Essentiality and Proficiency Tool offers the user the choice of selecting the level of essentiality of the

(d) The output that will be displayed when the user selects essentiality level 2

The key to easier navigation is the ability to control the amount of content provided. The Essentiality and Proficiency Tool offers the user the choice of selecting the level of essentiality of the information required.

(e) The text that will be displayed when the user selects essentiality level 3

The Essentiality and Proficiency Tool offers the user the choice of selecting the level of essentiality of the information required.

(f) The text that will be displayed when the user selects level 4

Figure 5.2 An essentiality-rated passage processed into its essentiality based outputs

As stated above, in some instances the most essential information can be found in the middle of a paragraph or even at the end, this is defined as 'nested essentiality'. Figure 5.3 illustrates nested essentiality. Part (a) of figure 5.3 shows the original passage. Part (b) demonstrates how the passage has been assigned an essentiality level 2 yet contains a more essential sentence in the middle which has been assigned a nested essentiality level 4. The level 2 essentiality starts at the beginning of the passage with [Level 2] and closes at the end of the third sentence with [/Level 2]. The second sentence which states the importance of carrying a passport at all times is marked-up with [Level 4] and closes with [/Level 4]. Hence what happens is:

[Level 2] [Level 4] [/Level 4] [/Level 2]

What we end up with is level 4 nesting with level 2. So when the user selects an essentiality level 4 they will be presented with part (c) of figure 5.3. If the user selected level 2 they would be presented the (a) original passage. Two levels of essentiality are being used in figure 5.3 purely as an example to illustrate how nested essentiality works.

| Travellers should take care of all important documents. A passport must be carried at all times. Travellers should ensure they have travel insurance cover suitable for the holiday. |
|---|

(a) Original passage

| **[LEVEL 2]** Travellers should take care of all important documents. **[LEVEL 4]** A passport must be carried at all times. **[/LEVEL 4]** Travellers should ensure they have travel insurance cover suitable for the holiday. **[/LEVEL 2]** |
|---|

(b) Passage marked-up with nested essentiality

| A passport must be carried at all times. |
|---|

(c) The sentence that would be displayed when the user selects essentiality level 4

Figure 5.3 Nested essentiality

The importance of nested essentiality is that it enables the author to drill down further when drawing out the essential information. The essential information in figure 5.3 is:

'A passport must be carried at all times.'

Hence the user has the opportunity to request the least volume of text by selecting essentiality level 4 (in figure 5.3) and will receive the most essential information.

### 5.2.1 User Parameters

Figure 5.4 illustrates how the tool would further allow the user to apply their own formatting preferences. Each change in format represents a different set of user parameters that could be required by individual users. As each user has a different set of presentation requirements when it comes to using the Web, a profile can be defined through a collection of parameters such as font size, font colour, background colour and text style.

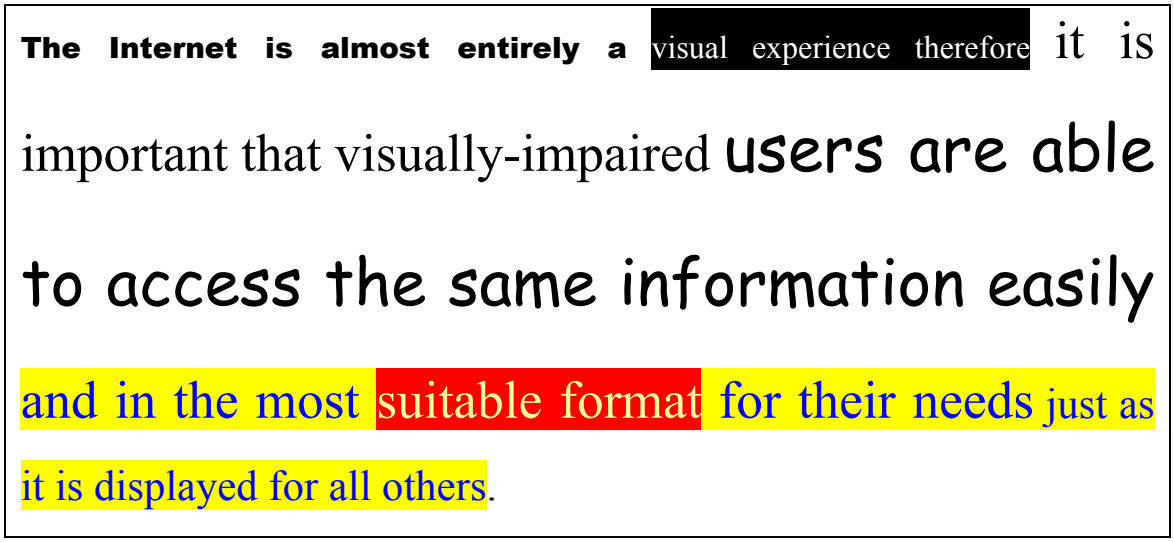



Figure 5.4 Different formatting parameters

The parameters are chosen to allow the results to be displayed in a form suitable for users across a wide range of conditions. Profiles will differ substantially across a range of users and their visual conditions. A default profile will prevent the user having to fill in an initially blank form which may be time consuming and stressful. The values contained in the selected default profile can be manipulated subsequently by the user to tune the results.

Although assistive technology, application settings and operating systems (OS) may already enable users to apply formatting preferences, the benefit of being able apply the preferences through the Essentiality & Proficiency tool lies in the fact that users can very simply switch between different profiles. Some users need to adjust the parameters within the course of the day as identified in the empirical study. When users select formatting preferences for example in OS the settings are formatted during the

first start-up and will not be adjusted again. However as the empirical study showed that user requirements change during the course of the day and hence the Essentiality & Proficiency tool allows the user the freedom of switching between profiles (which are set-up by the user) based on the requirements for the particular time of day that they accessing the Web.

When this is added to the user's ability to set an essentiality rating of information based on how much time they have to browse the Web or simply based on how much information they can cope with on a page, the whole package becomes a useful tool. By this means, maybe with the aid of some assistive technology the user is able have just the right amount of information on the page displayed in a form relevant to the severity of their impairment. Certainly, the initial value of essentiality is one of the significant parameters for users severe visual impairment. It is believed that through the use of this tool the Web will be made easier to use for all user types of visual impairment and will therefore become more accessible to those with disabilities.

### 5.2.2 Process Breakdown

The Essentiality & Proficiency tool is a proxy-like tool that will enable users to create a user profile (see table 5.1 for a process breakdown for the tool) and apply it to the viewing of any essentiality-assigned Web page. The parameters available for the creation of user profiles are based on user requirements that have been gathered from the feedback from the preliminary survey and empirical study. Two PhD students with visual impairments were also consulted throughout the design of the tool. One student had no useful vision and was a refreshable Braille display user. The other had nystagmus which is a mild visual impairment and used screen magnification software.

Table 5.1 Process breakdown for the Essentiality & Proficiency tool

| | | |
|---|---|---|
| Author | Marking-up | The author rates and then marks up essential content. |
| User | Defining | Allows the user to choose an initial profile description that best suits their requirements. |
| | Requesting | Allows the user to request a URL, the same one as everyone else uses. |
| Server/Filter | Capturing | Captures the contents of the Web site using standard *http* requests. |
| | Processing | Processes Web content through the Essentiality & Proficiency filter. |
| | Rendering | Displays the information according to the selected display profile. |

In our approach (see table 5.1) the user will be able to view the content of a Web page in accordance with their needs as they set their own parameters. The parameters are set by the user selecting (see Defining in table 5.1) options in the Essentiality & Proficiency Web form which is the front end of the tool. The parameters that can be selected are for example the Font, Font size and Font colour that user would like. The parameters form the user profile which is then stored in a database. Once this is in place the user can then select (see Requesting in table 5.1) a Web page which will be filtered (see Processing in table 5.1) in accordance to the user profile. The user can create any number of profiles and these will all be stored in the database. The user will only need to create the user profile once and can use it each time they use Web pages.

## 5.3 Essentiality Mark-Up

As explained earlier, essentiality refers to the author's mark-up in accordance with what is identified as most essential for the user, when conveying information through their Website. The essentiality will be measured as a level from 1 to 10. To start with, level 1 will include everything, whilst at the other end of the scale level 10 identifies only the most essential information. As discussed in chapter 4 the ten levels have been chosen based on the earlier collaboration between the author, Francessca Smith and Colin Machin.

The Essentiality & Proficiency tool asks the user to select the level of essentiality that they would like to view. The user's understanding of essentiality will be based on the help section which will contain the ten levels and a description of the type content that can be found at each level.

As stated earlier, the Essentiality & Proficiency tool allows the entire transformation take place upon transmission to the user. This is also an important factor when this tool is used to limit the content when, for example, a low-bandwidth connection is in use. In all events the actual source of the Web page is left untouched and is delivered to the essentiality filter by means of a normal *http* request. Of course, for the essentiality factor of our tool, the source code will have to be altered by the author to include essentiality tags, but this will be the same page that is accessed by and delivered to users unaware of the essentiality scheme. The proposed method for this is inspired by microformatting as it allowed pages to be able to comply with current standards and be acceptable to accessibility checkers.

### 5.3.1 Microformatting

Microformatting is a method of marking up information without creating new tags that are not natively valid HTML. Within that scheme, a given paragraph could be tagged with an essentiality value of 9 by means of:

...

i.e. by adding a class attribute with the specific value "ess9" to the enclosing tag.

In table 5.2 the essentiality class has been attached to the  tag. The class can also be attached to a number of other tags, for example

<tr class="ess5"> </tr>

<td class="ess7"> </td>

Table 5.2 A template for assigning essentiality levels

| Essentiality Level | Description of content |
|---|---|
| ... | Purely aesthetic content |
| ... | Content that is mostly aesthetic, and of little or no information value |
| ... | Content that has little information value |
| ... | General information 'take it or leave it' content |
| ... | Information that could be of importance to minorities |
| ... | Information important to some people |
| ... | Information important to many people |
| ... | Information beyond the basics |
| ... | Important information for all |
| ... | Vital information on the page; the raison d'être for the page, if not the site |

There are a number of questions that need to be answered when applying essentiality to the source code:

- Does the content, which needs to be assigned with essentiality, already have a tag?
- Does the tag have a style?

The reasons for asking these questions are as follows: if the place that the author wants to put his style has already got a tag, then adding the style is a straightforward process. However if there is already a tag and the tag has a class attribute then the author has two alternatives. Either

i) add the essentiality class as an extension of the existing class

 text

becomes

text

or

ii) add another tag

text

This technique is called nesting.

Nesting is important when the author has to put in the tag himself. A tag has to be introduced if the place that the author wishes to mark-up with essentiality has no tag. For instance, in order to put essentiality styling the author has to adopt a tag. If the piece of information selected for styling has no tag, then a new one has to be introduced to apply the style. However it is important to understand that nesting cannot always be done with the same type of tag within itself.

Bad example

< p>< /p>< /p>

Good example

Furthermore if what the author wishes to mark does not have a tag then he has to introduce a  tag. For example if a paragraph has been assigned an essentiality level 5 and a sentence within that paragraph is seen as encapsulating the core information, the author may want to assign it a higher level of 7. This special use of  enables the author to tag the content without any applying any other tags which might alter the appearance or flow of the paragraph. For instance

### 5.3.2 Use of CSS

When working at essentiality level E the proposed tool will provide each page with (E-1) styles; ess1, ess2, ... ess (E-1), all of which are defined in CSS as {display:none;} Which has the effect of hiding from the user all the content with essentiality level less than E.

## 5.4 Essentiality in Practice

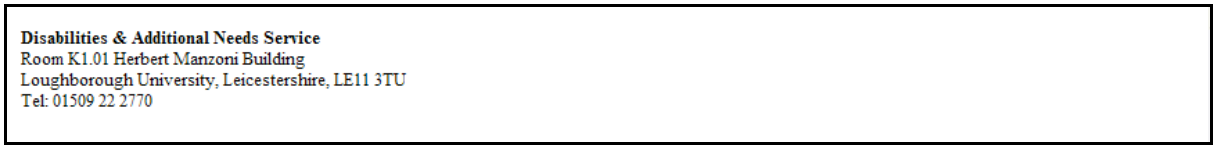
Figure 5.5 displays a first attempt by an author at marking up a live Website. A very simple page was chosen, which has a number of distinct areas each of which can be identified as more or less essential. In spite of its simplicity, the exercise illustrates the direction that this approach could take. The site selected was the "contacts" page of Loughborough University's Disabilities & Additional Needs Service (DANS). In this attempt we focus the decisions on essentiality upon the Web author’s experience of what the target users would need to know when trying to contact DANS. We are basing the decisions on the Web author’s experience because it is the Web author who is

marking-up the content of DANS. This first attempt is meant to highlight the initial challenges of the practical implementation.

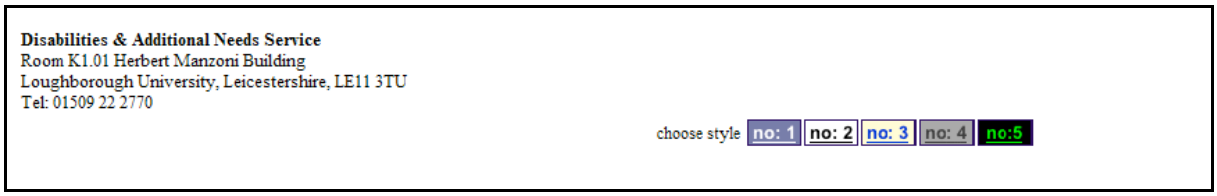
In this case, the content was marked up by hand, although a separate project examined the use of browser plug-in technologies to aid the author in marking up the content (Yangfan 2005). In particular, the use of XUL, an XML-type language, within the Mozilla framework had been chosen for initial work. The aim of this project was to develop an essentiality editor, to ease the burden on the author by providing an automated way of adding tags. The Essen Editor allows the author to simply highlight a passage of the site and then assign an essentiality value to that passage. With added previewing of the content at varying essentiality levels, the author is relieved of the burden of having to hand-code the essentiality levels into the source.

Examination of the screen-shots in figure 5.5 reveals the content delivered at each user setting of essentiality level. At the level that reveals only the content considered by the author to be of greatest importance, the user is presented with simply the name and address of the DANS unit. As the user reduces the level of acceptance, more and more detail is provided, until ultimately the site's entire contacts page is delivered to the reader.

It is worth noting that this site is already equipped as one might hope and expect, with features to improve accessibility of the site. Four alternative styles of presentation are available and these become visible at a high (although not the highest) level of user-chosen essentiality. It is expected that sites using our Essentiality and Proficiency scheme along with user profiling will not require such facilities in the future. Indeed, the scheme will offer a much larger number of alternative views of the site, with the one delivered to a given user being optimal.




(a) with user essentiality set to 10




(b) with user essentiality set to 9




(c) with user essentiality set to 6




(d) with user essentiality set to 4




(e) with user essentiality set to 1 (revealing the original page)

Figure 5.5 Essentiality in practice: DANS

## 5.5 Possible Alternative Technical Solution

Another technical solution was perceived before the current solution was developed (figure 5.6). This was to develop a filter using an apache server, XML for content descriptions and XSLT for the presentation. The essentiality would be assigned with homemade XML tags for example <essen> </essen>. However the creation of new tags was not adopted as they would present another accessibility issue and they would also break page standards. Furthermore, although the XML and XSLT technology could still have been used with microformats, the idea was dropped for practical reasons involving the speed of development.

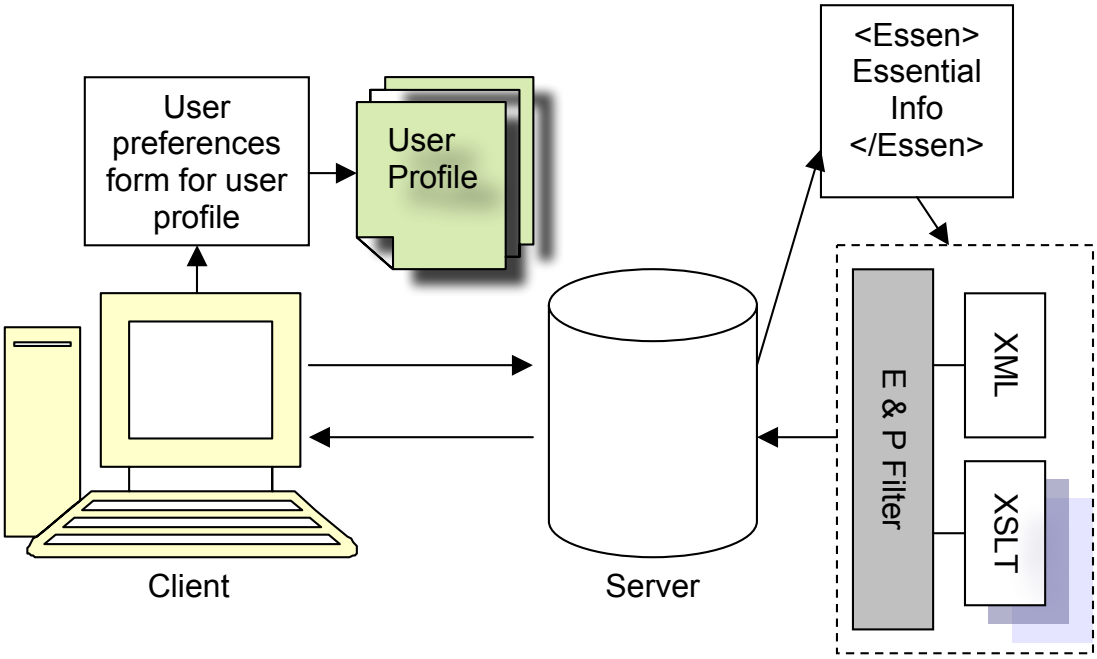



Figure 5.6 First technical solution for the Essentiality & Proficiency tool

## 5.6 Technical Solution

The Essentiality and Proficiency tool has been developed by Roger Stone using PHP, CSS, and a MySQL database and run on a departmental Intranet. The reason for running it on a departmental Intranet was that an authenticating server allowed the functionality of user identification and hence the ability to assign personalised profiles.

### 5.6.1 How it Works

The Essentiality and Proficiency tool has been developed so suitably marked up material can be delivered to users specifying their preferred level of essentiality. The

tool uses a system function to obtain a Web page as a text file. It then edits the file to include all the styles specified in the user profile and the styles which enforce the accessibility view. So that the tool can also work on any links that may be clicked, all the URLs (images, links, form actions, etc) in the document are redirected through the tool. Thus for example a link of the form

< href="http://www.x.y">link</a>

might be rewritten as

<a href="filter.home/filter.php?doc=http://www.x.y&profile=...">link</a>

### 5.6.2 Related Work

The work reported here concentrates on material derived from static Web pages. There is a need to consider how the Essentiality & Proficiency Tool can be applied to pages created dynamically. At first sight this appears difficult, but as many dynamic pages are derived by entering dynamic text, such as results from calculations, into what is effectively static text, the problem is not insurmountable. We would need to ensure that appropriate essentiality rating of the static content is provided, having given due regard to the presentation of the final page. A separate project investigated the principles involved here (Wu 2005).

## 5.7 Testing the Filter

The next phase of the project was to test the functionality of the Essentiality & Proficiency tool with essentiality marked up Websites. The functionality tests were carried out by the author. The first functionality test was conducted with a mocked-up Webpage. The Web page was a very simple page that contained a few images and text. The content had been marked with different essentiality levels. The importance of the initial test was to ensure that the CSS function display:none did allow the content assigned with the selected essentiality level and above to be returned to the user, in other words that the content was reduced to the required volume. This test was successful.

The second functionality test was to ascertain whether the user profile applied to the navigational links on the page. In other words did the user preferred styles carry across when the user clicked on a navigation link and went deeper into the Website? This test was conducted by setting up a user profile with pronounced changes for example by

choosing a very high-contrasting background colour (magenta) against a strong text colour (navy blue) and different font face (comic sans). The colours were selected on the premise that the changes would be easily identified when applied to the test Web page. The outcome from running the test was that changes only applied to the initial page being viewed. This led to more specific investigation into what needed to be done to ensure that that all the links on the page carried the profile.

A further test was carried out to ensure that the reduced volume of output was actually accessible to screen readers. Although it was visually evident that the volume of information was reduced when returned to the user, the question then arose as to whether the CSS function display:none actually did hide the content from the screen reader. The main concern was that although it did not display the content on the screen, the screen reader would still read it out. The functionality tests run using a screen reader showed that the tool worked as envisaged; the screen reader only read out what was on the screen.

The second version of the tool brought to light the issue of nested essentiality and whether it would work in practice. The obvious example to address this issue was the use of tables and the question as to what would happen to tables that had table data tagged at different levels of essentiality. Would the table collapse into a smaller version when the unessential data was removed?

A table was created up for UK tourist attractions and each column marked up with a different level of essentiality. There were five columns assigned the essentiality levels 1, 3, 5, 8 and 10. The page was tested through the filter, with the required essentiality set at level 5. It was envisaged that the tool would remove the two columns of data assigned with essentiality level 1 and 3, displaying the remaining three columns: attraction name (level 10), address (level 8) and telephone number (level 5). The outcome was that the tool did indeed return a collapsed table with the required volume of information.

Further tests identified different issues such as the limitations of working with frames and the inability to override some CSS styles in Web pages. The tests also brought to light the need for added functionality such as a help section that operates as a user

manual and the ability to change link and hover colour. Changing link and hover colour was very important for navigation awareness, i.e. if the user selects blue as the text colour and the Webpage visited link colour is also blue then there will be no way for the user to identify links that have already been visited.

