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Raneem Saqr
Information Systems and Decision Sciences (ISDS), University of South Florida, Tampa, FL, United States., rsaqr@mail.usf.edu

Anol Bhattacherjee
Information Systems, University of South Florida, Tampa, FL, United States., abhatt@usf.edu

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Raneem R. Saqr
University of South Florida
rsaqr@mail.usf.edu

Anol Bhattacherjee
University of South Florida
abhatt@usf.edu

ABSTRACT

This paper applies and extends the Unified Theory of Acceptance and Use of Technology (UTAUT) to understand website usage among visually impaired users. We propose two new constructs, web accessibility and vision impairment level, and suggest that these constructs moderate the effects of UTAUT constructs on behavioral intention and actual usage behavior of visually impaired users. We present a plan to empirically test our proposed hypotheses using a field survey of visually impaired users regarding their usage of a website that conforms to accessibility guidelines. This paper contributes to research by drawing attention to the disabled population – an underserved area of information systems research, by identifying relevant constructs that apply in this unique context, and by elucidating how these constructs influence their technology usage.

Keywords (Required)

Web accessibility, visually impaired, People with Disabilities, Unified Theory of Acceptance and Use of Technology

INTRODUCTION

More than 50 million people in the United Sates today have some level of disability (U.S. Census Bureau, 2010), 21.5 million of whom suffer from some level of vision loss (National Center for Health Statistics, 2010). Though advancements in technologies have improved many aspects of our lives in a general sense, the disabled population has not seen their fair share of these benefits. In fact, very little effort has been made to understand the needs of disabled people or design technologies that address their needs.

The goal of this paper is to understand the factors that contributes to the use of Internet websites among the visual impaired population. Drawing on guidelines proposed by the Web Accessibility Initiative (WAI), we construct a measure for a "web accessibility" construct, and examine how this construct impacts website usage behavior among the visually impaired, relative to their level of vision impairment.

This paper will proceed as follows. First, we start with a review of the literature related to the visually impaired and web accessibility. The review identifies the different disability models and the role of technology in assisting the disabled population in general and the visually impaired in particular, and the gaps in the literature that can be the focus of future research. Second, we identify constructs - web accessibility and vision impairment level – salient to the visually impaired population and formulate a set of hypotheses by extending the Unified Theory of Acceptance and Use of Technology (UTAUT) to the unique context of this population. Third, we outline the research methods to be used to empirically test the proposed hypotheses using a survey questionnaire, within the context of a website specifically designed for visually impaired people. The data will be analyzed using structural equation modeling techniques.

LITERATURE REVIEW

Articles were collected via a computerized search of the ABI/Inform online database. The keywords used in the search were: disabilities, information systems, information technology. This search was restricted to scholarly journals articles excluding newspapers and books, which yielded 86 articles. Based on a manual reading of the titles and abstracts, we narrowed down our search results to 18 articles that were most relevant to the visually impaired population. To ensure that we did not miss any key articles, we conducted a second search using the keywords: visually impaired, web accessibility, information systems, information technology. This search resulted in 12 papers of which four were already included in the first search, seven were irrelevant to the subject in hand and one article was relevant to our study and was added to our search results.

From the remaining articles, we discarded non-academic papers, leading to a final set of 14 articles. These articles were examined, synthesized, and analyzed, results of which are presented below.

Disability Models

Prior studies suggest four societal views of people with disabilities and their needs: (1) medical model, (2) social model, (3) functional diversity model and (4) critical model.

The medical model views disabilities as a medical condition or disease. People with disabilities are considered as individuals with limitations and their contribution to the society is restricted to them being "cured". This perception of people with disability is highly unfair and biased because it discriminates against physical, sensory, or cognitive abilities (Toboso, 2010).

The social model views disability as a social rather than a medical problem. The limitations that people with disability face in their personal, social and career lives is attributed to society. It is society's responsibility to create a suitable environment that enables the disabled to function and contribute to the society as normal people do (Williams, Jamali, and Nicholas, 2006).

The third model places value in diversity and views disability in a positive light. Society should benefit from diversity as different segments play different roles, all of which can contribute to the betterment of society. Also, this model stresses on the fact that people with disabilities need more or different resources than normal people to function (Toboso, 2010).

The fourth model, critical disability model, focuses on the role of technology in assisting people with disabilities. It suggests that people with disabilities should be involved in technology design and benefit from technology use. The model proposes that technology should include people with disability in its design focus (Adam, and Kreps, 2006). This study's focus on website design and usage among visually impaired people is consistent with the critical disability model.