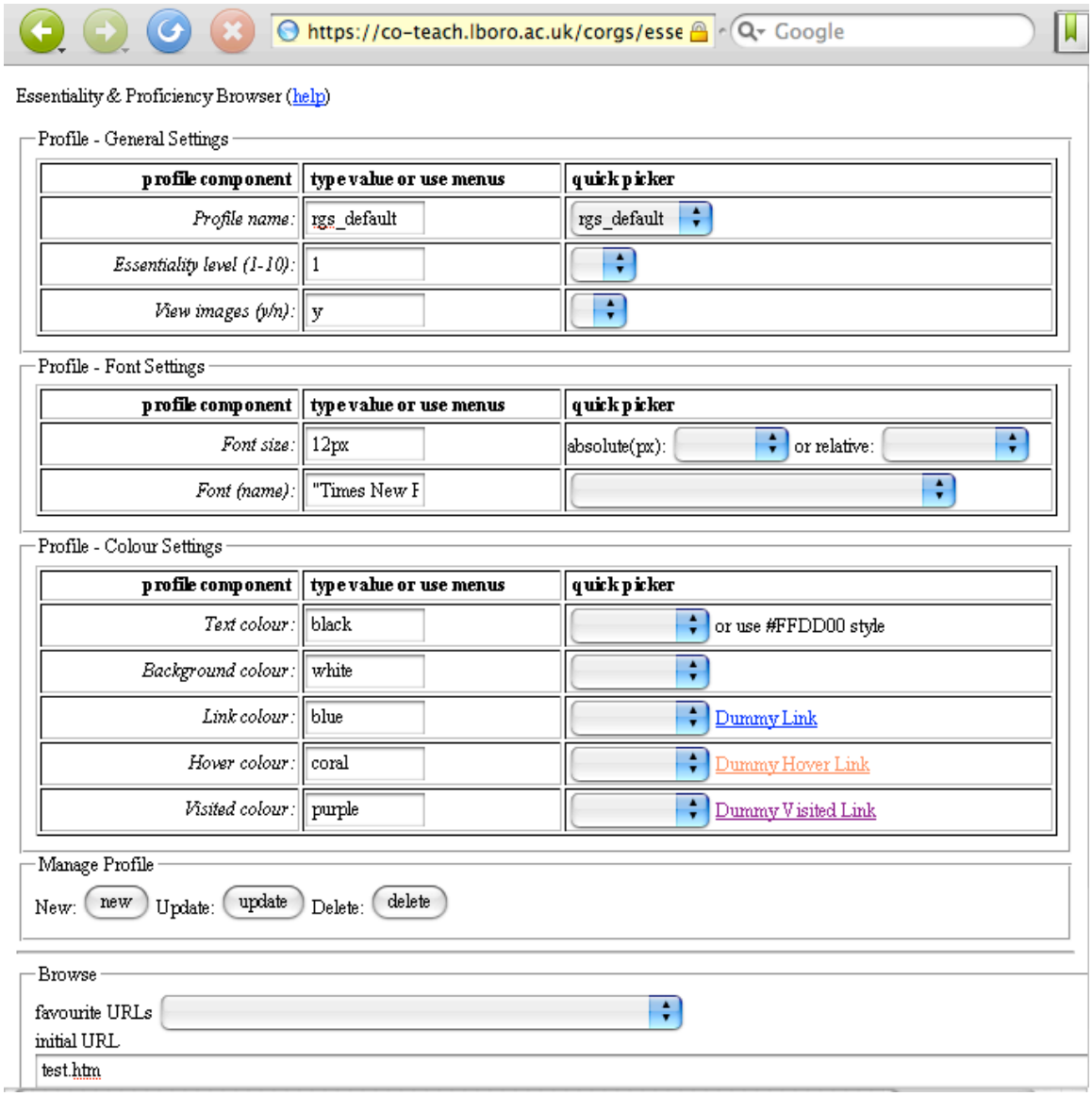



Figure 5.7 The Essentiality & Proficiency user interface

The iterative development of the Essentiality & Proficiency tool stopped at version six as it was believed that the required functionality had been reached. Figure 5.7 shows the final version (version six) of the Essentiality & Proficiency tool user interface. The next step was to evaluate the tool.

## Chapter Summary

This chapter reported the design and development of the prototype Essentiality & Proficiency tool. The system design and system architecture of the Essentiality & Proficiency tool was discussed. The chapter also reported how the tool was tested prior to the formative evaluation of the tool. The formative evaluation is reported in the following chapter.

# Chapter 6- Evaluating the Essentiality & Proficiency Tool

## Chapter Preface

This Chapter discusses in detail the formative evaluation of the prototype Essentiality & Proficiency tool. Following on from the empirical work in Chapter 4 and the development of the prototype Essentiality & Proficiency tool in Chapter 5, this chapter presents the experimental design methodology to test the main hypothesis, the results, the discussion and the conclusion.

## 6.1 Experimental Design

An experiment (see table 6.1) was designed to test how effective the Essentiality & Proficiency tool is when searching for specific information. The experiment would compare what happens when the related samples independent variable (IV) essentiality is absent (condition 1) with what happens when it is present and preset (condition 2). If the essentiality does make it easier to search a volume of information then we would expect the dependent variable (task completion time in seconds) to be greater in condition 1 than in condition 2. If the essentiality does not make the process of searching for specific information faster, then we should not expect a difference. A third condition (condition 3) was also set to see what happens when the independent variable is present and manipulated by the participant. The manipulation of the independent variable (essentiality) occurs when the participant selects a level of essentiality from ten levels to use when searching for information. In contrast the level of essentiality is preset in condition 2.

The primary dependent variable (DV) is the task completion time which is the time taken in seconds to find the correct answer to a task. The task completion time was measured when information was sought during the three conditions. The second dependent variable is the correct answer itself.

Table 6.1 A breakdown of the experiments

| Condition | Type of condition | Essentiality (IV) | Experiments | Great Central Railway WEEK 1 | Nationwide WEEK 2 |
|---|---|---|---|---|---|
| **1** | Controlled | Absent | Conducted on an original website | *Essentiality Absent **(EAW1)*** **Task1:** As a present for your friend's birthday you have decided to buy them the chance to drive a locomotive. How old do you have to be to drive a diesel locomotive? | *Essentiality Absent **(EAW2)*** **Task 4:** Banking over the Internet is becoming more and more convenient; you have decided that you want to have the opportunity to explore the features of current accounts. How many months worth of current account transactions can you view? |
| **2** | Experimental | Present (Preset) | Conducted on an essentiality marked-up site using the Essentiality & Proficiency tool with a preset essentiality level 6. | *Essentiality Preset **(EPW1)*** **Task 2:** You are doing a project for college where you will present an overview of the Great Central Railway. Which year marked the silver jubilee of the Great Central Railway Company? | *Essentiality Preset **(EPW2)*** **Task 5:** You have seen a house that you like and now need to find out about mortgages. How much free mortgage payment protection insurance can you expect to get? |
| **3** | Experimental | Present (Manipulated) | Conducted on an essentiality marked-up site using the Essentiality & Proficiency tool where the essentiality level is set by the participant themselves. | *Essentiality Manipulated **(EMW1)*** **Task 3:** You are interested in seeing the latest model railway construction of Ruddington's G.C.R. Station. You want to know whether it is ready for viewing. Find the telephone number for the G C R (Nottingham). | *Essentiality Manipulated **(EMW2)*** **Task 6:** You have lost your credit card and need to report it missing. Find the telephone number to report your card missing. |

Note: Table 6.1 shows two weeks of testing. Week 1 and week 2 are the weeks when the experiments took place. There was a gap of 2 weeks between week 1 and week 2.

## 6.2 Participants

The Essentiality & Proficiency tool had initially been designed for people with visual impairments as described in Chapter 2, section 2.3. For this reason it was important to test it with a sample group from the target population. Visually-impaired participants are difficult to recruit so an opportunistic sample of people was found. The participants were recruited through Dr Colin Machin's contacts at the RNIB College Loughborough and DANs at Loughborough University.

There were nine participants overall. Due to the small number of participants, all nine participants tested the tool in each condition. There were seven male participants and two female participants. The age range for the participants was between 18 to 52, with a mean age of 30 years (SD = 12.8). Table 6.2 shows that the participants were categorised into three levels of visual impairment and at what stage it occurred in their lives. Table 6.2 clearly shows that the participants represented various visual impairments that have been acquired at different stages in life.

Table 6.2 Severity and duration of visual impairment

| | From birth | Acquired at a young age | Acquired it later in life |
|---|---|---|---|
| Low impairment | - | - | 1 |
| Mild impairment | 3 | 2 | - |
| No vision | 1 | 2 | - |

Screen reading software and screen magnification were evident as the dominant assistive technologies being used by the participants. Five participants used screen reading software and four participants used screen magnification.

Participants were asked to rate their skill level when using a computer (table 6.3). Due to the universal nature of the tool it was important to test the tool with users with different skill levels. The table shows declared skill levels of the participants.

Table 6.3 Computer skills level when using PC

| | Novice user | Intermediate user | Advanced user | Developer |
|---|---|---|---|---|
| No of participants | 1 | 4 | 2 | 2 |

The participants were asked how often they frequented Websites to ensure that they did have some contact with the technology being tested and to ensure that the test would not be wasted. The participants frequented Websites, with six visiting Websites more than once a day, two visiting once a day and one person visiting Websites less frequently than once a month.

The participants were asked about the Web accessibility problems they faced. Although this question had already been addressed by the preliminary survey in Chapter 4, it was reiterated here to gauge the underlying Web accessibility problems faced specifically by the participants (see Appendix L). The most prominent accessibility issues experienced by the participants when attempting to find information on Websites were complicated navigation schemes (eight participants) and too much information presented (seven participants). Six participants felt that navigations schemes needed to be learnt and five participants thought that there were too many links.

All nine participants were students, seven of whom were studying at the RNIB College Loughborough and two were students at Loughborough University. These specialised institutions catered for the participants by providing the necessary assistive technology for the participants and were already set up to meet their requirements. The decision was made to test the participants in their own environment as it would put them at ease and therefore ensure that the tasks are undertaken in the natural/real environment. Ethical clearance was gained from the Ethical Advisory Committee (EAC 2006) at Loughborough University before designing the experiment.

## 6.3 Apparatus and Materials

The basic apparatus used in the experiments was a Dell computer (750 MHz, 512 MB RAM, and 500 MB hard disk drive) set up with Internet Explorer version 6 and the assistive technologies Jaws version 7 and Zoomtext version 5.1. The Essentiality &

Proficiency user interface (as shown in Chapter 5, figure 5.7) was displayed on a 17 inch CRT monitor which was placed in front of the participant.

Ideally real Websites would have been used for the experiment. However as the Websites were not marked-up for essentiality, copies were made of two real Websites (the Great Central Railway and Nationwide) and the essentiality mark-up was added by hand. The choice of Website and the details of how they were marked up are explained in more detail in Appendix F. The Essentiality & Proficiency user interface had a link to the Great Central Railway (GCR) Website (see figure 6.1) and the Nationwide Website (see figure 6.2) both of which would be used in conditions1, 2 and 3. The GCR Website would be used in week 1 of the experiments and Nationwide would be used in week 2.




Figure 6.1 Example of pages from the Great Central Railway (GCR) Website showing the homepage, the Drive a Train page and the Contact page (Accessed 03/12/06)

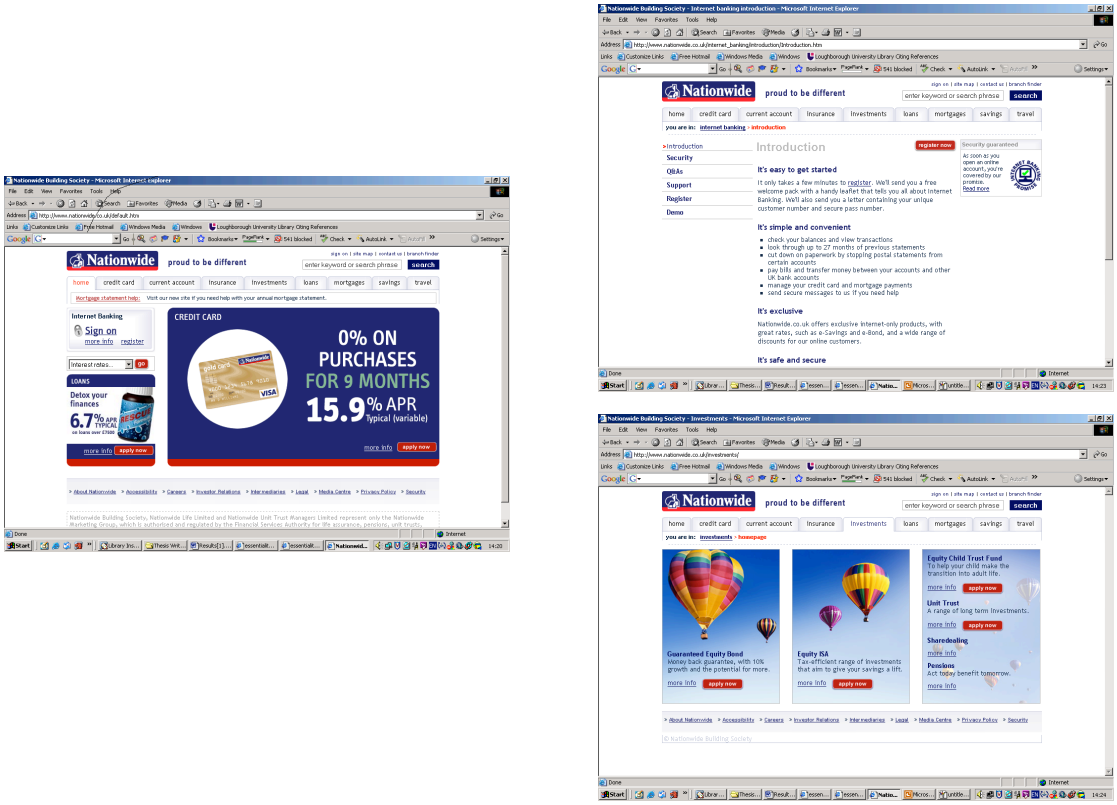



Figure 6.2 Example of pages from the Nationwide Website showing the homepage, the Internet Banking page and the Investments page (Accessed 10/01/07)

There was a list of tasks that accompanied each Website and would be performed by the participants. The design of the tasks: EAW1, EPW1, EMW1, EAW2, EPW2 and EMW2 (as shown in table 6.1) was integral to the evaluation of the Essentiality & Proficiency tool (see Appendix G for a detailed account of the task design). The tasks were carefully designed to be of the same level of difficulty incorporating a similar volume of information in terms of text and the number of pages that would have to be sorted through to complete the task. Before the visually impaired participants undertook the experiments, the relative difficulty of the tasks was tested informally. A comparison was made using 6 able bodied students. The students were divided into two groups of 3 and given one task each. The students were timed during the task. This informal test showed that the tasks took approximately similar times to complete.

A stop watch was used to time how long it took all the participants to complete the experiments. Pens and paper were used to record the times and any other responses. The

participants were asked to talk through their thought process and this was captured by a dictaphone.

In terms of printed material (see Appendix H), there was:

1. Essentiality & Proficiency information sheet with contact details
2. Information sheet explaining the experiment
3. Informed consent form

A usability test script and user evaluation questions were also used in the experiments (see Appendix I). The purpose of the usability test script was to ensure that there were no differences on behalf of the author in conducting the experimental procedure.

## 6.4 Procedure

A total number of nine participants took part in the formative evaluation of the Essentiality & Proficiency tool. The tests were conducted over a period of four weeks. Each participant was given the contact details, the information sheet explaining the usability test and the consent form (see Appendix H). These were provided prior to the tests and were made available in standard print, large print and electronic format. Each participant was asked to sign the consent form and return it at the start of the test.

Each participant was invited separately. When they arrived they were asked to answer a participant background questionnaire prior to commencing the test. This was read out to them from a test script (see Appendix I) which was followed to ensure the consistency and flow in each test.

Each participant was questioned for background information and then taken through a guided tour of the interface of the Essentiality & Proficiency tool. As they reviewed the interface they were asked to talk through their thought process. The participant was asked to go through each setting of the interface and were asked whether they needed to adjust that setting. This established a profile for the participant.

Once a profile had been created for the participant, the participant was then asked to select a URL from the drop down menu and to view it using the tool. The participant was then asked to speak out their impression of the site and if it had been manipulated

to their requirements and whether it met their expectations. Then the main experiments were carried out after which the participant was interviewed to gauge their opinion of the tool and what did and did not work for them. Finally the researcher thanked the participant and escorted them out.

## 6.5 Control

Separate tests were conducted for difficulty of task and the order effects of the experiment such as improvement due to practice and familiarity or deterioration in performance due to boredom. This control test was run with ten PhD students from the Department of Computer Science at Loughborough University. There were an equal number of female and male student participants. The student participants' age range was 21 to 41 years old, with a mean of 27.3. The student participants were divided into two groups: the control group and the counterbalance group.

**Control Group**

The control group conducted the three tasks which are listed under the labels Task 1, Task 2 and Task 3 in table 6.1. For this group, essentiality (the independent variable) was absent in all three tasks as the aim of the experiments was to examine the difficulty in task without the presence of the independent variable. The tasks were conducted on the original GCR site and the dependent variable was the time it took in seconds to answer the task.

Table 6.4 A control design using related samples to examine the difficulty in task when searching for task-based information without the independent variable

| GCR | Task 1 | Task 2 | Task 3 |
|---|---|---|---|
| Order of tasks | 1st | 2nd | 3rd |

n = 5 participants in each condition

Table 6.5 shows the average task completion times for five participants that took the control experiments. From table 6.5 it is evident that the task completion times vary quite a bit.

Table 6.5 Task completion times for the control experiments

| GCR | Task 1 | Task 2 | Task 3 |
|---|---|---|---|
| M | 109 | 169.2 | 76 |
| SD | 99 | 137.2 | 81.3 |

M = mean; SD = standard deviation; n = 5 participants in each condition

An alpha level of .05 was used for all the statistical tests (see Appendix N). Analysis of the data from the control experiments in Appendix M using the related *t* test showed that the task completion time obtained when the sighted participants conducted Task 1 was not statistically significant when comparing with the task completion times of participants for Task 2, $t$ (4) = -1.044, $p$ = .355 (two-tailed). Therefore the null hypothesis that Task 2 is not more difficult to complete than Task 1 is accepted.

There was no statistical significance when the *t*-test was used to analyse the task completion times obtained by participants conducting Task 3 when compared to the task completion times obtained when conducting Task 1 , $t$ (4) = .499, $p$ = .644. Therefore the null hypothesis that Task 3 is not more difficult than Task 1 is accepted

**Counterbalance Group**

The counterbalance group (see table 6.6) conducted the three GCR tasks EAW1, EPW1 and EMW1 (see table 6.1) under the three conditions of essentiality absent, essentiality preset and essentiality manipulated. The original order for the main experiments was essentiality absent, essentiality preset and essentiality manipulated. However the experiments were reordered for the counterbalance group as the aim of the experiment was to examine order effect in terms of improvement due to practice and familiarity or deterioration due to boredom.

Table 6.6 A counterbalanced design using related samples to examine the effects of essentially when searching for task-based information.

| Essentiality: | Absent | Preset | Manipulated |
|---|---|---|---|
| Order of tasks | 2nd | 3rd | 1st |

n = 5 participants in each condition

Table 6.7 shows mean and the variation distribution of the task completion times for the counterbalanced experiments.

Table 6.7 Task completion times for the counterbalanced experiments.

| Essentiality: | Manipulated | Absent | Preset |
|---|---|---|---|
| M | 41.4 | 37.4 | 31.4 |
| SD | 19 | 13.7 | 12.7 |

M = mean; SD = standard deviation; n = 5 participants in each condition

An alpha level of .05 was used for all the statistical tests (see Appendix N). Analysis of the data from the counterbalanced experiments in Appendix M using the related *t* test showed that the task completion time obtained when the sighted participants conducted the manipulated essentiality task during the GCR experiment was not statistically significant when comparing with the task completion times of participants when essentiality was not used during the experiment, t (4) = .276, $p$ = .796 (two-tailed). Therefore the null hypothesis that manipulating the essentiality does not lead to a shorter task completion time is accepted.

The *t* test is used analyse the data from the counterbalanced experiment conditions of essentiality absent and essentially preset (see Appendix M). The *t* test shows that there was no statistical significance in the task completion times obtained when the essentiality preset task was completed last, compared to the task completion times obtained when essentiality absent is completed in the second place, $t$ (4) = .899, $p$ = .419 (two-tailed). Therefore the null hypothesis that the order effect of the tasks reduces task completion time is accepted.

## 6.6 Main Results from Visually Impaired Participants

As reported earlier nine participants with a range of visual impairments took part in the GCR experiments and five took part in the Nationwide experiments. There were five participants in the Nationwide experiments as these were designed to understand what happens when the Essentiality & Proficiency tool is used on a second attempt and with a different genre of website. So the five participants came from the original nine that took part in the GCR experiments. This section first reports the results from the

experiments and then reports the participants' impressions of the Essentiality & Proficiency tool.

### 6.6.1 Inferential Statistics

Table 6.8 presents the mean and standard deviation task completion times (see Appendix O) for the GCR experiment. Table 6.9 presents the mean and standard deviation task completion times for the Nationwide experiment.