Technology and Visual Disability

The limited literature on technology support for the disabled suggests that technology can play a big role in integrating people with disabilities in the society and offering them experiences typical of normal people. Much of this research focuses on technologies to assist the disabled in a learning environment. Many projects were carried out to enhance the experience of students with physical, sensory and mental disabilities (Williams, Bunning, and Kennedy, 2007).

Prior research points out a few library and information services specialized to the needs of the visually impaired. From those that relates to technology are (Babalola, and Yacob, 2011):

- Talking books and newspapers: audio versions of books and periodic that are pre-recorded.
- Screen magnifiers: software that enlarges text and content such as Zoomtext.
- Screen readers: software that reads out the content to the user such as Windows-Eyes.
- Voice recognition software: software that enables users input/output data and commands through speech such as Dragon.

Some of the above technologies, such as screen readers and screen magnifiers, help improve website accessibility among the visually impaired population. However, it is not quite known to what extent the improved accessibility translates into actual utilization of these websites among the visually impaired.

Web Accessibility

World Wide Web Consortium's (W3C, 2005) Web Accessibility Initiative (WAI) views web accessibility as a circumstance whereby people with disabilities can effectively perceive, understand, navigate, and interact with the web. However, this is not a definition, but rather an outcome of web accessibility. Moreover, web accessibility is viewed in the literature as an attribute of web design, as perceived by potential users, rather than a user attribute. Given the lack of an appropriate definition of this concept, we extend the above view to define web accessibility as the inclusion of design features on a website that can help people with disabilities effectively perceive, understand, navigate, and interact with that website. WAI categorizes and measures web accessibility in terms of three levels of website feature priorities (W3C, 2008):

- Priority 1: features that *must* be satisfied by the web content developer, such as providing text equivalent for non-text elements (e.g. images, graphical representations of text, video, etc.).
- Priority 2: features that *should* be satisfied by the web content developer, such as providing information about the general layout of a site (e.g., a site map or table of contents).

- Priority 3: features that *may* be addressed by the web content developer, such as expanding each abbreviation or acronym in a document where it first occurs is an example of a priority 3 category.

A website is considered accessible when it complies with priority 1 guidelines, even if priority 2 and 3 guidelines are not met. Most websites currently implementing WAI guidelines are either government websites or government aided/funded websites. There has also been some experimental attempts to develop better technology to assist visually impaired individuals to access online content (e.g. Petrie, Weber, and Fisher, 2005; Jeong, 2008).

Our analysis of the literature review revealed several limitations and gaps. First, further research is needed to improve the concept of web accessibility, especially for the visually impaired, and the design of accessible websites. The proposed W3C guidelines appear to be insufficient in meeting different levels of visual impairments. Second, most current studies tend to be exploratory rather that explanatory, and do not have any theoretical basis or hypothesis testing. Third, although prior studies have examined technology (e.g. website design), they have overlooked how these design features may influence the usage behavior of the visually impaired or whether these new design features serve their goals. In light of these gaps in the literature, this paper examines the following research question:

- What factors allow or hinder visually impaired users' actual usage of accessible websites?

THEORY AND HYPOTHESES

To explain the visually impaired users' website usage intentions and behavior, we employ the Unified Theory of Acceptance and Use of Technology (UTAUT) as the starting point in our analysis. UTAUT examines the intention and behaviors of the general population of IT users (Venkatesh, Morris, Davis, and Davis, 2003), and is therefore relevant for our study. However, since our focus is on a very specific segment of the user population, namely visually impaired people, appropriate modifications are needed to customize this generic model to our target population.

UTAUT suggests eight constructs: four direct determinants of usage intention or behavior (performance expectancy, effort expectancy, social influence, and facilitating conditions) and four moderators that influence the impact on the direct determinants on intention and/or behavior (gender, age, experience, and voluntariness of use) (Venkatesh et. al., 2003). Performance expectancy is defined as the degree to which an individual believes that using the system will help in attaining job. Effort expectancy is the degree of ease associated with the use of the system. Social influence is the degree to which an individual perceives that important others believe he/she should use the new system. Facilitating conditions refer to the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system. The first three determinants are presumed to impact usage intention in UTAUT, while facilitating conditions are found to impact actual usage behavior. These effects are well documented and tested in the UTAUT literature, and are not repeated here to conserve space. Rather, we examine how this theory can be extended to understand the usage intention/behavior of visually impaired users. We exclude gender, age, and experience from our analysis because these demographic factors are largely outside user control. We also exclude voluntariness because voluntariness is implicit in UTAUT in that it is a model of voluntary IT usage and cannot be applied in mandatory settings.