Table 6.8 Task completion time in seconds for GCR Experiment

| Essentiality: | Absent | Preset | Manipulated |
|---|---|---|---|
| M | 283.3 | 210.6 | 135 |
| SD | 117.5 | 114.9 | 112 |

M = mean; SD = standard deviation; n = 9 in each condition

Table 6.8 and table 6.9 show that the mean task completion times for both the GCR and Nationwide experiments were shorter in the condition essentiality preset than the condition essentiality absent. The mean task completion times were also shorter when the participants manipulated the essentiality than when the essentiality was absent.

Table 6.9 Task completion time in seconds for Nationwide Website over the three conditions

| Essentiality: | Absent | Preset | Manipulated |
|---|---|---|---|
| M | 211 | 101.4 | 203.2 |
| SD | 119.5 | 43 | 125 |

M = mean; SD = standard deviation; n = 5 participants in each condition

It is evident that the mean task completion times (DV) differ quite a bit under the three conditions (see table 6.8 and table 6.9). The SD results in table 6.8 show that there is a high variation between the task completion times obtained by the participants in each condition.

The essentiality manipulated condition for both the GCR and the Nationwide experiments enabled the participants to select any level of essentiality between 1 and 10 (see Appendix O). The values for the essentiality level selected by the user had the

modes 5 and 8 for the GCR experiment and mode 8 for the Nationwide experiment. The mode for the essentiality levels used in the Nationwide experiment was essentiality level 8.

Figure 6.3 shows the percentage of correct answers achieved by the participants during the three essentiality conditions: absent, preset and manipulated (see Appendix P). The results show that the percentages of correct answers increase with the introduction of the independent variable (essentiality). For example the participants achieved 44 % correct answers during the essentiality absent condition for the GCR experiment and 60% for the Nationwide experiment. In contrast 89 % correct answers were achieved when essentiality was preset in the GCR experiments and 100% for the Nationwide experiments.

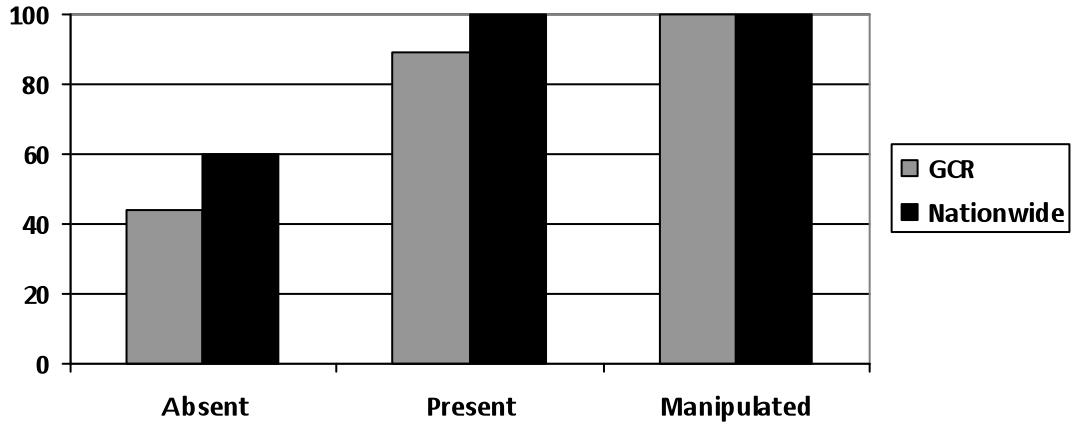



Figure 6.3 Bar chart showing the percentage of correct answers achieved in both the GCR and Nationwide experiments

This section has presented the inferential statics for the dependent variables task completion time and correct answer. The following section presents that statistical analysis of the data.

### 6.6.2 Statistical Significance

An alpha level of .05 was used for all the statistical tests. Analysis of the data in Appendix O using the related *t* test showed that the task completion time obtained when participants used a set essentiality during the GCR experiment was not statistically significant when comparing with the task completion times of participants when

essentiality was not used during the GCR experiment, $t$ (8) = 1.90, $p$ = .094 (two-tailed). Therefore the null hypothesis that using a preset essentiality does not lead to a shorter task completion time is accepted.

However statistical significance is shown when analysis using the related $t$ test is conducted between the task completion times obtained by the participants when they manipulated the essentiality is compared to the task completion times for the participants when essentiality was absent, $t$ (8) = 3.37, $p$ = .010 (two-tailed). In this instance the null hypothesis that being able to manipulate essentiality does not lead to shorter task completion time is rejected.

In contrast, analysis of the data (see Appendix O) using the related $t$ test showed that the task completion time obtained when participants used a set essentiality on the Nationwide Website was not statistically significant when comparing with the task completion times for when essentiality was not used, $t$ (4) = 2.37, $p$ = .077 (two-tailed). Therefore the null hypothesis that using a preset essentiality does not lead to a shorter task completion time is accepted.

There was no statistical significance when the $t$-test was used to analyse the task completion time obtained by participants when essentiality was manipulated to task completion time when essentiality was absent, $t$ (4) = .138, $p$ = .897. (See Appendix Q.) In this instance, the null hypothesis that being able to manipulate essentiality does not lead to shorter task completion time is accepted.

Table 6.10 Results in seconds for same 5 participants GCR Website over the three conditions (conducted 2 Weeks Earlier)

| Essentiality: | Absent | Preset | Manipulated |
|---|---|---|---|
| M | 294 | 193 | 84 |
| SD | 148.3 | 146.5 | 93.4 |

M = mean; SD = standard deviation; n = 5 participants in each condition

A difference is clearly seen when the mean task completion times for the GCR experiments for the same five participants that undertook the Nationwide experiments

are compared (see Table 6.10). Analysis of the data using the *t*-test does not show the reduction in task completion time when essentiality is preset to be statistically significant to task completion times essentiality is absent, $t$ (4) = 1.75, $p$ = .154. However there is a statistical significance when the *t*-test is used to analyse the task completion times for when the essentiality is manipulated to task completion times when essentiality is absent, $t$ (4) = 3.26, $p$ = .031.

The Cochran's $Q$ test for related observations was used to analyse the GCR data in Appendix P to see if essentiality (independent variable) affected the outcome of the participants getting the correct answer. The null hypothesis is that essentiality does not help participants to get the correct answer. The results show that essentiality is statistically significant in getting the correct answer in the GCR experiments, d.f = 2, $Q$ = 8.4 and $p$ = .015. Therefore the null hypothesis is rejected.

The Cochran's $Q$ test was repeated for the Nationwide experiments. However analysis of the Natiowide results in Appendix P showed that essentiality was not statistically significant in obtaining the correct answer, d.f = 2, $Q$ = 4.0 and $p$ = .135. The null hypothesis was therefore accepted.

This section has presented the results from the GCR and Nationwide experiments under the three essentiality conditions: absent, preset and manipulated. The results have presented the statistical significance of essentiality. The following section presents a summary of the key observations made during the GCR and Nationwide.

### 6.6.3 Observations

Observations were made during the experiments. There were three key points of interest, these were labelling of the Websites, skim reading and workarounds. Participants' experienced difficulty with the labelling in the Websites. For example many of the participants commented upon the labelling in the GCR Website. The participants questioned the labelling of the navigation menu as they felt that it hindered their task completion.

It was observed that the participants using both screen reading software and screen magnification had a tendency to read the first sentence of the paragraphs to make an

assumption on whether it contained the information they were looking. Participants often missed the answer due to the skimming of the text. Often the participant was on the correct page and had skimmed over the answer a number of times.

The participants tried to use workarounds to aid them in completing the experiments. Workarounds are shortcut methods used to get around a problem. For example when the participants were searching for the task based information they would attempt to use the find function in their screen reader to find the correct information.

### 6.6.4 Participant impressions of the Essentiality & Proficiency Tool

This section summarises the participants' feelings and impressions of the proficiency side of the Essentiality & Proficiency tool as captured during the guided tour of the interface (see Appendix R). As stated in the procedure (see section 6.4) the guided tour was conducted prior to the experiments.

Initial response to the Essentiality & Proficiency Interface

The general initial impression of the Essentiality & Proficiency interface was very positive. Participants described their initial impression using positive statements such as: "*the layout is very good", "really good settings"* and "*very clear"*. The interface was seen in general to be "*simple"* and "*straightforward"*. Some participants were slightly more dubious about the interface using terms such as "*challenging", "scary"* and that there is "*a lot on the page"*.

Comprehension of the Essentiality & Proficiency tool

Participants generally understood most elements of the Essentiality & Proficiency tool. However the participants identified presentation terminology such as "*Link colour"* and "*Hover colour"* with which they were not familiar and sought clarification.

Compiling user profiles

Although a majority of the participants found that *it was easy* to compile their user profile, a small number of participants found the process "*a bit challenging"*.

Navigating the Essentiality & Proficiency tool

As the Essentiality & Proficiency tool is proposed to increase accessibility to information it was important to verify that the sample participants could navigate around the interface without incurring more obstacles. The general consensus was that "*it was easy to navigate"*. Some participants found it easier to navigate once they had "*gained an impression of the interface and knew what they were looking at"*. However a few participants experienced difficulty when navigating the interface.

Problems faced by the participants when using the Essentiality & Proficiency tool

Screen reader users experienced problems with the instantaneously updating nature of the form on the set-up page for the tool. In particular the problems stemmed from the refreshing of the page when presentation settings were inserted into form elements. The participants found that they were thrown out of form mode and had to start from the top each time.

In contrast screen magnification users found the instantaneous updating an effective process as they were able to see the changes and whether they were suitable or needed changing before they were applied to their chosen Website.

Important Features of the Essentiality & Proficiency tool

When the participants were asked which feature of the Essentiality & Proficiency interface was most important to them there was a divide. The screen reader users found the tool as a whole a "*good idea"*. However greater importance was actually given to the ability to be able to select an essentiality level.

In contrast the screen magnification users identified the ability to select specific presentation settings (the Proficiency side of the tool) as important to them. The participants mostly identified the level of Essentiality and the ability to remove images as the most important features of the Essentiality & Proficiency tool.

Application of user profile to chosen Web page

Overall participants appeared to be very happy with the outcome of their user profile when applied to a Web page of their choice. The following are an example of how some of the participants responded:

*"Wow, actually this is quite a lot better than the original site. I'm impressed."*

*"Better than I expected"*

*"I think its very good"*

*" It's very good actually there's a lot more information on the Website, that is displayed that isn't normally there, makes it more accessible"*

*"Yes it's less cluttered and more easier to see what the important thing is"*

There was one negative opinion of the application of the user profile to a chosen Web page. It was felt that there was no facility for fewer links in the user profile.

Overall Impression of the Essentiality & Proficiency Tool

Although participants commented on problems that they specifically experienced with the tool, the overall opinion was that "*the interface was easy to navigate and the form easy to fill."* When questioned if the participants had found what they expected the results show that the tool "*performed beyond their expectations*."

### 6.6.5 Post Experiment Feedback

This section reports the participants' opinions post experiment. The participants were asked open and closed questions about their experience of the Essentiality & Proficiency tool. The participants were asked to respond to the closed questions using a Likert scale, for example, strongly agree to strongly disagree (see Appendix S and Appendix T).

Experience Gained from Using the Essentiality & Proficiency Tool

The participants gave very positive responses about their experience gained from using the Essentiality & Proficiency tool. Most participants *agreed* that the interface was simple to follow. The participants *strongly agreed* that applying their personal preferences made the viewing the Web page easier. The participants found it *difficult* to access the information in the Web page without the Essentiality & Proficiency tool. The participants felt that it was *easy* to locate the information with the tool. Participants

felt that it was *easy* to understand the concept of essentiality and the essentiality levels and it was also *easy* to apply the idea of essentiality and essentiality levels to a Web page.

Application of Essentiality

The participants were asked whether they thought that applying essentiality, in the manner that they had in the experiment, was worthwhile. The participants felt that *yes* it was definitely worthwhile. The participants again answered *yes*, when asked if they would like to see essentiality applied to other types of long electronic documents.

Benefit Future Experience of Using the Web

All participants stated that the tool would benefit them when using Web pages. The participants highlighted that the tool made their "*experience a lot easier"*, that they *"like[d] the way it clears the screen and just [gave] you text."* And that using the tool *"would speed thing up a lot."*

Suggested Improvements to Essentiality & Proficiency tool

All participants suggested ways in which the tool could be improved, the most pressing improvements identified are:

- To reduce the number of keystrokes needed to open and select options in the combo boxes.
- To make the help section more visible so that the users could check with it to find out what the different levels of essentiality are related?

The other improvements suggested, range from, wishing the links contained in Web pages to be identified in the Essentiality & Proficiency interface, to stating how many links there are and whether the user desires them. In other words the participants desire the option to remove the links. At the other end of the spectrum there was a suggestion to assign sounds to the links to say what the links do.

Anything Disliked about the Tool

When questioned whether the participants had found anything that they did not like about the tool, the general consensus was that they *did not find anything that they did not like about the tool.* Participants even went on to say that overall "*it was very good."*

However some issues were raised for example getting lost in the interface when creating their profile, whether there might be cases when the essentiality level may remove the information sought by the user and the essentiality key not being user-friendly.

## 6.7 Discussion

The results are not wholly consistent with the experimental hypothesis; the task completion time was not significantly shorter when essentiality was preset than when essentiality was absent. This was the case for both the GCR experiments and Nationwide experiments which were conducted two weeks later. A possible explanation for this is that the participants experienced difficulties with the labelling of the Websites which hindered their task completion. Another explanation is that participants' skim read only the first line of the information and therefore missed the answer during their first interaction with the text and then had to re-read the text to find the answer.

The task completion time was significantly shorter when the participants manipulated the essentiality than when the essentiality was absent in the GCR experiment. One possible reason for this is that the control experiment showed no significant difference in the difficulty of the task when essentiality was manipulated when compared to the task when essentiality was absent. However another possible reason for this is that the participants on average selected a higher level of essentiality and therefore had less information to sort through for this task, if this is the case, then it can be argued that there is a causal relationship between essentiality and task completion time.

The task completion time was not significantly shorter when the participants manipulated the essentiality when compared with the absence of essentiality during the Nationwide experiments. This may suggest that experience of the essentiality does not affect the task completion time, as the participants that took the Nationwide experiments, also completed the GCR experiments two weeks earlier and therefore had already experienced firsthand use of essentiality. Furthermore this may also refute the argument from the counterbalanced experiment which stated that the order effect of tasks reduces task completion time.

The results have shown that task completion time did not significantly reduce during the three conditions in the Nationwide experiments. The Nationwide experiments were conducted to test whether participants would show a similar increase in performance when using Essentiality & Proficiency tool on a second attempt and with a different genre of Website. As formerly stated a two-week time gap was given between the initial set of experiments with the GCR Website and the second set of experiments with the Nationwide Website. This was significant because the participants would not have fresh experience of the tool during the retest.

However the task completion had significantly reduced for the same participants during the GCR experiments. This may suggest that the participants found it harder to use essentiality in a Website which was structurally different to the GCR Website. Another explanation is that information may have disappeared when a high level of essentiality was selected. In this instance participants would have had to select a lower level of essentiality to find the correct information. Researchers may need to ensure that participants are made aware that they can change the essentiality level within each page.

During the GCR experiment, participants achieved a significantly higher number of correct answers when essentiality was preset and when essentiality was manipulated when compared with the absence of essentiality. This is consistent with the hypothesis that essentiality does make it easier to search information. However, although the participants achieved a higher percentage of correct answers during the Nationwide experiments, they were not significantly higher.

The chosen sample size could have two effects. On the one had it could contribute to the higher percentage of correct answers over the three conditions in the Nationwide experiment. On the other hand, though, it could reduce the statistical significance of the results. It can be argued that as the sample size was small (five for the Nationwide experiments and nine for the GCR experiments) there was insufficient power to show a greater statistical significance across the experiments. In such instances, increasing the alpha size from .05 to .10 is suggested (Harris 2008).

As detailed in section 6.1 the essentiality manipulated condition allowed the participants to select their own level of essentiality. The information sought in the essentiality

manipulated condition for both the GCR and Nationwide experiments was assigned essentiality level 9. The participants were not aware of the essentiality level assigned to the information they were seeking and therefore had to guess which level to use. The results show that on the whole participants selected essentiality levels were appropriate for them to find the information. However there was one instance where a participant selected essentiality level 10 which meant that the information that they were seeking was filtered out and that they then had to reselect another level to find the information. The process of select and reselect would have some impact on the task completion time as well as on whether participant gained the correct answer.

The results have shown that there is some statistical significance when using essentiality to find information. The results to some degree support the hypothesis that by assigning essentiality levels, users with visual impairments are better able to access information than when attempting to access it from sites in their original state. The results from the participants are not used to make inferences about people with visual impairments as a whole but rather to represent the population at the RNIB College Loughborough and DANs at Loughborough College. Able-bodied student participants were used as well as those with visual impairments. The student participants were recruited to act as control in the experiments. Researchers should consider replicating the experiment with a greater sample of able bodied participants (as participants with visual impairments were difficult to recruit) to establish whether there is a causal relationship between essentiality and the dependent variables task completion time and correct answer as suggested by these findings.

The findings of this formative research is limited in its theoretical implications as it has introduced essentiality and tested whether it would work as a concept when coupled with proficiency. Participants stated in the post experiment that they understood how essentiality works and that they would like to see essentiality applied to other electronic documents. Furthermore participants felt that the Essentiality & Proficiency tool would benefit their web browsing experience. One explanation for their favourable response is that the participants were aware of the aims of this research and responded in favour of the research.

Section 2.3 of Chapter 2 stated that the visual transformation of Web pages in terms of presentation is less important to screen reader users than it is for screen magnification users. The importance of Web adaptation as reported in section 2.8.2 was clearly evident when the participants compiled their user profiles during the guided tour. (See Appendix U for example of screenshots which show the distinction between the Web adaptation requirements for screen magnification users.) The screen reader users made fewer changes to the visual display. The most important feature identified by the screen reader users was content adaptation in terms of the level of essentiality as identified in section 2.8 of Chapter 2. In contrast the screen magnification users identified the tool as a whole to be useful.

As participants have identified the importance of essentiality, further work should include an extensive development of the essentiality levels, producing a rigorous framework which can be applied across different genres of Websites and also extend to different electronic documents. The process of analysing the GCR and Nationwide sites for essentiality (see Appendix F) required the author to make choices on behalf of the original Web authors. The author felt confident that the essentiality mark-up was staying true to the original author's intentions. One of the reasons for the confidence is that the Web author uses different styles i.e. different font faces and font sizes, to draw the user's attention to specific content. It transpires that the Web authors are already thinking about essentiality of various parts of the content but not actually in terms of essentiality, in that they are doing it subconsciously rather than overtly. Hence, although the Web authors are thinking in terms of essentiality they are leaving out the mark-up with levels of essentiality.

Modifications identified specifically for the Essentiality & Proficiency tool

As the participants responded positively to the Essentiality & Proficiency tool during both the guided tour and the post experiment feedback, they were asked what improvements they would like to be made to the tool. The modifications will enable researchers to test the concept of Essentiality & Proficiency with fewer confounding variables. Researchers should increase the visibility of the essentiality key within the Essentiality & Proficiency interface as this would allow the participants a greater understanding of what each level of essentiality will show.

Two versions of the preferences form would have to be developed to resolve the problem of the screen reader users' being thrown out of form mode. One version would be for screen reader users which would enable them to fully complete the form before the changes take place. The second one would be an instantaneously updating form that would allow the users to view the changes and ascertain that they are correct before they are applied to their chosen Website.

A point to note is that the filter has been designed to remove images if the user so chooses. One of the suggestions as a further improvement for the Essentiality & Proficiency Tool would be leave ALT texts for the user where the image has been removed. This is to ensure that the semantic content is present for all users whether they are able to use the images for their information content or not.

## 6.8 Conclusion

The findings suggest that essentiality makes some difference to easing access to important information contained in Websites by reducing the volume of information and retaining only the most important information. Further work is required to make Essentiality & Proficiency a more robust concept. After addressing the modifications the next step would be to replicate this study with a greater number of participants.

### Chapter Summary

This chapter has reported the formative evaluation of the prototype Essentiality & Proficiency tool. The experimental design methodology used to test the main hypothesis has been presented, followed by the results, the discussion and the conclusion. The following Chapter draws together the key findings of this research and presents the future directions for Essentiality & Proficiency.

# Chapter 7- Conclusion

## Chapter Preface

This final chapter summarises and concludes the research in Essentiality & Proficiency. Directions for future work are discussed alongside work that is already evolving as a result of this research.

## 7.1 Main Contribution of Thesis

The main theoretical contribution of this thesis is the combination of the concepts of Essentiality & Proficiency which, when considered together, seem to have some usefulness in the area of accessibility. The main practical contribution is an experimental approach to one way of implementing Essentiality which demonstrates some usefulness in the area of Web accessibility.

### 7.1.1 Overview

The main aim of this thesis has been to introduce the concept of Essentiality & Proficiency as having the potential to improve access to the Web. The Essentiality & Proficiency concept has been developed as a means to make inaccessible Websites accessible and control the volume of content in order to achieve effective rendering of information, thus reducing the user's need to trawl through vast amounts of unnecessary information.

Chapter 1 provided an overview of the aims of the research. Chapter 2 presented a review of how people with Visual impairments are affected by the inaccessibility of the Web. Legislation such as the DDA 1995 and Section 508 of the Rehabilitation Act were reviewed to gain an understanding of the legal measures being taken to address the problems of inaccessibility. Web accessibility has been discussed with an extensive review of the WCAG guidelines and accessibility tools. Chapter 2 identified that great measures have been taken to address the issues of Web accessibility. However Web inaccessibility exists and a case has been made for the need to develop a Web personalisation solution which not only adapts the visual presentation but also adapts the content. There is a review of the different Web personalisation techniques being developed in current research which attempt to bridge the gap between an inaccessible

Web to a fully accessible Web. These are explored as a baseline for the Essentiality and Proficiency concept.

Chapter 3 provided a detailed explanation of the concepts of Essentiality and Proficiency and has shown how they have been brought together to form the concept of Essentiality & Proficiency. Essentiality has been defined as a means of restricting the volume of information presented from a Website. Proficiency has been defined as the user's ability to accept information coupled with what their assistive technology can accept. Chapter 4 reported the preliminary survey which informed the development of Essentiality & Proficiency into a technology demonstrator. Chapter 4 also reported the empirical study which tested the technology demonstrator. The findings from the empirical study highlighted both the benefits and the limitations of the study. The technology demonstrator was enthusiastically received by the users, encouraging progression to a full prototype Essentiality & Proficiency tool

Chapter 5 reported the design and iterative development of the prototype Essentiality & Proficiency tool. There was a discussion of the system design and system architecture of the prototype Essentiality & Proficiency tool. Chapter 6 detailed the evaluation of the prototype Essentiality & Proficiency tool including the experimental design methodology, the results and the discussion.

## 7.2 Essentiality & Proficiency

Web Personalisation has been presented in current research as a possible means to alleviate Web inaccessibility (see section 2.8). The research looks at personalising the Websites to the user requirements to make Web content more accessible. This research extends the work by presenting Essentiality & Proficiency as one possible approach to tackle Web accessibility.

At its simplest the concept of Essentiality & Proficiency allows the user to select a volume of information and present it to their requirements. Section 2.8.3 has identified that Proficiency is not a novel idea as a solution to Web accessibility. However it can be argued that when coupled with Essentiality, it offers a unique additional accessibility which differs from the solutions presented in current research as shown in 2.8.5.

The uniqueness lies in the ability to reduce the volume of information to a digestible amount and then view according to their personal requirements, for example residual sight, in addition to the requirements based on the user agent / assistive technology. Essentiality has been found to offer some improvement in accessing information (see section 6.6.2).

Section 2.8.2 has identified limitations of current work, which range from (a) targeting a single group of end-users and therefore not achieving universal accessibility (see section 2.7) to (b) producing multiple versions of the site, where the user chooses the best fit which means that the site will only exactly fit to the requirements of a small proportion of users and for the rest it will be an approximate fit.

The concept of Essentiality & Proficiency has been developed to address the limitations (a) and (b) by adopting approach (c) which would be to have one version of a site which is modified (via user profile measurements) and delivered on an individual basis. For this reason, a novel means of making a site more accessible is presented; by encouraging the Web author to help tag the content with essentiality for the proposed user base. The application of Essentiality & Proficiency in turn renders alternative displays of the same site and content. Hence the use of Essentiality & Proficiency reduces the need for alternative versions of Websites and increases accessibility in terms of reducing the user's workload by allowing them to state how much content both they and their user agent can digest.

The empirical findings document the need for Essentiality & Proficiency and the formative study provides further evidence to show that the implementation of the concept does to some degree increase the accessibility of Web pages. However, although the concept has been tested with the sample of people with visual impairments, it has been developed with universal access in mind.

### 7.2.1 Visual impairments and the need for Essentiality & Proficiency

The underlying issues of this research are still very much at the forefront of problems faced by people with visual impairments. Many steps have been taken to address Web

accessibility as highlighted in section 2.6, however issues are still being identified by people with visual impairments as stated in section 2.6.7. For example

> *"I've just come across a Website that claims to have WAI – AA and WCAG 1.0 having a symbol in the corner of the screen. The thing I don't agree with is the colour contrast – white text on a light blue background."*
>
> (BCAB 2007)

Although Web authors are trying to make their Websites accessible and are achieving compliance in accordance to WCAG guidelines (detailed in section 2.6) some people with visual impairments (see section 2.6.7) feel that their needs are still not being met as demonstrated in the above quote. The findings of this research in section 4.1.5 have reinforced this argument. People with visual impairments want to be able to personalise the Web page to their requirements as was found in section 4.2 which explored the need for user profiles as discussed in section 2.8.1.

One of the most important lessons learnt in this research is that visual impairments cannot be categorised into three generic groups. Furthermore everyone in a particular group will not have exactly the same presentation needs as suggested in section 4.1.2. Section 4.2.2 details the highly refined user profiles that were used in the empirical study. However the following statements show how it would be wrong to simply state that a person who is blind has no sight whatsoever and therefore has no use for images:

> *"Software developers are designing their applications solely around speech applications, as they just assume that if someone is blind they can't see. I have got a small amount of sight, and I have found it very difficult to trust Jaws alone without magnification."*
>
> *"I do like to see pictures as well, if only through a glass darkly. I often shut Lunar off for this. If the photographs are not in too much detail and if I know what they are I can after a while see them. I think this is due to the brain filling in what it knows should be there. Some days I am good at getting a fix on a picture other days not…"*
>
> *(BCAB 2007)*

The results in section 4.3.2 showed that it was wrong to pigeonhole people with visual impairments into three profiles. In contrast section 6.6.5 identified how the Essentiality & Proficiency tool could be tuned to better meet their unique requirements.

Section 4.4 highlighted another important finding; that user needs change throughout the day. This has been reiterated in BCAB (2007) for example:

> *"Quality of vision can change daily with a lot of eye conditions which can limit ability if you rely too much on it for computer use – this was my position a few years ago, which meant that with magnification I could use the PC only about 20% of the time."*

This statement evidences the need for Essentiality & Proficiency in terms of being able to create and store multiple profiles that cater for the differing requirements throughout day.

People with visual impairments want to be able to make decisions about what they view and how they view it (see section 4.1.5 and 6.6.4). Section 4.2.1 shows how the presentation requirements can vary from one person to the next. This is further evidence of the need for Essentiality & Proficiency.

Web accessibility issues do not stop with the ability to change presentation formats but require the added functionality of addressing the volume of information. Section 2.3 1 has detailed the difficulties experienced by people with visual impairments when using assistive technology with audio and visual renderings. These difficulties are exacerbated further with the presence of a large volume of information.

Section 2.8.3 presents the similarities between the difficulties experienced by user agents and people with visual impairments when receiving large volumes of information. This is the fundamental argument for Essentiality & Proficiency and this research has shown that people with visual impairments want to be able to control the volume of information presented in Websites as well as how it is presented to them as evidenced in section 4.1.5 and 6.6.4.

## 7.3 Limitations and Further Work

This research has presented a formative evaluation of Essentiality and Proficiency. In the process of developing the concept of Essentiality & Proficiency this research has reported some very interesting findings with respect to the accessibility problems

experienced by people with visual impairments. However there have been limitations to this research.

### 7.3.1 Limitations of the Experimental Methodology

Limitations have been identified both in section 4.5.1 of the empirical study and in 6.7 of the formative evaluation. The empirical study (see section 4.2) and the formative evaluation (see chapter 6) had a mixture of participants with a range of visual impairments, ages and PC skill levels. This was to ensure that the findings would be externally valid. The experiments in the formative evaluation were designed with related samples in order to ensure that differences in task completion times under the different conditions would not be caused by individual differences. However using related samples meant that there would be the possibility of order effects. Although this research has attempted to address the issue of order affects in section 6.5, it appears that there was some carry-over effect. Even though the empirical study was more quasi-experimental in design, in comparison to the formative evaluation, it appears that there was some carry-over effect there too.

The implication of this is that the significance of Essentiality easing access to information may actually have an alternative explanation as discussed in section 6.7. For this reason it would be advisable in future work to run the experiment with unrelated samples. Harris (2008) states that the advantage of unrelated samples is the absence of order effects. The disadvantage is that there needs to be a greater number of participants for the study and that it introduces individual differences. However the individual differences can to some degree be controlled through the random assignment of the participants to the experiments.

### 7.3.2 Limitations of Essentiality & Proficiency

Limitations identified with the concept of Essentiality & Proficiency have led to areas of further work that should be expanded. Repeating the study and addressing such limitations will provide a greater insight into the significance of Essentiality & Proficiency on the Web browsing experience of people with visual impairments.

#### 7.3.2.1 Reducing User Responsibility

One such problem, at the moment, is that of asking the user to select an essentiality level. This implies that the user has to have prior knowledge of essentiality and to some extent, carries with it an implication that the user needs some insight into the mind of the author. The solution to this would be for the tool to work iteratively in order to hone the content to the user's capability or that of their agent.

For example, if screen reading software is being used and the user can only take 1000 words per page, the tool would iteratively find the most appropriate 1000 words. It would do this by starting at a low level of essentiality and assessing the volume of information produced. If this exceeds the target of 1000 words the essentiality level would be increased and a further assessment made. This process would continue until the resulting word count is below 1000. The process would take place automatically hence reducing the burden on the user.

#### 7.3.2.2 Developing Essentiality Web Authoring Guidelines

Guidelines will need to be set for a new concept which might be called a "standardised essentiality rating", which will ensure that pages are compliant for use with the tool. It is important to note that the standardised essentiality rating can only be guidelines and not rules, as Web sites vary so much in content and intent. However, the standardised essentiality rating will enable the users to learn how much content is associated with each essentiality rating and find one that fits their requirements. As a result the user's view of essentiality would, by this means, be precise.

One possible method for setting a standardised essentiality rating would be to rate the words in an absolute way. For example the user may want a certain number of words per page such 0-100, 100-200, 200-300 etc. Using a 10 point essentiality scale this would easily deal with a 1000 word page. However based on this standard; a page which contains only 100 words, would all be one level of essentiality and in a page with 10000 words, 9000 would all be in one level of essentiality.

Alternatively it could be done in a relative way. The number of words in a page could be counted and then an approximate one tenth could be included in each essentiality level. Each page would then have 10 essentiality levels with a smooth transition from

one to the next. The problem that may then occur is that in a colossal page, the essential view may still have too many words. For simplicity these ideas have been presented using a linear scale, but of course a non-linear scale could be used. Another possibility would be to define levels by phrases, as attempted in section 4.2.4, such as "purely aesthetic", "mostly aesthetic", "general information", "important information ", "vital information" etc.

#### *7.3.2.3 Keeping the Intentions of the Author's Vision*

Another limitation is whilst the author marks-up each passage, there might be some scope for the author telling how best to render the content. The goal is to find a method to keep the intentions of the author's vision without stepping beyond the user limitations i.e. their proficiency. This can be likened to finding a fuzzy way (figure 9.1) of defining and matching both the author's intentions and the user's requirements.

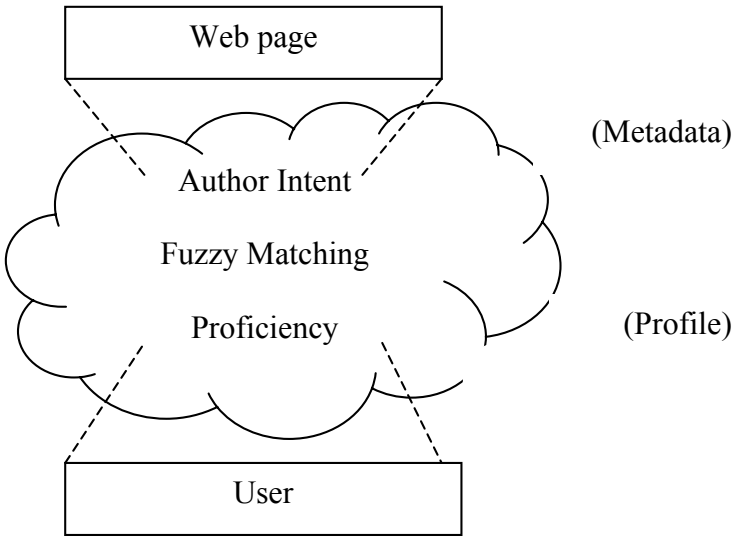



Figure 9.1 Fuzzy matching of author's intentions with user requirements

#### *7.3.2.4 Incorporating Search into the Essentiality & Proficiency Tool*

This relates to the correlation between what the author feels is important to what the viewer feels to be important. On the one hand there is the possibility that passing the results of a search through the Essentiality & Proficiency tool might lead to inconsistency and confusion. For example, in static pages, if the user navigates to a "contact us" page and conducts a browser search for "complaints" which is in the full page, they may not find it on the cut down version of page that they are viewing

because of the essentiality level. In this instance the user will not find what they are looking for. The solution to this problem would be to train the user to switch essentiality to show all content before doing a browser search.

On the other hand, a dynamic page such as Google, which is a very popular searching service, presents us with a different scenario. Imagine that the user types a search string into Google and receives the usual multitude of hits. Google strips out the author's HTML tags and replaces it with its own, which it uses to highlight the user's selected keywords. If Google was to insert high essentiality mark-up along with its own tags to highlight the users search words, this would be ideal for the user as Google is the author of the search results page. The search results page would be fashioned to the user by only displaying output of a high essentiality.

## 7.4 Taking Essentiality Further: Essentiality Tracks

This research has generated significant interest and has led to the commencement of another PhD with a working title of "Towards a Theoretical Framework for Accessing Structured Information and its Applications", which is currently being undertaken by Matthew Tylee Atkinson within the Research School of Informatics at Loughborough University. Where Essentiality & Proficiency has been based on the universal accessibility approach and to some degree the contextual accessibility approach as discussed in section 2.7, this continuing research is working towards contextual accessibility in the form of Essentiality Tracks. Essentiality Tracks takes the concept of essentiality and looks at developing it into a method that presents structured information in long electronic documents to people in an accessible way. More information can be found at http://mta.agrip.org.uk/research.shtml

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# Appendix A

## Interview questions for preliminary survey

# User Questionnaire

Introduction

We are doing some research into how the Internet can be made easier to use for people with sight problems. The interview will last approximately 15 minutes.

1. Gender:

2. Age:

18 – 25
26 – 33
34 – 41
42 – 49
50 – 57
58 – 65
66 – 73
74 – 81
82 +

3. Ethnic origin:

**What is your ethnic group?**

Choose ONE section from A to E, then tick the appropriate box to indicate your cultural background.

**A White**

- ☐ British
  - ☐ English
  - ☐ Scottish
  - ☐ Welsh
  - ☐ Other, please write in
- ☐ Irish
- ☐ Any other White background, please write in

**B Mixed**

- ☐ White and Black Caribbean
- ☐ White and Black African
- ☐ White and Asian
- ☐ Any other Mixed background, please write in

**C Asian, Asian British, Asian English, Asian Scottish, or Asian Welsh**

- ☐ Indian
- ☐ Pakistani
- ☐ Bangladeshi
- ☐ Any other Asian background, please write in

**D Black, Black British, Black English, Black Scottish, or Black Welsh**

- ☐ Caribbean
- ☐ African
- ☐ Any other Black background, please write in

**E Chinese, Chinese British, Chinese English, Chinese Scottish, Chinese Welsh, or other ethnic group**

- ☐ Chinese
- ☐ Any other background, please write in

4. Do you have any additional disabilities as well as sight loss?

Yes / no

If yes which of the following does it fall under:

Hearing
Mobility
Cognitive

5. How does your condition affect how you can use a computer?

(Could be tunnel vision, no sight, problems with colour contrasts, problems using keyboard etc.)

_____

6. What computer programs do you use?

_____

7. Do you use assistive technologies to access these?

Yes/No

If yes which assistive technologies do you use?

_____

8. What is your main use of the Internet? For example e-mail, gaming, music

_____

9. How often do you use the Internet?

Daily
Once a week
Once a month
Never

If never, what stops you from using the Internet?

_____

10. What difficulties do you have when using the Internet?

Too many links
Too much information on a page
Too many pictures and text on a page
Other _____

11. What annoys you when using the Internet?

Pop up boxes
Too much information on a page
Too many pictures and text on a page
Too many links
Flashing banners
Other _____

12. Do you use any assistive technologies when accessing the Internet (e.g. screen readers)?

Yes
No

13. If yes, which ones?

Screen reader (Jaws or similar)
Refreshable Braille display
Web adaptation tool
Screen magnifier
Trackball or split keyboards
Computer settings
Voice Recognition
Other _____

14. Do you find it easier to read and understand text of a certain size and colour on the Internet?

Yes
No

15. If yes, how do you change this setting?

Screen Magnifier
Computer settings
Other _____

16. Is the background colour of a web site important to you?

Yes
No

17. If yes, what are your favourite colours on a website?

White on black
Black on white
Yellow on blue
Green on black
Other_____

18. How useful would you find it if you could change the following on the Internet?

Text font
Text size
Text colour
Background colour
Amount of images on a page
Amount of information shown on a web page

19. Is there a certain text size you work with on the Internet?

Yes
No

20. Do you find there is too much text on web pages, making them hard to use?

Yes
No

21. Would reducing the amount of text on a page help you?

Yes
No

22. How could the Internet be made easier for you to use?

_____
_____
_____

23. Does the accessibility of websites effect which ones you can use?
    Yes
    No

24. Which sites do you find easy to use?

_____
_____

25. What do you like about them?

_____
_____
_____

Our current work involves making a tool which will allow a range of people to access web pages in a way that is suitable for their needs. The writer of the web page identifies the importance of the information in the page. The person is then able to set a rating of importance to work out the amount of information put on the page. For example, the higher the importance entered, the less text put on the page making it easier to read and understand.

26. Would you like to change the amount of pictures shown on a web page?
    Yes
    No

27. If yes, would you like to select images by:
    Their size
    How important they are to the page
    Completely remove images

28. How important is the use of sound on a web page?
    Very Important
    Important
    Not sure
    Not very important
    Unimportant

29. Do you feel there is a need for this tool?
    Yes
    No

30. If this tool were available, would it appeal to you?
    Yes
    No

Many thanks for taking time to answer these questions.

# Appendix B

## Online questionnaire for requirements capture

**Requirements Capture - User Questionnaire Essentiality and Proficiency Tool for the Visually Impaired**

Users are seen as an important part of this project, therefore we would be most grateful if you could take some of your time to complete this questionnaire.

The questionnaire consists of 32 questions, these include:
· Questions about yourself as a user (please note - all responses will be kept in strictest confidence).
· Questions asking you to select a response that most closely matches your experience.
· Questions asking you to briefly describe your experiences or feelings towards using the web.

Approximate completion time: 20 minutes

1. Gender

- ☐ male
- ☐ Female

2. Age

- ☐ 18 - 25
- ☐ 26 - 33
- ☐ 34 - 41
- ☐ 42 - 49
- ☐ 50 - 57
- ☐ 58 +

3. Occupation

4. Ethnic Origin

5. Do you consider yourself to have a disability?

If no skip to question

- [ ] Yes
- [ ] No

6. Please state your type of disability:

- [ ] Vision
- [ ] Hearing
- [ ] Mobility
- [ ] Cognitive

7. Please specify your condition:

8. Do you consider your condition to be deteriorating?

- [ ] Yes
- [ ] No

9. Do you wear contact lenses or glasses to correct your vision?

- [ ] Yes
- [ ] No

10. What is your main use of the internet? For example e-mail, gaming, music

11. How familiar are you with using the internet?

- [ ] Experienced
- [ ] Intermediate
- [ ] Occasional user
- [ ] First time user

12. What difficulties do you experience when using the Internet?

- [ ] Too many links
- [ ] Overload of information
- [ ] Visual clutterance
- [ ] Lack of white space

Other:

13. What annoyances do you experience whilst using the Internet?

- [ ] Pop up advertising
- [ ] Overload of information
- [ ] Visual clutterance
- [ ] Animated advertising banners
- [ ] Too many links
- [ ] Lack of white space

Other please specify):

14. Do you use any assistive technologies?

- [ ] Yes
- [ ] No

15. If yes, please select from the list below:

- [ ] Screen Reader (JAWS or similar)
- [ ] Refreshable Braille display
- [ ] Web Adaptation tool
- [ ] CCTV
- [ ] Screen Magnifier
- [ ] Alternative devices such as Trackball and split keyboards
- [ ] Accessibility settings in your operating system (for example Windows or Mac)
- [ ] Voice Recognition Software

Other (please specify):

16. Do you find it easier to digest text of a certain size and colour?

- [ ] Yes
- [ ] No

17. If yes, how do you manipulate this?

- [ ] Screen Magnifier
- [ ] Accessibility settings in your operating system (for example Windows or Mac)

Other (please specify):

18. Is the background colour of a web site important to you?

- [ ] Yes
- [ ] No

19. If yes, What is your preference of colour?

- [ ] White on black
- [ ] Black on white
- [ ] Yellow on blue
- [ ] Green on black

Other (please specify):

20. How useful would you find it if you could manipulate the following for use on the Internet?

Text Font:

- [ ] Very useful
- [ ] Useful
- [ ] Not sure
- [ ] Not very useful
- [ ] Useless

Text Size:

- [ ] Very useful
- [ ] Useful
- [ ] Not sure
- [ ] Not very useful
- [ ] Useless

Text colour:

- [ ] Very useful
- [ ] Useful
- [ ] Not sure
- [ ] Not very useful
- [ ] Useless

Background Colour:

- [ ] Very useful
- [ ] Useful
- [ ] Not sure
- [ ] Not very useful
- [ ] Useless

White Space:

- [ ] Very useful
- [ ] Useful
- [ ] Not sure
- [ ] Not very useful
- [ ] Useless

Amount of images on a page:

- [ ] Very useful
- [ ] Useful
- [ ] Not sure
- [ ] Not very useful
- [ ] Useless

Volume of information Displayed on a web page:

- ☐ Very useful
- ☐ Useful
- ☐ Not sure
- ☐ Not very useful
- ☐ Useless

21. Is there a specific text size you work with on the Internet?

- ☐ Yes
- ☐ No

22. Do you find the volume of text on web pages overwhelming, making them hard to use?

- ☐ Yes
- ☐ No

23. Would reducing the amount of text on a page to the essential information ease your use of the Internet?

- ☐ Yes
- ☐ No

24. In your opinion, how can the Internet be made easier to use?

25. Does the accessibility of websites impact your use of them?

- [ ] Yes
- [ ] No

26. Are there any sites you could name that are easy to use?

27. What do you like about them?

28. Would you like to manipulate the amount of pictures displayed on a web page?

- [ ] Yes
- [ ] No

29. If yes, would you like to select images by:

- [ ] Their dimensions
- [ ] How essential they are to the page content
- [ ] completely remove images

30. How important is the use of sound on a web page to aid your understanding for example on a film trailer?

- [ ] Very Important
- [ ] Important
- [ ] Not sure
- [ ] Not very important
- [ ] Unimportant

Our current work involves developing a tool which will allow a range of users to access web content in the format that is most suitable for their needs. There author of the web page is to identify the essentiality of the information in the page. The user is then able to set a rating of essentiality to determine the volume of information output on the page. For example, the higher the essentiality rating the less the text output making the page easier to read and digest.

31. Do you feel there is a need for this tool?

☐ Yes

☐ No

32. If this tool was available, would it appeal to you?

☐ Yes

☐ No

Many thanks for taking time to answer these questions.
All responses will remain anonymous and will be used only for the purposes of this project. Please save your document and email back to Tony Warren

Francesca and Jatinder

For further details about the project please contact:
F.Smith-01@student.lboro.ac.uk
J.Dhiensa@lboro.ac.uk

# Appendix C

## Complete set of results from questionnaire survey

| | | |
|---|---|---|
| **1. Gender** | Male | **22** |
| | Female | **16** |
| | | |
| **2. Age** | 18 -25 | **21** |
| | 26 - 33 | **11** |
| | 34 - 41 | **2** |
| | 42 - 49 | **3** |
| | 50 - 57 | **1** |
| | 58 - 65 | **0** |
| | 66 - 73 | **0** |
| | 74 - 81 | **0** |
| | 82+ | **0** |
| | | |
| **3. Occupation** | Student | **19** |
| | professional | **16** |
| | unemployed | **3** |
| | | |
| **4. Ethnic Origin** | | |
| | White British | **24** |
| | Asian | **2** |
| | Chinese | **4** |
| | African | **1** |
| | Lebanese | **1** |
| | Turkish | **1** |
| | Spanish | **2** |
| | Arab | **1** |
| | Mixed race | **1** |
| | Welsh | **1** |
| | | |
| **5. Do you consider yourself to have a disability?** | | |
| **If no skip to question 9** | Yes | **32** |
| | No | **6** |
| | | |
| **6. Please state your type of disability:** | Vision | **26** |
| | Hearing | **1** |
| | Mobility | **3** |
| | Cognitive | **2** |
| | | |
| **7. Please specify your condition:** | Dyslexia | **1** |
| | Cerebal Palsy - Athetoid | **1** |
| | Photphobia | **1** |
| | Blind | **7** |
| | Dyspraxia | **1** |
| | Blind wheelchair user | **1** |
| | Short Sighted | **8** |
| | Colour blind | **4** |
| | Long sighted | **7** |
| | Ocular albinism | **1** |
| | | |
| **8. Do you consider your condition to be deteriorating?** | | |
| | Yes | **6** |

| | | |
|---|---|---|
| | No | 26 |
| **9. Do you wear contact lenses or glasses to correct your vision?** | | |
| | Yes | 22 |
| | No | 18 |
| **10. What is your main use of the internet?** | | |
| | Research | 17 |
| | Work | 5 |
| | Email | 32 |
| | MSN | 3 |
| | News | 8 |
| | Shopping | 8 |
| | Music | 5 |
| | Games | 4 |
| | Browsing | 7 |
| | Banking | 4 |
| | Other | 5 |
| **11. How familiar are you with using the internet?** | Experienced | 30 |
| | Intermediate | 5 |
| | Occasional | 3 |
| | First Time | 0 |
| **12. What difficulties do you experience when using the Internet?** | | |
| | Too many links | 10 |
| | Overload of info | 26 |
| | Visual Clutterance | 15 |
| | Lack of white space | 3 |
| | Other: | 11 |
| **13. What annoyances do you experience whilst using the Internet?** | | |
| | Pop up ads | 32 |
| | Overload of info | 18 |
| | Visual Clutterance | 12 |
| | Lack of white space | 4 |
| | Too many links | 8 |
| | animated ad banners | 22 |
| | other | 6 |
| **14. Do you use any assistive technologies?** | | |
| | Yes | 27 |
| | No | 11 |
| **15. If yes, please select from the list below:** | | |
| | Screen Reader | 8 |

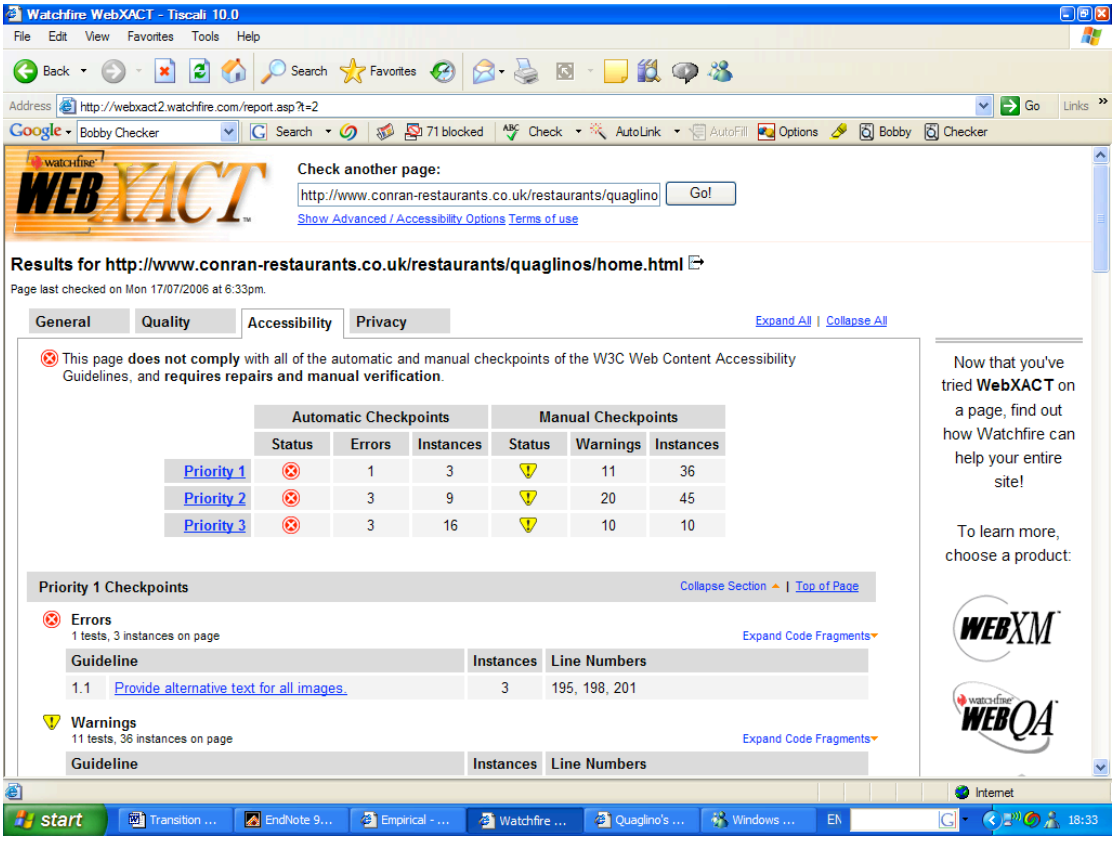
| | | |
|---|---|---|
| | Refreshable braille display | 2 |
| | Web adaptation tool | 0 |
| | CCTV | 0 |
| | Screen magnifier | 11 |
| | Alt devices | 1 |
| | op system settings | 4 |
| | voice recognition | 0 |
| | other | 1 |
| | | |
| **16. Do you find it easier to digest text of a certain size and colour?** | | |
| | yes | 19 |
| | no | 19 |
| | | |
| **17. If yes, how do you manipulate this?** | | |
| | Screen magnifier | 5 |
| | Op system | 11 |
| | Other | 4 |
| | | |
| **18. Is the background colour of a web site important to you?** | | |
| | yes | 22 |
| | no | 14 |
| | | |
| **19. If yes, What is your preference of colour?** | | 4 |
| | white on black | |
| | Black on white | 14 |
| | yellow on blue | 1 |
| | green on black | 0 |
| | other | 5 |
| | | |
| **20. How useful would you find it if you could manipulate the following for use on the Internet?** | | |
| **Text Font:** | very useful | 7 |
| | useful | 19 |
| | not sure | 4 |
| | not very useful | 8 |
| | useless | 1 |
| | | |
| **Text Size:** | very useful | 13 |
| | useful | 21 |
| | not sure | 2 |
| | not very useful | 4 |
| | useless | 1 |
| | | |
| **Text colour:** | very useful | 6 |
| | useful | 20 |
| | not sure | 4 |
| | not very useful | 4 |
| | useless | 2 |
| | | |
| **Background Colour:** | very useful | 9 |

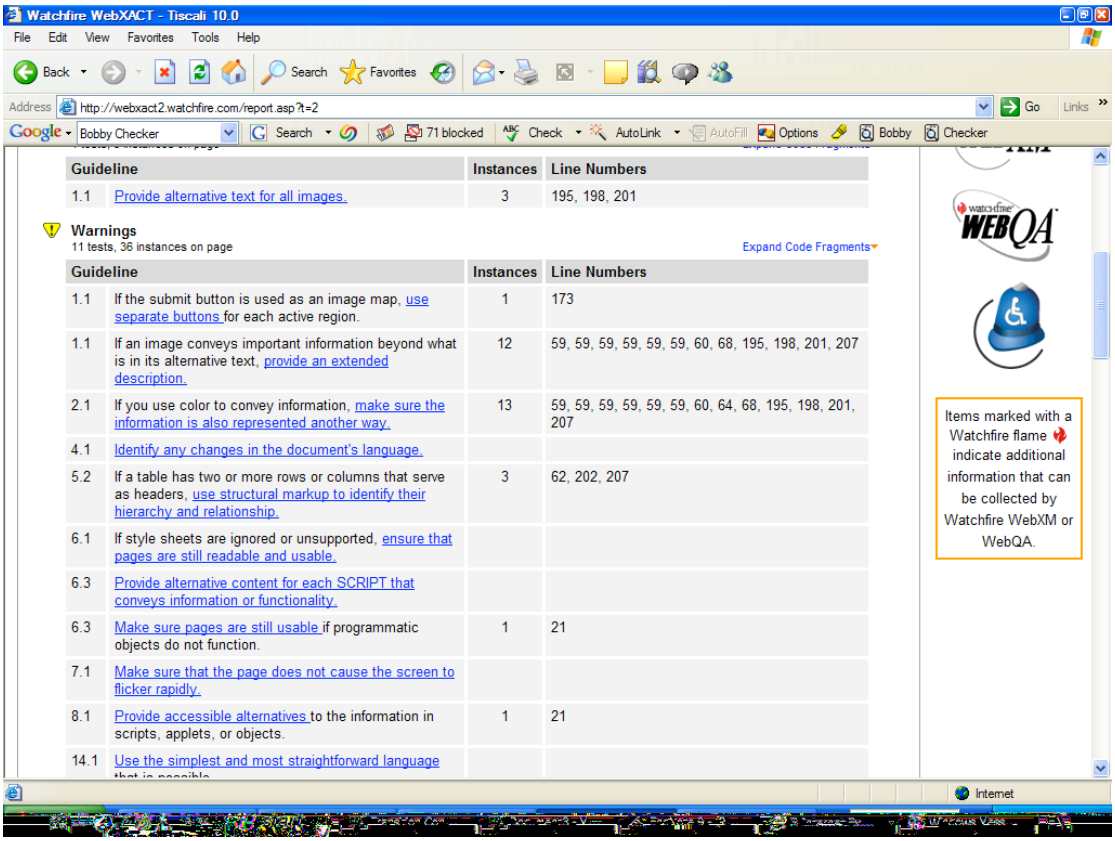
| | | |
|---|---|---|
| | useful | 18 |
| | not sure | 3 |
| | not very useful | 6 |
| | useless | 2 |
| **White Space:** | very useful | 4 |
| | useful | 11 |
| | not sure | 13 |
| | not very useful | 7 |
| | useless | 2 |
| **Amount of images on a page:** | very useful | 12 |
| | useful | 14 |
| | not sure | 9 |
| | not very useful | 3 |
| | useless | 0 |
| **Volume of information Displayed on a web page:** | very useful | 12 |
| | useful | 19 |
| | not sure | 4 |
| | not very useful | 2 |
| | useless | 1 |
| **21. Is there a specific text size you work with on the Internet?** | yes | 8 |
| | no | 30 |
| **22. Do you find the volume of text on web pages overwhelming, making them hard to use?** | yes | 24 |
| | no | 14 |
| **23. Would reducing the amount of text on a page to the essential information ease your use of the Internet?** | yes | 29 |
| | no | 9 |
| **24. In your opinion, how can the Internet be made easier to use?** | Simplified/better page layout | 11 |
| | Better navigation | 4 |
| | Remove adverts | 7 |
| | Search engines more efficient | 8 |
| | Remove irrelevant information | 10 |
| | Clearer pages | 2 |
| | Better accessibility and conformance to design standards | 5 |
| | other | 12 |
| **25. Does the accessibility of websites impact your use of them?** | yes | 28 |
| | no | 10 |

| | | |
|---|---|---|
| **26. Are there any sites you could name that are easy to use?** | | |
| | www.google.co.uk | 8 |
| | www.easyjet.co.uk | 3 |
| | www.bbc.co.uk | 10 |
| | www.hotmail.com | 3 |
| | www.ebay.co.uk | 4 |
| | www.yahoo.co.uk | 2 |
| | www.tesco.co.uk | 1 |
| | www.lboro.ac.uk | 3 |
| | Other | 29 |
| **27. What do you like about them?** | Clear | 8 |
| | Easy navigation | 11 |
| | Easy to use | 14 |
| | Simple | 6 |
| | Consistent layout/ style | 11 |
| | Quick to load | 5 |
| | No JAVA | 1 |
| | No Ads | 2 |
| | Not too much Information | 3 |
| | Attactive | 2 |
| | Can change many formatting prefs | 2 |
| **28. Would you like to manipulate the amount of pictures displayed on a web page?** | yes | 28 |
| | no | 10 |
| **29. If yes, would you like to select images by:** | Their dimentions | 9 |
| | How essential | 23 |
| | Remove images | 7 |
| **30. How important is the use of sound on a web page to aid your understanding for example on a film trailer?** | Very important | 10 |
| | Important | 14 |
| | Not sure | 6 |
| | Not very important | 6 |
| | Unimportant | 2 |
| **31. Do you feel there is a need for this tool?** | yes | 37 |
| | no | 1 |
| **32. If this tool was available, would it appeal to you?** | yes | 33 |
| | no | 5 |

# Appendix D

## Bobby/WebXACT report for Quaglino's Web page


Watchfire WebXACT - Tiscali 10.0
File Edit View Favorites Tools Help
Back Search Favorites
Address http://webxact2.watchfire.com/report.asp?t=2
Go Links
Google Bobby Checker Search 71 blocked Check AutoLink AutoFill Options Bobby Checker
WEBXACT
Check another page:
http://www.conran-restaurants.co.uk/restaurants/quaglino
Go!
Show Advanced / Accessibility Options Terms of use
Results for http://www.conran-restaurants.co.uk/restaurants/quaglinos/home.html
Page last checked on Mon 17/07/2006 at 6:33pm.
General Quality Accessibility Privacy
Expand All | Collapse All
This page does not comply with all of the automatic and manual checkpoints of the W3C Web Content Accessibility Guidelines, and requires repairs and manual verification.
Automatic Checkpoints
Manual Checkpoints
Status Errors Instances Status Warnings Instances
Priority 1 1 3 11 36
Priority 2 3 9 20 45
Priority 3 3 16 10 10
Priority 1 Checkpoints
Collapse Section | Top of Page
Errors
1 tests, 3 instances on page
Expand Code Fragments
Guideline Instances Line Numbers
1.1 Provide alternative text for all images. 3 195, 198, 201
Warnings
11 tests, 36 instances on page
Expand Code Fragments
Guideline Instances Line Numbers
Now that you've tried WebXACT on a page, find out how Watchfire can help your entire site!
To learn more, choose a product:
WEBXM
WEBQA
Internet
start
Transition ...
EndNote 9...
Empirical - ...
Watchfire ...
Quaglino's ...
Windows ...
EN
18:33


Watchfire WebXACT - Tiscali 10.0
File Edit View Favorites Tools Help
Back Search Favorites
Address http://webxact2.watchfire.com/report.asp?t=2
Go Links
Google Bobby Checker Search 71 blocked Check AutoLink AutoFill Options Bobby Checker
Guideline Instances Line Numbers
1.1 Provide alternative text for all images. 3 195, 198, 201
Warnings
11 tests, 36 instances on page
Expand Code Fragments
Guideline Instances Line Numbers
1.1 If the submit button is used as an image map, use separate buttons for each active region. 1 173
1.1 If an image conveys important information beyond what is in its alternative text, provide an extended description. 12 59, 59, 59, 59, 59, 59, 60, 68, 195, 198, 201, 207
2.1 If you use color to convey information, make sure the information is also represented another way. 13 59, 59, 59, 59, 59, 59, 60, 64, 68, 195, 198, 201, 207
4.1 Identify any changes in the document's language.
5.2 If a table has two or more rows or columns that serve as headers, use structural markup to identify their hierarchy and relationship. 3 62, 202, 207
6.1 If style sheets are ignored or unsupported, ensure that pages are still readable and usable.
6.3 Provide alternative content for each SCRIPT that conveys information or functionality.
6.3 Make sure pages are still usable if programmatic objects do not function. 1 21
7.1 Make sure that the page does not cause the screen to flicker rapidly.
8.1 Provide accessible alternatives to the information in scripts, applets, or objects. 1 21
14.1 Use the simplest and most straightforward language
WEBQA
Items marked with a Watchfire flame indicate additional information that can be collected by Watchfire WebXM or WebQA.
Internet

# Appendix E

## Essentiality & Proficiency: Post task questions

# Essentiality & Proficiency: Post Task Questions

1. On your first impressions, which site is more suitable for your needs? Why?

2. What differences do you notice between the sites?

3. If you could change anything about your preferred site, what would it be?

4. Is the site you have chosen as your preference the most suitable with the assistive technologies you use?

5. Which site has the correct volume of information present for your needs?

6. Is there enough, too few, or the right amount of images on the page to suit your preferences?

7. On your preferred web site, do the formatting settings meet your needs or would you like to change them further? If so how?

8. Which site do you find the easiest to use?

9. Would you like it if all the web sites could be changed to your preferred format?

Thank you for your help.

# Appendix F

## Identifying Websites for Essentiality mark-up

## Identifying Websites for Essentiality Mark-up

Deciding which websites to choose for task analysis was dependent on them meeting a number of criteria. Firstly the requirements were established on the basis that it would keep the users engaged and therefore meaningful results will be gained. The second criterion was to use realistic sites in order to ensure scientific rigour and avoid bias. It was important to ensure that the sites enabled the participants to carry out common tasks, undertaken daily and that they would be looking for real information that was not completely new to them. The rationale for this requirement was that the user should not be given the additional workload of finding information that they do not know anything about and therefore being unable to carry out the task altogether. However it was felt that the websites should represent different genres and also be representative of collections of different information formats (text, images etc.) and sites that real users would visit.

A question of operating systems also arose at this stage. Although the tool had already been tested on different browsers (Internet Explorer, Mozilla, Mozilla Firefox and Safari) for browser portability, it was important to ensure that the test was being designed with the operating system used by the study population in mind. This question was directed to both RNIB College Loughborough and DANS, the response was that all the participants worked with Windows due to industry standards.

### 7.2.1 Selected Web sites

The results from the email survey conducted for the empirical study showed that there were two categories of websites generally used by people with visual impairments. These were:

- Services
- Entertainment

Hence these were the genres of sites that were chosen for the tests as they were a true reflection of sites used daily by the sample group.

A number of websites belonging to banking services such as Loughborough Building Society, Barclays and Halifax were considered for the experiments. Music websites,

gaming websites and a site devoted to Star Wars were also considered in terms of entertainment websites. These sites did not fully meet the criteria; Loughborough Building Society had sections that were still under construction whereby others (gaming websites) were not as information-rich as was required for the efficacy of the test. Furthermore some of the sites were too specialised in terms of interest and therefore it was felt that they would not fully engage participant interest.

However the websites identified for the formative experiments were chosen to not only represent different genres but also different models of construction. Firstly the GCR (Great Central Railway Loughborough) site was chosen to represent the Entertainment genre as it promotes an activity local to the participants. The Nationwide Building Society website was chosen as it was a service that was evidently utilised by the sample group (as discussed above). Secondly the GCR site had the appearance of an organically-grown site in that it is less structured (see Figure F.1.1), which is apparent from its asymmetrical cross-linking. The coloured lines in figure F.1.1 show the asymmetrical cross-linking between the pages of the GCR website. The arrows depict the direction in which the links occur. For example the black line shows that the Home page links to all the other pages. The What's On page (shown by the red line) links to Dining page, Timetable page and the Contact page. The More page only links to the Homepage and therefore demonstrates the asymmetrical cross-linking.

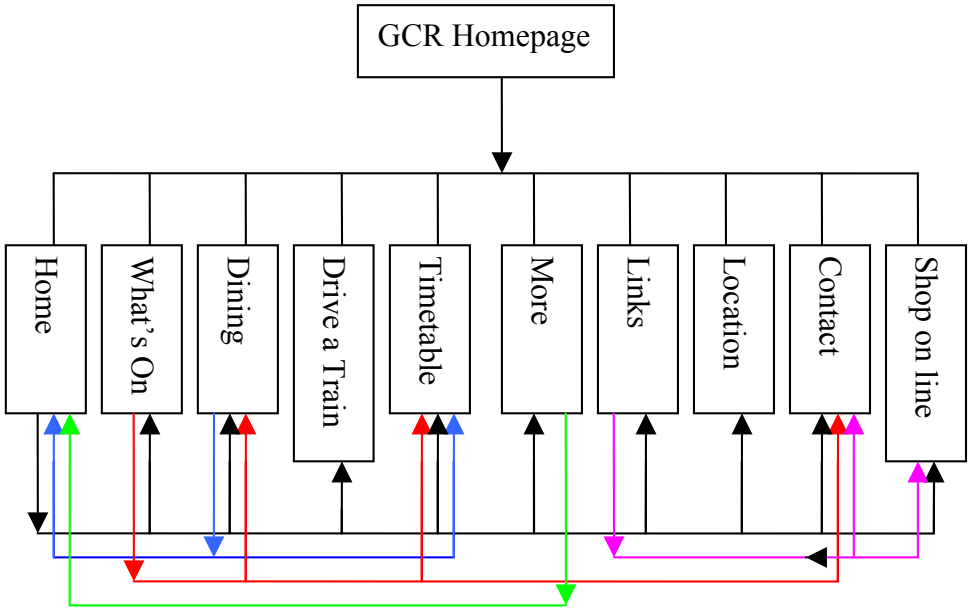



**Figure F.1.1 Organic structure of the Great Central Railway website**

In contrast the Nationwide website was chosen due to its hierarchical ordering (see Figure F.1.2) which led to a more homogenous appearance. Figure F.1.2 shows how the Nationwide website is structured into a top level of navigation pages (for example Credit card, Current account and Insurance) which link to lower level pages (shown by the little boxes). The coloured lines show how the top level pages link to the lower level pages. Each individual colour represents an area of Nationwide services for example Investments is shown by the red line and Mortgages by the green line. All the arrows link down to the lower level pages as this demonstrates the hierarchical ordering of Nationwide website.

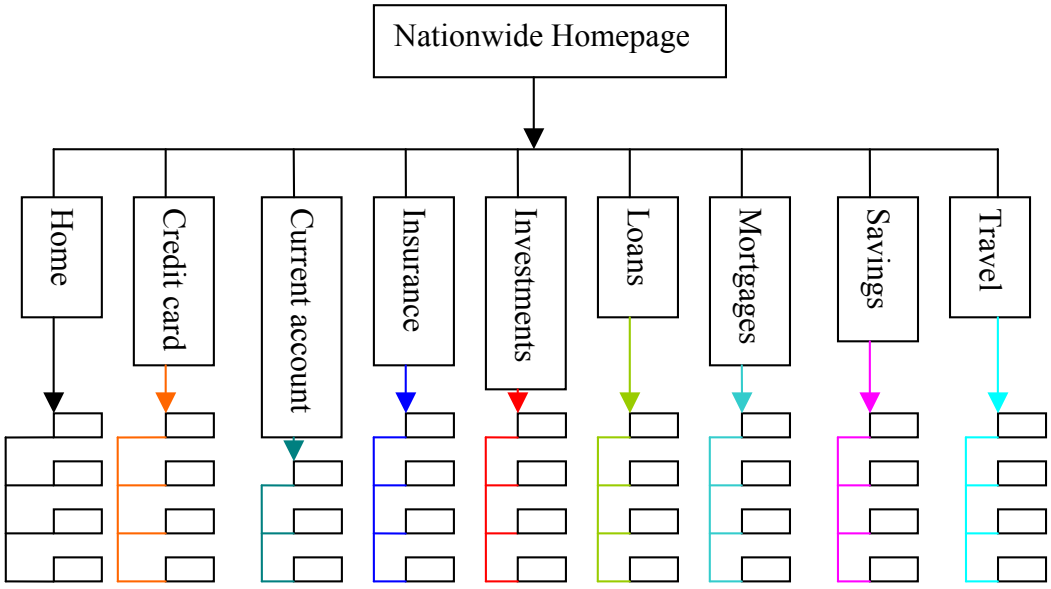



**Figure F.1.2 Hierarchical structure of the Nationwide website**

### 7.3.3 Setting Essentiality Levels and Marking up the Websites

Dr Machin and the author attempted to assign levels of essentiality to the Great Central Railway and to the Nationwide websites that had been mirrored from live sites. A storyboard approach was undertaken to critically analyse the content for essentiality. The process began by obtaining source code and screen layouts for each webpage. This produced a visual mapping of the tree structure of the site, which showed that both the sites were many levels deep. Both sites were studied at length and it was decided that to maintain the integrity of the site the participant should be able to navigate three levels deep into the site. The site would be made self-contained by making all external links redundant. This was done to ensure efficacy of the test and that the user was not lead astray.

On completion, the essentiality annotation was then transferred to the source code.

# Appendix G

# Task design

# Task Design

## Great Central Railway

Three tasks were designed to be completed on the Great Central Railway website www.gcrailway.co.uk The three tasks:

1. As a present for your friend's birthday you have decided to buy them the chance to drive a locomotive. How old do you have to be to drive a diesel locomotive?
2. You are doing a project for college where you will present an overview of the Great Central Railway. Which year marked the silver jubilee of the Great Central Railway Company?
3. You are interested in seeing the latest model railway construction of Ruddington's G.C.R. Station. You want to know whether it is ready for viewing. Find the telephone number for the Great Central Railway (Nottingham).

It is important to note that these tasks are similar in difficulty and would be completed equally quickly by able bodied users. When designing the tasks the author ensured that a similar volume of information in terms of amount of text and number of pages would have to be sorted through in order to get to the answer. The difficulty in task was then tested experimentally by six able bodied students. The students were divided into two groups and given one task each. The students were timed during the task. The results showed that the tasks took approximately similar times to complete.

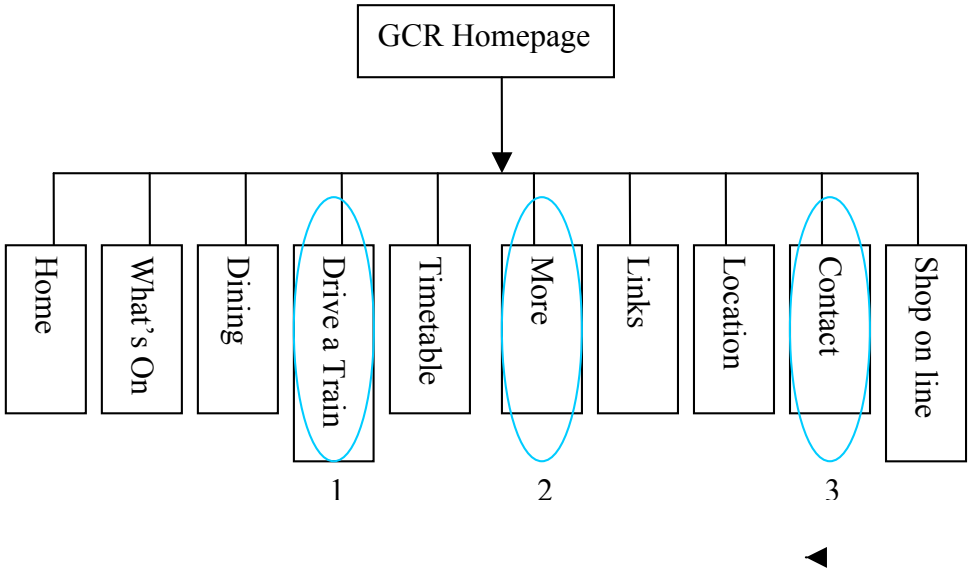



Figure G.1.1 Top-level navigation map for the GCR website marked with the location

of answers to Task 1-3

Figure G.1.1 illustrates where the answers were embedded in the GCR website. The numbers correspond to the number of the task and the blue circles show the web page where the answer to the task is found. A breakdown of the tasks follows giving more detail about each individual task.

**Task 1 – Essentiality Absent (EAW1)**

Two links are required to find the correct answer: *21 years old.*

Links: *Home – Drive a Train*

The answer to Task 1 can be found embedded two-thirds of the way down in the page entitled "Drive a Train" as shown by the number 1 in figure G.1.1. Task 1 is conducted to show that searching for particular information in a site that contains a large amount of information is not a simple process and can take people with VI a good deal of time. The independent variable is absent in this task.

**Task 2 – Essentiality Preset (EPW1)**

Two links are required to find the correct answer: *2001.*

Links: *Home – More*

Task 2 again asks the user to work through a page containing a vast amount of text. Figure G.1.1 shows that the answer is found in the "More" page which has been

identified by the number 2. This task allows the participant to make full use of the Essentiality & Proficiency tool. The participants are advised to conduct the task using a preset essentiality level 6. The independent variable is present and preset in this task.

**Task 3 – Essentiality Manipulated (EMW1)**

Three links are required to find the correct answer: *(0115) 9405705*

Links: *Home – Contact- Great Central Railway Nottingham*

Task 3 serves to identify whether the user has grasped the concept of Essentiality & Proficiency by allowing the participant to set their own essentiality level. The number 3 on figure G.1.1 shows where the answer is located in the GCR website. The independent variable is manipulated by the participant in this task.

Table G.1.1 summarises the GCR tasks with their ID, whether the independent variable is absent, preset or manipulated and the task itself.

Table G.1.1 Summarisation of GCR website based experiments

| Experiment ID | Variables | Task |
|---|---|---|
| EAW1 | Task conducted on original GCR website. No variables have been altered. | As a present for your friend's birthday you have decided to buy them the chance to drive a locomotive. How old do you have to be to drive a diesel locomotive? |
| EPW1 | Task conducted using Essentiality & Proficiency tool and essentiality marked up website. User is asked to use a preset essentiality level 6. | You are doing a project for college where you will present an overview of the Great Central Railway. Which year marked the silver jubilee of the Great Central Railway Company? |
| EMW1 | Task conducted using Essentiality & Proficiency tool and essentiality marked up website. User is asked to select their own essentiality setting. | You are interested in seeing the latest model railway construction of Ruddington's G.C.R. Station. You want to know whether it is ready for viewing. Find the telephone number for the Great Central Railway (Nottingham) |

**Nationwide**

The purpose of the experiments is to test what happens when the independent variable (essentiality) is absent (condition 1) with what happens when it is present and preset (condition 2). If the essentiality does make it easier to search a volume of information

then we would expect the dependent variable (time in seconds) to be greater in condition 1 than in condition 2. If the essentiality does not make the process of searching for specific information faster, then we should not expect such difference. The Nationwide is used for a second round of experiments to test whether what we find in the first set of experiments with the GCR website is consistent with the findings of the second set of findings. If it is then it can be used as to support the case for the Essentiality & Proficiency tool.

Figure G.1.2 shows, the answers to the Task 4 and Task 5 were to be found embedded in the same depth of information. As described earlier, it was important to ensure that difficulty in task for condition 1 and condition 2 are similar.

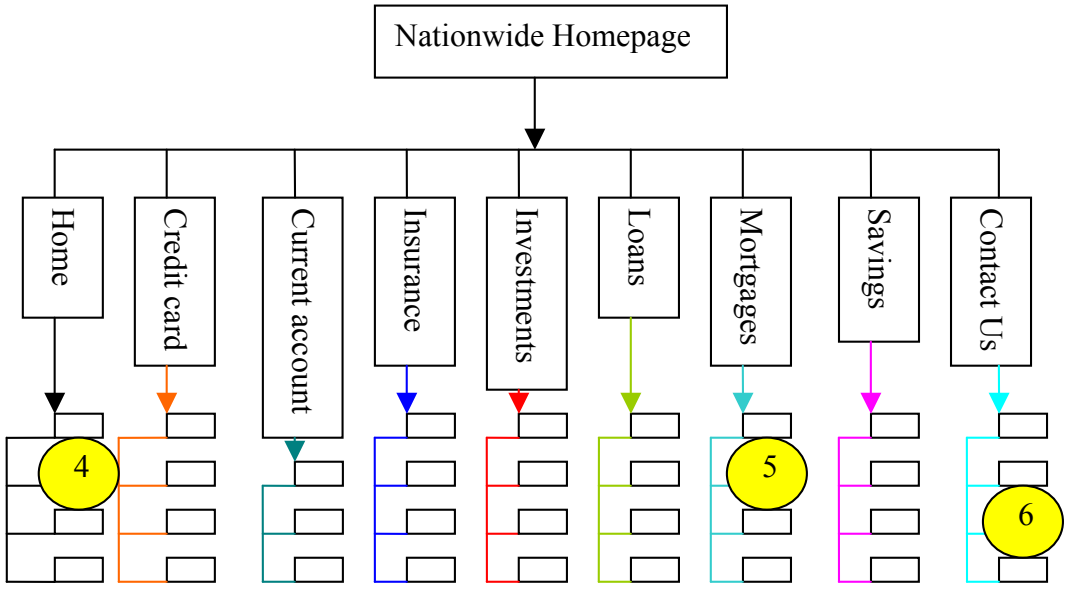



Figure G.1.2 Navigation map of Nationwide website marked with the location of answers to tasks 4-6

**Task 4 – Essentiality Absent (EAW2)**

Three links was the minimum number of links required to find the correct answer: *15 months worth of transactions.* The location of the answer is shown by the number 4 in figure G.1.2.

Links: *Home – Banking – Internet Banking*

The independent variable is absent in this task.

**Task 5 - Essentiality Preset (EPW2)**

Again three links was the minimum number of links required to find the correct answer: *free mortgage payment protection insurance for 3 months.* Number 5 illustrates where the answer is found in figure G.1.2.

Links: *Home – Mortgages – Mortgage for Homebuyers*

The independent variable is preset in this task.

**Task 6 - Essentiality Manipulated (EMW2)**

Three links was the minimum number used to find the correct answer: *08457 99 22 22.* Number 6 shows where this answer can be found in figure G.1.2.

Links: *Home – Contact us – Telephone Numbers*

The independent variable is manipulated by the participant in this task.

Table G.1.2 summarises the tasks designed for the experiment on the Nationwide website. The table sets out the IDs for the experiments, alongside the absence, presence or manipulation of the independent variable and the tasks themselves.

Table G.1.2 Summarisation of Nationwide website based experiments

| Experiment ID | Variables | Task |
|---|---|---|
| EAW2 | Task conducted on original Nationwide website. No variables have been altered. | Banking over the Internet is becoming more and more convenient; you have decided that you want to have the opportunity to explore the features of current accounts. How many months worth of current account transactions can you view? |
| EPW2 | Task conducted using Essentiality & Proficiency tool and essentiality marked up website. User is asked to use a preset essentiality level 6. | You have seen a house that you like and now need to find out about mortgages. How much free mortgage payment protection insurance can you expect to get? |
| EMW2 | Task conducted using Essentiality & Proficiency tool and essentiality marked up website. User is asked to select their own essentiality setting. | You have lost your credit card and need to report it missing. Find the telephone number to report your card missing. |

# Appendix H

**(i) Essentiality & Proficiency information sheet with contact details**

**(ii) Information sheet explaining the usability test**

**(iii) Informed consent form**

# Essentiality and Proficiency Tool

A typical web page is made up of vast amounts of information that may or may not be of use to all users. The web page is made up of images, text, adverts etc. As all this information is available the question arises of whether it is of use to the needs of the user. For example will images be of use to a visually impaired user? Furthermore would vast amounts of text be useful for a dyslexic user or would they find the inclusion of images more beneficial?

The purpose of this work is to test the *essentiality and proficiency* tool for usability. The aim of the tool is to allow a range of users' access to web content in the format most suitable for their needs. Essentiality in this project refers to process of the author identifying the information that is deemed essential to appropriately represent the intent of the content. Proficiency, on the other hand, refers to such aspects as the ability of the rendering device to display various types of content or the ability of the user to receive the content.

Web sites are believed to operate as services under the Disability Discrimination Act 1995 and therefore there is a legal requirement for them to be made accessible. This tool will be designed as a universal tool that will further increase accessibility.

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Department: +44(0)1509 222681
E-mail: J.Dhiensa@lboro.ac.uk

Loughborough University

# eACCESSIBILITY OF WEB CONTENT
# USABILITY TEST FOR THE ESSENTIALITY & PROFICIENCY TOOL
# RESEARCH STUDY

## Information

You have been selected for this study because you are visually impaired. The study is based on a usability testing through observation and structured tasks. The information from this study will be used to analyze the effectiveness and usability of the Essentiality and Proficiency Tool. The aim of the tool is to increase accessibility to Internet for visually impaired pc users. The results of the study will be published as academic papers and presentations, and as a website.

You will be given 10 minutes to explore the tool and speak out your impressions. You will then be asked to complete 3 tasks. The aim of your exploration is to gather your first impressions of the tool. The aim of the structured tasks is to find out the effectiveness of the Essentiality and Proficiency tool. The tasks will take approximately 20 minutes. You will be asked to complete a task without the tool. Then you will be asked to complete 2 tasks using the tool and finally answer some questions.

The information you provide is entirely confidential and your identity will not be disclosed to any third parties. The data will be held at Loughborough University. You can withdraw from the research at any time. This research will not impact on your medical care.

# eACCESSIBILITY OF WEB CONTENT
# USABILITY TEST FOR
# THE ESSENTIALITY & PROFICIENCY TOOL
# RESEARCH STUDY

## INFORMED CONSENT FORM

**(to be completed after Participant Information Sheet**

**has been read)**

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Loughborough University Ethical Advisory Committee.

I have read and understood the information sheet and this consent form.

I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in the study.

I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing.

I understand that all the information I provide will be treated in strict confidence.

I agree to participate in this study.

Your name _____

Your signature _____

Signature of investigator _____

Date _____

# Appendix I

## Usability test script

# Usability Test Script

## *Introduction:*

Hi, welcome and thank you for coming. How are you? Have you had a busy day?

I'm Jatinder and I'm here today to try and understand how well the Essentiality & Proficiency tool works people who are its audience. This is Michael who will be observing what we are doing today. I've asked you here today to see what you think of the Essentiality & Proficiency tool: what works for you and what doesn't.

This usability test should take 30 minutes.

We will be recording what happens here today, but the recording is for analysis only. It's primarily so I don't have to sit here and take notes and I can concentrate on talking to you. It is strictly for research and will not be publicly broadcasted.

Like I said I would like you to help me with a product we have been developing. The Essentiality & Proficiency tool has been designed for users like you. That's why we would really like to know what you think about it and what does and does not work for you. It's currently in an early stage of development, so not everything you're going to see will work right.

The procedure that we are going to do goes like this: we are going to start out and talk about the problems you have with the web, what you like and dislike, the problems that may occur… Then I am going to show you the Essentiality & Proficiency tool and have you try out a couple of things with and without it. Then we will wrap up, I'll ask you a couple of questions about it and we are done.

Do you have any questions?

I would just like to draw you attention to the statement of informed consent. It sets out your rights as a person who is participating in this kind of your research.

As a participant in this research:

- You may stop at any time.
- You may ask questions at any time.
- You may leave at any time.
- There is no deception involved.
- Your answers are kept confidential.

Any questions before we start?

Let's begin.

In a minute, I'm going to ask you to turn on the monitor. We will take a look at the tool and I will give you some instructions about how to use it. Remember that we are here to test the tool and this has no reflection on you. There is absolutely nothing that you can do wrong. If anything doesn't work or looks wrong, it's a not your fault but a flaw in the tool. I would appreciate it if you tell me about anything that isn't working, similarly I would like it if you tell about features of the tool that you like or even enjoy using.

Be as honest as possible… If you really don't like something, say so. The tool has been designed for you as its user; I really want to know what works and doesn't work for you.

# Appendix J

## Response to per-Element probe questions

| Element | Per Element Probes | | |
|---|---|---|---|
| | | | |
| | **In a couple of words, what do you think this does?** | **What does the label mean?** | **What do you think will happen when you change this?** |
| **Profile Name** | Should I put User 1 in? | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | I will put my name in. | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | That's profile name, do we type anything in there or leave what's already in there? | | <no response> |
| | <no response> | <no response> | How many letters does it have to be? |
| | Right my username. | <no response> | <no response> |
| | | | |
| **Essentiality View** | View options of essentiality levels | <no response> | I'm not really sure |
| | Esses… the name of your website | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | It says essential view box, when you scroll down dah dah dah. The combo box says 1 - 10 so it makes you flick through it with out properly speaking out. | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | There are numbers. | Essential Level 1 to 10. | <no response> |

| | | | |
|---|---|---|---|
| | It's essentiality level, is that set at 1? | That's where you choose essentiality, isn't it? | <no response> |
| | I have essentiality level here. | <no response> | <no response> |
| | Which way does the scale go? | <no response> | I was thinking it was the opposite way around. |
| | | | |
| **View Images** | <no response> | images | I don't want any images |
| | See that's on about images, the images on a page. | See that's on about images, the images on a page. | I'm going to... see how it deals with it and if it's not right I will take it off. |
| | <no response> | <no response> | <no response> |
| | It's view images | It's view images | To have images… would put me off. |
| | View images | View images | I couldn't say |
| | <no response> | View images? | <no response> |
| | View images | <no response> | <no response> |
| | Got view image with a combo box. | So this is view images. | At the moment it is set at y, so do I leave it at that or what? |
| | so view images y or n | <no response> | No, not to worry about that. I'll live with that… yes that's alright. |
| | View images | <no response> | which I will leave on yes, I think. |
| | | | |
| **Font Size** | <no response> | <no response> | <no response> |
| | It's the size of the font, | It's the size of the font, | Leave it as it is. |
| | I'm not sure | I'm not sure | I'm not sure |
| | <no response> | <no response> | I would keep it as it is because if I have it at it's largest that will be really big and you can't get head around your screen because that's too big. So to get an idea you have it big enough, because if you have it too small it could be like a picture becuase it would just look like lines. |
| | Yes I know what Font size is. | <no response> | Let's change it to 16. |

| | | | |
|---|---|---|---|
| | I see, is it uhm… is it a quick way to change the font size? I though so. | Font size? | Font size 14 |
| | Qu-ick Pi-ck-er | <no response> | It's changed. 26 |
| | you have a second section with Fonts. | What is the absolute? | … as long as it's 12 or anything between 12 and 20 is ideal for Jaws. If it starts going lower or higher then it will affect how Jaws reads but normally 12 is perfect. We can actually leave that. |
| | <no response> | <no response> | <no response> |
| | Uhm now I want text size to be medium I think. Ah that's a thing, I was using Firefox to alter the size. | <no response> | Because it was on medium before, it was on small on this, but I've blown it up to medium already because that's how I work. I mean if I was using Internet Explorer I couldn't do it like that because Internet Explorer limits you to what sizes you can use. But Firefox doesn't. That's too big really, yeah. Ah, this is probably the equivalent to medium but I will blow it up in the browser. (Would normally use medium) |
| | | | |
| **Font name** | I didn't expect it to do so much… I think it's quite clever | <no response> | <no response> |
| | <no response> | It's at the type, the type of the font | <no response> |
| | I'm not sure | I'm not sure | I'm not sure |
| | <no response> | <no response> | <no response> |
| | Font name, like Arial | <no response> | Nah, no need to change |
| | I see Times New Roman, Times, Serif. | <no response> | I usually use Arial |
| | F-o-nt name | Yes it's the size and … | Uhm, bold. |
| | Now Font, now Times yeah. Doesn't really matter about that but most people prefer Arial but it doesn't affect the way Jaws reads. | | So that can be left at that. |
| | <no response> | <no response> | Alright I will put Arial. |

| | | | |
|---|---|---|---|
| | The Font | | I need Sans Serif. I'm not sure about this… Arial doesn't… I will see what the difference is between Arial and the other one. Ah, this ia better, the Verdana. |
| | | | |
| **Font Settings** | There is rather a lot to it. Uhm, given… You have to give enough information to get what you want | | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | | | |
| **Text Colour** | <no response> | <no response> | <no response> |
| | <no response> | <no response> | Just go through colour for background, text colour and so on |
| | <no response> | <no response> | <no response> |
| | It just says colour settings. | <no response> | <no response> |
| | Text colour, background, same thing? | <no response> | <no response> |
| | Is it a? Oh, ok. | Text colour | Text colour black, that's fine. |
| | Text colour | The colur of the text. | <no response> |
| | colour setting now for a screenreader, for some people that have a bit of sight and use a combination of the screen reader and a bit of sight. Now some people have high contrast black with white text… That screws Jaws up completely. | use ffdd colour style, so that's where, is that where you can choose your own hexdecimal coding? | <no response> |
| | <no response> | <no response> | <no response> |

| | | | |
|---|---|---|---|
| | <no response> | <no response> | Uh I'm fine with the colours really because it's bright all around. |
| | | | |
| **Background Colour** | Changes the background of the screen | The background of the screen | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | Erm that's the background again. | <no response> | <no response> |
| | I think I will change the background. | <no response> | Ah, there is black. Gold… oh its gone blank, now that's too dark. I can't see any of this, I will change this. I will change that… ah that's much better. |
| | let's have a look at what background colours you've got? | Background colour | Just wanna be a nice calm colour which isn't white? |
| | Background colour? | What's aqua? | (easier to read) Yeah… normally I have yellow. |
| | Background colour | that's where is somebody wanted… so these changes here, if we made these changes, say like somebody decided they wanted a black background on white text… | Would it take place on this page now or would it take place once you have set it all? (E: On this page) The only snag I can see with that happening is, uhm, obviously you choose the Font colour first. So if the person wanted uhm, am I getting it right, no. That would be ok, yeah yeah. So somebody chose, they wanted black text and the background was already set black. Well what would happen, with it being, until you get the form modes changed, what would happen is that until you get the changes Jaws wouldn't be able to read zinch because it wouldn't see black text on black background... although that setting is alright but somebody changed that to black yeah or say like they wanted black background but with white text. If somebofy chose white text as soon as they tabbed down they would have a completely white screen. |

| | | | |
|---|---|---|---|
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | | | |
| **Hover Colour & Visted Link Colour** | <no response> | The colour that you get when you highlight it | <no response> |
| | <no response> | <no response> | <no response> |
| | <no response> | <no response> | <no response> |
| | one of them is a combo box and one is a link in the second one. | Oh I see, link colour… link yeah, link as in links onto… Hover… when the cursor goes over it I gues? | I wouldn't use that personally. |
| | Link colour, hover colour, visited colour. | What is it? I don't know. | I will leave them as they are. |
| | Ah link colour, hover colour | what's hover colour? | Visited colour purple |
| | Line colour… me - I can't say the word. Hover colour. | what is that? | Keep them as they are. |
| | Dummy Link. Hover colour! H-O-V-E-R? For a minute I thought it should be cover…Then there is the visted colour. Link colour, medium blue? | What's a hover link?(When asked about the dummy link) Yes I see, you're giving everybody the option to change loads of different colour styles on the page. Link the visited link or the unvisited link, the active link to suit their visual impairment. That's good. (Link Colour) What's that for? | They can choose a… dummy link yeah. That's hover colour you were saying about. And visited link yeah. That's purple link yeah, so that can be changed as well some people who want the bar to come over orange or red… |
| | <no response> | <no response> | <no response> |
| | I do <understand>, I wonder if somebody who wasn't a web developer would. | <no response> | change the hover link to… orange. |

# Appendix K

## A sample user transcript

# USER 10 Transcription

**User 10:** **U10**

**Evaluator:** **E**

## *User's Initial Impressions from Guided Tour of the Essentiality & Proficiency Tool/ Filter Interface.*

E: So if you just take a look at it first. Well if you just tell me what you do and what you think from just looking at it.
U10: I can see the separate frames for different specifications so that's quite good. Oh the help button I'm going to click on that. I'll make the text bigger. Oh I see so this is explaining each of these settings. Ah it's showing you what essentiality level this page is being shown at.
E: Yup.
U10: Ah, it says it's at 5.
E: Ok if you go back to the filter. So, now that you have had a click look around it, what was the first thing that you were drawn to on the page?
U10: Uhm, I'd say these text boxes here are quite obvious. The ones on this side weren't originally and uhm, I see that you can type something in individually if you know what it is or you can just choose from the list of things which is available.
E: Yup ok.
U10: Which are available!
E: So what's the second thing that you thought oh, that struck you?
U10: The organisation of it's quite logical because you've got its general stuff and then it goes into more formatting things.
E: What's your overall impression of it so far?
U10: Ah for my point of view it's quite well laid out. I'd be interested to see if it's accessible for screen reader users. Although at the moment I can't see any reason why it wouldn't be if you've put up all the mark-up in the tables and everything because it suits being laid out in a tabular way doesn't it?
E: Yup.
U10: Uhm that seems alright.
E: Right, now what we are going to do is; we're going to go through it and you're going to make you're changes. So if you start with profile names and give yourself a name, you are going to have to delete that Aardvark.
U10: Right my username.
E: The essentiality at this level, for this task doesn't matter so if you want to put it 1 for now.
U10: Which way does the scale go?
E: 1 is include everything and 10 is only the most essential.
U10: Oh I see. I was thinking it was the opposite way around.
E: So what label have you come to next or rather which form element are you on?
U10: Oh view images which I will leave on yes, I think.
E: Ok, if you just work you way through it now.
U10: Uhm now I want text size to be medium I think. Ah now that's a thing, I was using Firefox to alter the size.

E: Right, ok.
U10: So should I not? Because that's the way I normally do it.
E: you know now you have set medium on this…
U10: But now it's gone even bigger.
E: Is that too big for you?
U10: Because it was on medium before, it was on small on this, but I've blown it up to medium already because that's how I work. I mean if I was using Internet Explorer I couldn't do it like that because Internet Explorer limits you into what sizes you can use.
E: Right.
U10: But Firefox doesn't.
E: Is this now too big for you?
U10: That's too big really, yeah.
E: Well if you just want to drop it down to the one…
U10: I'll put it to the one it was before.
E: Is that ok for you?
U10: Ah, this is probably the equivalent to medium but I blow it up in the browser.
E: Ok, if you weren't already using Firefox you would use the medium?
U10: Yes.
E: Yes ok. What about the next form?
U10: The font… I need uh the Sans Serif. I'm not sure about this… Arial doesn't… I will see what the difference is between Arial and the other one. Ah, this is better, the Verdana. Uh I'm fine with the colours really because it's quite bright all around.
E: Ok but do you understand all the links, the labels there though?
U10: I do, I wonder if somebody who wasn't a web developer would. But it's probably quite easy really, to understand.
E: Right, ok. So your profile set to how you'd like it now, at the moment?
U10: Yeah.
E: So if you go back to the top…
U10: Actually I think I might go back to change the hover link to red, uh not red because it uses that elsewhere doesn't it? Uhm, uhm, what would I be able to see? What would be easy for me to see? Uhm orange. Yeah that's right, better.
E: Right ok, so if we go back to the top, and you know where you added your name there is a little tilde there. Can you just delete that? Right, and then go down and click new. Ok so that's your profile, that's been created how you wanted it for now, ok? Right, if uhm, if you go into favourite URLs and select one. Any of the bottom ones.
U10: National rail, that's going to be an interesting one.
E: Ok, before you do anything, what would you expect to happen next?
U10: Expect to happen next in terms of what do I think the tools going to do or what I normally see?
E: Yeah, what do think the tool will do for you?
U10: Uhm, well I know some of these things use frames and buttons for the tool may go into different frames, so it could do that. Or it might actually add something to the code of the page that comes out.
E: On this filter and when you filled in the form, what was the most important thing on the form for you?
U10: I would say it's going to be probably the essentiality.
E: Right ok. Uhm, did you find it easy to navigate around this form?
U10: Yes. The only thing that I could uh, well I'm just wondering why as I say that why the buttons don't quite look like buttons. I understand that somebody has chosen this because uh, that presumably makes it easier for them to read the buttons. But if the borders could be a

bit bigger or something or they could make it look more like buttons because in away that, to me, seems a bit strange. I mean to be honest all you need are buttons to be labelled with new, update and delete. You could just have the buttons.
E: Right ok.
U10: I would imagine.
E: Did uhm, did you find it easy to fill in the form?
U10: Yes although I didn't type in things manually I just picked them from the list. I'm not sure…
E: Ok, alright for you to go on the page you actually selected what would you normally do?
U10: Uhm well it's fine typing in the URL there, it would be nice in the future if you could make it to be able to uhm when you click on the URL in your bookmarks uh apply your settings to it.
E: Right.
U10: And you could easily do that as a Firefox extension, I wouldn't have a clue how you do that in IE but uhm I understand that this is not the main thing we are looking at now it's a suggestion for the future.
E: It's alright, it's all helpful. So you'd, so you'd, what would you expect to do now?
U10: Well you could either type it in and click submit which is how it looks like it's going to work in this case. But in the future it might be nice to do it straight off.
E: Ok, do you want to click submit.
U10: Can't find my mouse… ok. Ah right… oh… wow, actually this is quite a lot better than the original site. I'm impressed.
E: Uhm have you found what you expected to?
U10: Uhm well I was wondering how you would do the tables and stuff but that's much better because it's so busy that website.
E: Yup, yup.
U10: I'm quite tempted to try and plan a journey now.

- End of Guided Tour -

## *Answers to User Evaluation Questions from Test 2*

1. The Essentiality and Proficiency Tool Interface is simple to follow.

Strongly Agree **Agree** Neutral Disagree Strongly Disagree

2. Applying personal preferences made viewing the web page easier.

**Strongly Agree** Agree Neutral Disagree Strongly Disagree

3. Rate how easy it was to find the information on the web page without the tool.

(Very Easy) 1 2 3 **4** 5 (Very Difficult)

4. Rate how easy it was to find the information on the web page with the tool.

(Very Easy) 1 **2** 3 4 5 (Very Difficult)

5. How easy was it to understand the idea of essentiality and essentiality levels?

Very easy **Easy** Neutral Hard Very hard

6. How easy was it to apply the idea of essentiality and essentiality levels?

Very easy Easy **Neutral** Hard Very hard

7. Do you think that applying the idea essentiality is worthwhile in this case?

[**Yes**, No]

8. Would you like to see the idea of essentiality applied to other long electronic documents?

[**Yes**, No]

9. Do you feel that this tool can be improved in any way?

[**Yes**, No]

If yes how do feel that the tool can be improved?
**U10: Uhm that's a good question, uh, I would, well it doesn't manage very well with websites with frames. And I can think of a couple of technical ways around that.**
**E: Ok.**
**U10: But also I would say, not necessary an improvement but maybe giving people the choice of, does it always go back to the level that you chose in the viewer when you have changed it on the page. Or does it give people the choice of either default back to the viewer level or stay at the one that has been chosen.**
**E: Right not do both?**
**U10: Well, uhm no you could alter it on one page but when you changed it on the page ask them if they want to stay at the one that they picked or go back to default.**
**E: Right ok.**
**U10: So it's an extra option basically in viewer.**

10. Do you feel this tool would benefit your experience of using the web?
**U10: With more… probably with those changes; yes.**

11. Is there anything about this tool that you didn't like?
**U10: I think I've mentioned already, this problem with frames and the behaviour isn't always exactly what you expect. So to add an option to that would be better.**

Usability Test – How could the usability test be made better?
**U10: Uhm… I'm not sure how you could really. I mean the best thing is to do more and more tests but you can't really do that so easily. I think the ones that you picked are reasonable to use, so uhm, taking into consideration the practical time constraint and stuff, I think are pretty good.**

# Appendix L

## Accessibility issues experienced by the participants

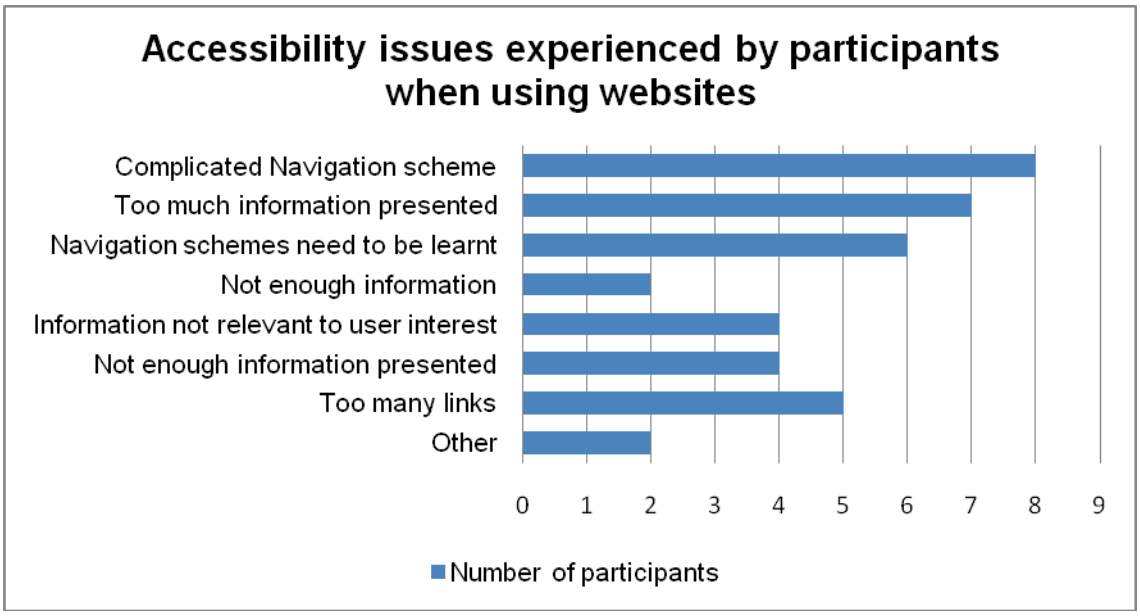



Figure L.1.1 Accessibility issues faced by the 9 participants of the main study

# Appendix M

## Task completion times for the Control experiments

## Control Experiment

| Participant | Task 1 | Task 2 | Task 3 |
|---|---|---|---|
| A | 35 | 315 | 165 |
| B | 105 | 45 | 165 |
| C | 280 | 322 | 20 |
| D | 55 | 80 | 20 |
| E | 70 | 84 | 10 |
| Mean | 109 | 169.2 | 76 |
| (SD) | 98.95706 | 137.1558 | 81.34802 |

## Counterbalance Experiment

| Participant | EMW1 (C) | EAW1 (C) | EPW1 (C) |
|---|---|---|---|
| A | 35 | 42 | 34 |
| B | 50 | 29 | 23 |
| C | 68 | 22 | 18 |
| D | 17 | 58 | 31 |
| E | 37 | 36 | 51 |
| Mean | 41.4 | 37.4 | 31.4 |
| (SD) | 18.95521 | 13.74045 | 12.66096 |

(SD): Standard Deviation (C): Counterbalance

# Appendix N

## Paired *t* tests for the Control experiments

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | | | | |
| | | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | | | |
| Pair 1 | Task 1 - Task 2 | -60.20000 | 128.90384 | 57.64755 | -220.25526 | 99.85526 | -1.044 | 4 | .355 |
| Pair 2 | Task 1 - Task 3 | 33.00000 | 147.88509 | 66.13622 | -150.62359 | 216.62359 | .499 | 4 | .644 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | | | | |
| | | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | | | |
| Pair 1 | EAW1 (C) - EMW1 (C) | -4.00000 | 32.43455 | 14.50517 | -44.27281 | 36.27281 | -.276 | 4 | .796 |
| Pair 2 | EAW1 (C) - EPW1 (C) | 6.00000 | 14.91643 | 6.67083 | -12.52120 | 24.52120 | .899 | 4 | .419 |

# Appendix O

## Task completion results and essentiality levels for GCR and Nationwide

## Task Completion Times for GCR

| GCR | EAW1 | EPW1 | EMW1 |
|---|---|---|---|
| | 360 | 225 | 40 |
| | 320 | 300 | 160 |
| | 180 | 230 | 90 |
| | 300 | 105 | 80 |
| | 220 | 165 | 195 |
| | 360 | 285 | 350 |
| | 350 | 415 | 245 |
| | 420 | 135 | 45 |
| | 40 | 35 | 10 |
| Mean | 283.3333 | 210.5556 | 135 |
| SD | 117.4734 | 114.9305 | 111.9989 |

## Task Completion Times for GCR

| Nationwide | EAW2 | EPW2 | EMW2 |
|---|---|---|---|
| | 270 | 120 | 215 |
| | 360 | 93 | 249 |
| | 165 | 134 | 372 |
| | 220 | 130 | 145 |
| | 40 | 30 | 35 |
| Mean | 211 | 101.4 | 203.2 |
| SD | 119.499 | 42.99767 | 124.9088 |

## Essentiality Levels for GCR

| GCR | EMW1 Essentiality Level |
|---|---|
| | 2 |
| | 5 |
| | 6 |
| | 8 |
| | 5 |
| | 7 |
| | 9 |
| | 8 |
| | 10 |
| | Mode : 5 & 8 |

## Essentiality Levels for GCR

| Nationwide | EMW2 Essentiality Level |
|---|---|
| | 5 |
| | 6 |
| | 8 |
| | 8 |
| | 1 |
| | Mode: 8 |

# Appendix P

## Correct answer results and Cochran tests for GCR and Nationwide

Table showing how successful the participants were in obtaining the correct information during the GCR experiments

| Participant | Essentiality Absent | Essentiality Preset | Essentiality Manipulated |
|---|---|---|---|
| P1 | X | ✓ | ✓ |
| P2 | X | X | ✓ |
| P3 | ✓ | ✓ | ✓ |
| P4 | ✓ | ✓ | ✓ |
| P5 | ✓ | ✓ | ✓ |
| P6 | X | ✓ | ✓ |
| P7 | X | ✓ | ✓ |
| P8 | X | ✓ | ✓ |
| P9 | ✓ | ✓ | ✓ |

Correct Answer = ✓ Gave Up = x

Table showing how successful the participants were in obtaining the correct information during the Nationwide experiments

| Participant | Essentiality Absent | Essentiality Preset | Essentiality Manipulated |
|---|---|---|---|
| P1 | X | ✓ | ✓ |
| P4 | X | ✓ | ✓ |
| P7 | ✓ | ✓ | ✓ |
| P8 | ✓ | ✓ | ✓ |
| P9 | ✓ | ✓ | ✓ |

Correct Answer = ✓ Gave Up = x

## Cochran test results for GCR

**Frequencies**

| | Value | |
|---|---|---|
| | 0 | 1 |
| EAW1 | 5 | 4 |
| EPW1 | 1 | 8 |
| EMW1 | 0 | 9 |

**Test Statistics**

| | |
|---|---|
| N | 9 |
| Cochran's Q | 8.400[a] |
| df | 2 |
| Asymp. Sig. | .015 |

a. 0 is treated as a success.

## Cochran test results for Nationwide

**Frequencies**

| | Value | |
|---|---|---|
| | 0 | 1 |
| EAW2 | 2 | 3 |
| EPW2 | 0 | 5 |
| EMW2 | 0 | 5 |

**Test Statistics**

| | |
|---|---|
| N | 5 |
| Cochran's Q | 4.000[a] |
| df | 2 |
| Asymp. Sig. | .135 |

a. 0 is treated as a success.

# Appendix Q

## Paired *t* tests for GCR and Nationwide

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | | | | |
| | | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | | | |
| Pair 1 | EAW1 - EPW1 | 72.77778 | 114.89428 | 38.29809 | -15.53778 | 161.09334 | 1.900 | 8 | .094 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | | | | |
| | | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | | | |
| Pair 1 | EAW1 - EMW1 | 148.33333 | 132.16940 | 44.05647 | 46.73894 | 249.92773 | 3.367 | 8 | .010 |

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval of the Difference | | | | |
| | | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | | | |
| Pair 1 | EAW2 - EPW2 | 109.60000 | 103.54854 | 46.30831 | -18.97249 | 238.17249 | 2.367 | 4 | .077 |

# Appendix R

## Breakdown of responses from the guided tour

| User ID | 1. What's the first thing that you are drawn to? |
|---|---|
| P1 | Probably the profile. |
| P2 | Esses… the name of your website. |
| P3 | It's the profile settings. |
| P4 | The first table about the essentials - there was a set of three tables on there. |
| P5 | Text colour. |
| P6 | The different words. |
| P7 | The large number of combo boxes and things to choose from and the different settings. |
| P8 | The combo boxes and the page looks relatively simple. |
| P9 | I'd say these text boxes here are quiet obvious… I see that you can type something in individually if you [know] what it is or you can choose from the list of things which are available. |

| User ID | 2. What's the second thing that you are drawn to? |
|---|---|
| P1 | The value. |
| P2 | I think what you are trying to do is to set up the page right? I think that's quite good. |
| P3 | Selecting the basic setting for browsing. |
| P4 | Goes straight from the central table into switching to the first option in the combo box.  Normally it reads them. |
| P5 | Background colour is interesting. |
| P6 | The numbers. |
| P7 | It is well laid out. |
| P8 | I like the fact that the page is relatively simple. |
| P9 | The organisation of [its] quite logical because you've got its general stuff and then it goes into more formatting things. |

| User ID | 3. What's the first thing that comes to mind when you first hear or see the page? |
|---|---|
| P1 | I find that there are a lot of options. |
| P2 | Uhm… |
| P3 | The essentiality view. |
| P4 | That it was a form. |
| P5 | I think the colour is alright and the browse is alright. |
| P6 | What is it? |
| P7 | There [wasn't] a load of rubbish on it. There weren't a load of graphics and flash movie things and things like that. |
| P8 | Sounds easy to figure anyway. |
| P9 | It's quite well laid out. |

| User ID | 4. What do you make of the interface? |
|---|---|
| P1 | The layouts very good. |
| P2 | There is a lot on the page. |
| P3 | It's got some really good settings on it.. |
| P4 | It's easy to perceive there's a form there and it's made up of different tables. It was quite clear. |
| P5 | I think it's scary because there are too many things in there. |
| P6 | Different and challenging. |
| P7 | It was straight and simple. And the first thing was at the top of the page and then there wasn't loads of links after it and you can see the settings in there. |
| P8 | Fairly straightforward… one or two bits where, very minor bits where it could be slightly more informative. Just at the bottom where it said delete, update and new. I think it would be better if they specified what they would be updating or deleting if clicked on. |
| P9 | It suits being laid out in a tabular way. |

| User ID | A. Participant questions in reference to hover colour and link colour |
|---|---|
| P4 | Oh I see, link colour… link yeah, link as in links onto… Hover… when the cursor goes over it I guess? |
| P5 | What is it? I don't know. |
| P6 | What's hover colour? |
| P7 | What is that? |
| P8 | What's a hover link? (When asked about the dummy link) Yes I see, you're giving everybody the option to change loads of different colour styles on the page. Link the visited link or the unvisited link, the active link to suit their visual impairment. That's good. (Link Colour) What's that for? |

| User ID | B. Participant response to the setting View Images |
|---|---|
| P1 | I don't want any images. |
| P2 | I'm going to... see how it deals with it and if it's not right I will take it off. |
| P4 | To have images… would put me off. |
| P5 | I couldn't say. |
| P7 | At the moment it is set at y, so do I leave it at that or what? |
| P8 | No, not to worry about that. I'll live with that… yes that's alright. |
| P9 | Which I will leave on yes, I think. |

| User ID | C. Participant response to Font Size |
|---|---|
| P2 | Leave it as it is. |
| P3 | I'm not sure |
| P4 | I would keep it as it is because if I have it at it's largest that will be really big and you can't get head around your screen because that's too big. So to get an idea you have it big enough, because if you have it too small it could be like a picture because it would just look like lines. |
| P5 | Let's change it to 16. |
| P6 | It's changed. 26. |
| P7 | … As long as it's 12 or anything between 12 and 20 is ideal for Jaws. If it starts going lower or higher then it will affect how Jaws reads but normally 12 is perfect. We can actually leave that. |
| P9 | Because it was on medium before, it was on small on this, but I've blown it up to medium already because that's how I work. I mean if I was using Internet Explorer I couldn't do it like that because Internet Explorer limits you to what sizes you can use. But Firefox doesn't. That's too big really, yeah. Ah, this is probably the equivalent to medium but I will blow it up in the browser. (Would normally use medium.) |

| User ID | 1. Without clicking on it, what do you expect to find on the page? How will it appear? |
|---|---|
| P1 | The options that I selected get carried over. I mean… like text only. |
| P2 | Uhm, lots of links, very cluttered. |
| P3 | Not sure. |
| P4 | It's bound to conflict with lots of volume there or might work, obviously the images will work perhaps but that doesn't matter. |
| P5 | That web site… |
| P6 | Uhm, the page will come up. |
| P7 | Uhm, eventually the homepage of Lycos. The original homepage and 1 or 2 relative links to take you to, to navigate around the Lycos site. |

| | |
|---|---|
| P8 | Uhm, I would expect Loughborough's University homepage to open. |
| P9 | Uhm, well I know some of these things use frames and buttons for the tool may go into different frames, so it could do that. Or it might actually add something to the code of the page that comes out. |

| User ID | 2. What's the most important thing (feature) on the screen for you? |
|---|---|
| P1 | The images or not…I mean whether you want the images or not |
| P3 | I think all of it. |
| P4 | Obviously once I had [got] to know how Jaws was working it was easy because it took me through… it was easy to follow. |
| P7 | Uhm, I think the fact that you have a good range of settings that you can change for the uhm visual impairment of the person and also the fact that it is clearly labelled which section is which and what is in each section. |
| P8 | For me, what I wanted to specify would have been, I would like a bit of information about the level of essentiality to turn into right that is the most essential. Personally being totally visually impaired, I'm not too worried about colours but I can see why other people might be. Partially sighted might need special fonts and colours and I can understand that. |
| P9 | I would say it's probably going to be the essentiality. |

| User ID | 3. Is there any information missing from here that you would need? |
|---|---|
| P1 | The labeling, uhm could be done a bit more simply because some of the labels… as they are written now, I wouldn't be able to, obviously, I wouldn't be able to recognise them. |
| P2 | I don't think so. |
| P3 | None that I can think of. |
| P4 | Yeah probably, like a, well probably gave an introduction but normally a website has more of an introduction and an idea of which tables would help… so there are three tables and in your head you know what, where you are heading. |

| | |
|---|---|
| P5 | Uhm, sometimes right, you have to change the name and that's it. The colour of the name. The links, when you have pictures it should be on black. Black Links. |
| P7 | I think it would be better once you've chose the actual website, to enter and it takes you to the website. Because for, I mean I understand what it is but for a new person, when it says browse button instead of a submit button. It says browse instead. |
| P8 | Uhm, a bit of background about what level 3 would mean as opposed to level 4. You could put perhaps at the top, some indication of what it means when you say you want an essentiality of 6 as opposed to a level 7. |

| **User ID** | **4. After you have filled it in, what would you do next?** |
|---|---|
| P2 | Enter. |
| P3 | It should give me every time you go on. |
| P4 | To apply the changes. |
| P5 | Well when you click on that, that might come up, that web site… |
| P6 | Uhm, save it? Or go on the page? (Referring to the favourite link that has been selected.) |
| P7 | Press enter. |
| P8 | Uhm, probably find an open browse button or actually press enter on here. |
| P9 | Uhm well it's fine typing in the URL there, it would be nice in the future if you could make it to be able to uhm when you click on the URL in your bookmarks to apply the setting. |

| User ID | 5. How would you complete the changes? What would you expect to click? |
|---|---|
| P1 | I would expect to click a button to take me to the page. |
| P2 | Press enter. |
| P3 | To link it to or something… via a link. |
| P4 | Press enter. |
| P5 | Well I think I would click on that. (Referring to the submit button.) |
| P6 | Click on it. |
| P7 | Right, that's a browse go button. Normally you think to choose enter and you expect to go onto that site, that's why I down arrowed thinking I was on the site and started to wade [through] the information. That way, because it didn't do that until you submit, you know. |
| P8 | Pressing enter |
| P9 | Well you could either type it in and click submit which is how it looks like it's going to work in this case. But in the future it might be nice to do it straight off. |

| User ID | 6. Do you find it easy to navigate around? |
|---|---|
| P1 | Uhm, roughly |
| P2 | Uhm, yeah in the end when I knew what I was looking for. |
| P3 | Yeah |
| P4 | Yeah, yeah once I kind of got into it a little bit. The flow of it, the way you follow the certain forms had different ways of doing it. Jaws interacts with it, it's not really the site but certainly how Jaws keeps doing it. |
| P5 | Very good, the information was very good. |
| P6 | Uhm, reading some of the words because some of them were difficult to say. |

| | |
|---|---|
| P7 | Yeah. |
| P8 | Yes it was virtually easy enough. |
| P9 | Yes. |

| User ID | 7. Do you find it easy to fill in the form? |
|---|---|
| P1 | Well there is quite a bit of information… and it's very close together. Some of it could be in bold to help break it up a bit. |
| P2 | I wouldn't say that it was that easy for me… no. |
| P3 | Yeah. |
| P4 | Erm yeah, yeah, the only trouble was like I said is trying to change right from the beginning and also, do you know it was hard to find out where you were. |
| P5 | Well it is the first time for me, so I tried very hard. Slightly difficult yes. |
| P6 | No. A bit challenging. |
| P7 | Yeah, yeah once you are there. |
| P8 | Uhm, relatively straightforward, just slightly disconcerting by the slightly unpredictable nature of what might happen, I mean I don't know whether it was something I was doing but when I clicked on an edit box I was put back to the profile name. Uhm the other thing, when I did try and do the combo box I had to expand it deliberately more than just pressing enter instead. Forms mode normally just expands the combo box anyway. I think it would be good if that was default instead of just having to expand at an extra keystroke. |
| P9 | Yes although I didn't type in things manually I just picked them up from the list. |

| User ID | 8. Have you found what you expected? |
|---|---|
| P1 | It's very good actually there's a lot more information on the website, that is displayed that isn't normally there, makes it more accessible |

| | |
|---|---|
| P2 | It's got links right at the top of the page… there are still a lot of links on the page. |
| P3 | yeah |
| P4 | Yeah I think so. I think probably the construction and er it's on there, like the examples and also maybe like templates at the bottom. Templates just to say sometimes rather than filling out that, like what's your favourite background colour? I didn't know mine was black with white on until I used Kurzweil which is a reader. When I used black with white on, I thought crikey I can see. I'd never have though that could work for me. It's easy to see in my mind, there are two columns and text on the right hand side and then going on to the left. So it's easier because it hasn't got all the images and that kind of thing. And yes it's less cluttered and more easier to see what the important thing is. Normally I go onto web pages and its all colours and I'm not quite sure what's text and what's not. |
| P5 | Oh yes, big font, all this I know that. I think it is very good. Very good. |
| P6 | Yeah. It's different. |
| P7 | Uh it was better than I expected. |
| P8 | I didn't hear the normal graphic logo so that's not duplicated the images, they're off as it were. Yes what I particularly, uhm let's see, uhm yes I have so far. |
| P9 | Wow, actually this is quite a lot better than the original site. I'm impressed. Uhm well I was wondering how you would do the tables and stuff but that's much better because it's so busy that website. |

# Appendix S

## Responses to post experiment evaluation

## Responses to Post Experiment

The answers to questions 1 – 6 were designed to be responded to on a Likert scale in order to assess whether the participants viewed the Essentiality & Proficiency tool positively or negatively. The responses are as follows:

| 1. The Essentiality and Proficiency Tool Interface is simple to follow. | | | | |
|---|---|---|---|---|
| Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
| 2 | 7 | - | - | - |

| 2. Applying personal preferences made viewing the web page easier. | | | | |
|---|---|---|---|---|
| Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
| 7 | 2 | - | - | - |

| 3. Rate how easy it was to find the information on the web page without the tool. | | | | |
|---|---|---|---|---|
| 1 (Very Easy) | 2 | 3 | 4 | 5 (Very Difficult) |
| 2 | - | 1 | 3 | 3 |

| 4. Rate how easy it was to find the information on the web page with the tool. | | | | |
|---|---|---|---|---|
| 1 (Very Easy) | 2 | 3 | 4 | 5 (Very Difficult) |
| 2 | 5 | 1 | 1 | - |

| 5. How easy was it to understand the idea of essentiality and essentiality levels? | | | | |
|---|---|---|---|---|
| Very Easy | Easy | Neutral | Hard | Very Hard |
| 3 | 4 | 1 | 1 | - |

| 6. How easy was it to apply the idea of essentiality and essentiality levels? | | | | |
|---|---|---|---|---|
| Very Easy | Easy | Neutral | Hard | Very Hard |
| 1 | 4 | 2 | 1 | 1 |

All participants responded *yes* to:

7. Do you think that applying the idea of essentiality is worthwhile in this case?
8. Would you like to see the idea of essentiality applied to other long electronic documents?

| **9. Do you feel that this tool can be improved in any way? How?** |
| --- |
| Yes… to make it easier to read different aspects of it. The text can be made bold or italic-sized, whatever necessary just to make it more distinguishable. |
| Yes. Maybe have like, do what happens, the same thing but for where people use speech and makes changes for them. Having less and less links, maybe a box stating how many links there are per page, yeah. Uhm, I don't know what others will think but you can't just go on like knowing what you want to see. We all see differently don't we? |
| When you click on the link, you could have background sound to say what the pages are. |
| Yes I think you need time to get used to it. For instance I wouldn't know whether to take level 3 or 6. With practice you get to know what kind of level you need. So that would be a little bit of experience but not bad experience... need a brief example because essentiality is something what you can't define. It's one thing trying to work out how essential it is to you but how do you know what is essential to them. |
| Do more work on the tool. On the web page, the links of the form. The filter could be improved as well. |
| Maybe a built in search, where you can find, put in specific thing that you are looking for on the webpage and you can link to it. A find section. I'd say the essentiality, if they were trimmed down to 5 essentiality levels, which were quite different in the levels themselves. But I think at the moment, I mean I have no idea if I click on 10, I mean I don't know what that will bring me up. I think a number 5 was a perfect setting for what I needed. It chopped out a lot of the info, those uhm random information you get. |
| Simpler words… half simple and half hard. To keep some of the stuff and make it simpler. |
| By allowing the changes to be made before it updates as it throws screen reader out of form mode. The second is, the last one combo box where you choose the website and being able to enter on it to get to the website rather than having to tab again to the submit. There is no need for a submit button because actually on the button it's browse so it makes it look like you are going to browse again. |
| Uhm, only minor tweaks to the functionality of it which I have already mentioned. About combo boxes opening/expanding by default, rather than me having to do an extra keystroke to expand. |
| I would, well it doesn't manage very well with websites with frames. And I can think of a couple of technical ways around that. But also I would say, not necessary an improvement but maybe giving people the choice of, does it go back to the level that you chose in the viewer when you have changed it on the page. Or does it give people the choice of either default back to the viewer level or stay at the one that has been chosen... you could alter it on one page but when you changed it on the page ask them if they want to stay at the one that they picked or go back to default. So it's an extra option basically in the viewer. |

| **10. Do you feel that this tool would benefit your experience of using the web?** |
| --- |
| Yes a great deal. Certainly make it a lot easier. |
| Yes |
| Yes |
| Yeah definatley makes it easy to find, secondly I like the way it clears the screen and just give you text. I think form using the Internet over a long period of time, I would like it produced online. From looking at the screen, websites are always busy nowadays, so something simple like that, simplitude and also working with Jaws, I would think would be great. |
| Yes |
| Yeah I think it would. I'm very impressed because I think the tool itself is something the people have been needing for a long time, to cut down the information from the web and to make it a lot easier to understand. |
| Yes |
| Yes it makes it easier. |
| Yes it would speed things up a lot. |
| With more… probably with those changes; yes. |

| **11. Is there anything that you didn't like about this tool?** |
| --- |
| Uhm no. Overall it was very good. |
| No not really… I did get a bit lost. Do you know when you have got the profile and you have the boxes on this side and the boxes on the other side. I just got a bit lost because I didn't know really what they were. |
| Not that I can think of. |
| I suppose there might be the potential in the essential bit, to get rid of the information that you might need. I mean that's not… That's a way of essentiality saving you time and hassle, so that you can learn. The disadvantages are the images I suppose but there is no way around that, if you can't see it, you can't see it. But that's not got anything to do with the actual tool itself. |
| It was ok. |
| Uhm, no not really. I mean I understand what it is. I understand that it's still in production stages as well. So I didn't come into this expecting, you know, something revolutionary because it's still in development. So for what it is, it's very good, I think it's very good. From a visually impaired prospective it would be very useful. |
| No. |
| Uhm, they're the obvi… the key not user friendly and in this stage they have to be user friendly… apart from that no, yeah it's great. |
| Uhm, no not really, I wouldn't have said. |
| I think I've mentioned already, this problem with the frames and the behaviour isn't always exactly what you expect. So to add an option to that would be better. |

# Appendix T

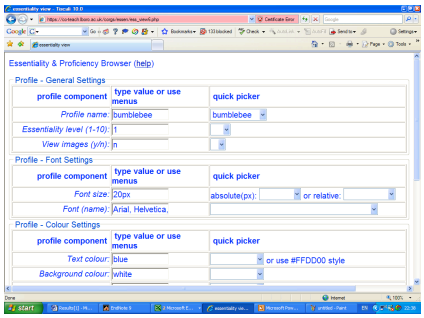
## Likert responses coded and analysed

Likert responses coded and analysed for Central tendency and Summarisation

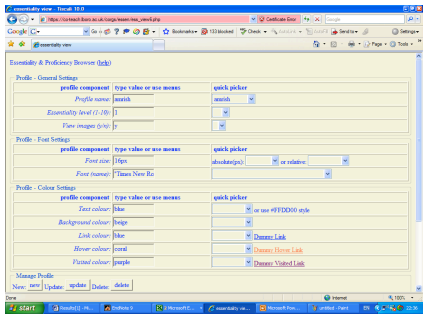
| | Simplicity | Preferences | Without | Effectiveness | Understanding | Application | Worthwhile | Other Docs | Improvement | Benefit | Dislike |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 1 | 5 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 |
| | 2 | 1 | 5 | 2 | 4 | 2 | 1 | 1 | 1 | 1 | 2 |
| | 2 | 2 | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 |
| | 1 | 1 | 4 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 |
| | 2 | 1 | 1 | 4 | 1 | 4 | 1 | 1 | 1 | 1 | 2 |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 2 |
| | 2 | 1 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 2 | 1 | 5 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 |
| | 2 | 1 | 4 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 |
| Mode | 2 | 1 | 4 & 5 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 2 |
| Common response | Agree | Strongly Agree | Difficult to very difficult | Easy | Easy | Easy | Yes | Yes | Yes tool could be improved | Yes the tool would benefit their experience of the Web | No |

# Appendix U

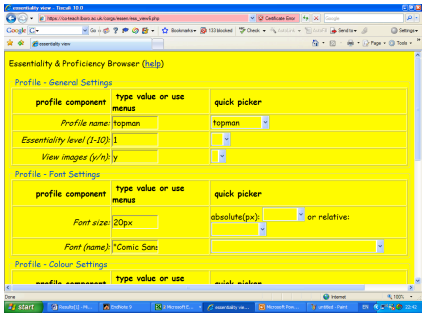
## Sample of profiles selected by participants that use screen magnification



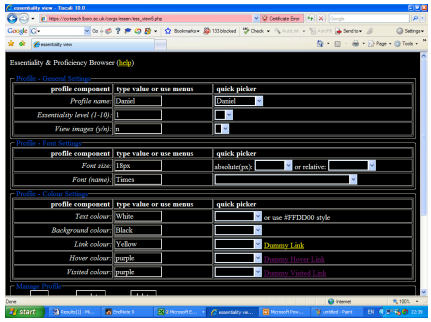
a) Medium Font size 20 and blue text colour and no images



b) Times New Roman, Font size 16, blue text on beige background



c) Comic Sans, medium Font size 20, black text on yellow background



d) Times New Roman, Font size 18, white on black background

Sample of profiles selected by participants that use screen magnification