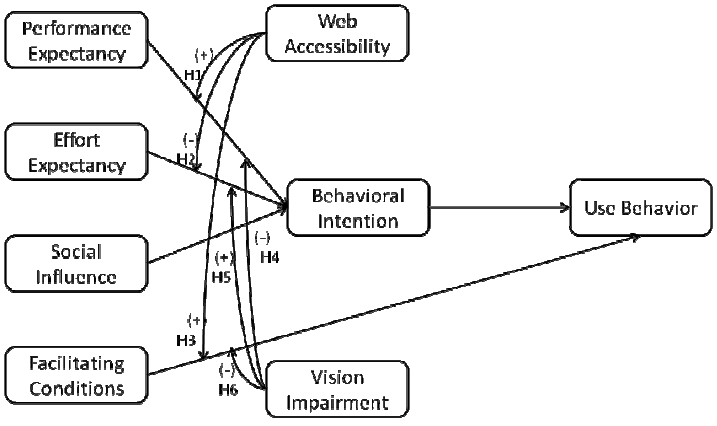

Figure 1. Research Model

Moderating Effects of Web Accessibility

In order to contextualize UTAUT to the visually impaired population, we add two new constructs salient to this population: web accessibility and visual impairment level. The effects of these constructs are shown in Figure 1. Because most websites are not designed for people with disabilities, the extent to which visually impaired users can use these websites will depend on the accessibility of these websites. Visually impaired users may believe that a given website is useful (i.e., is high in performance expectancy), but not intend to use it if it is not accessible. On the other hand, websites low in performance expectancy are also less likely to be used even if they are highly accessible. Websites that are simultaneously accessible and useful are the ones most likely to be used by visually-impaired users. Hence, we expect the relationship between performance expectancy and website usage intention of the website to be positively moderated by web accessibility. This expectation leads to our first hypothesis:

> **H1:** The effect of performance expectancy on usage intention among visually impaired users is positively moderated by web accessibility.

Venkatesh et al. (2003) suggest that effort expectancy has a stronger impact on intention of use during the initial phases of system use, and less so during later stages of use. However, given the often severe limitations of visually-impaired users, more accessible websites are likely to reduce the burden of effort expectancy (low ease of use) during both initial and later stages of website usage among this population. It can be reasonably expected that a website that is both accessible and easy to use is likely to engender strong positive usage intention among visually impaired users. Hence, we hypothesize.

> **H2:** The effect of effort expectancy on usage intention among visually impaired users is negatively moderated by web accessibility.

Facilitating conditions refer to organizational and technical infrastructure to support IT use. While the availability of such infrastructure will encourage website usage among the visual impaired, this effect is likely to be larger if the websites themselves are more accessible to begin with than if the websites are less accessible. For instance, less accessible websites are less likely to be used even in the presence of significant facilitating conditions. Thus, we expect that web accessibility will have a positive moderating effect on the relationship between facilitating conditions and visually impaired users' website usage behavior:

> **H3:** The effect of facilitating conditions on usage behavior among visually impaired users is positively moderated by web accessibility.

Moderating Effects of Vision Impairment

According to the American Foundation for the Blind, vision impaired people may vary along a scale from those who cannot see at all (total blindness) to those who have partial vision loss (mild blindness). Similar to the web accessibility construct, we expect that users' vision impairment level to moderate the relationships between the UTAUT constructs and usage intention/behavior. The less severe is a person's vision impairment level, the more likely is he/she to use a given website, provided that website is viewed as being useful (high in performance expectancy) or easy to use (low in effort expectancy). In other words, the severity of vision impairment is likely to negatively moderate the effect of performance expectancy and positively moderate the effect of effort expectancy on website usage intention. These expectations lead to our next two hypotheses:

> **H4:** The effect of performance expectancy on usage intention among visually impaired users is negatively moderated by their vision impairment level.

> **H5:** The effect of effort expectancy on usage intention among visually impaired users is positively moderated by their vision impairment level.

Similarly, while high facilitating conditions may tend to enhance web usage among visually-impaired users, this effect is likely to be attenuated for users with high severity of vision impairment. Such users may appreciate the organizational and technical infrastructure to support their use of a website, but feel that their disability level is too high for them to take advantage of that infrastructure. On the contrary, if they have lower levels of vision impairment, they are more likely to enhance their website use, given the same organizational and technical infrastructure. Hence, we hypothesize,

H6: The effect of facilitating conditions on usage behavior among visually impaired users is negatively moderated by their vision impairment level.

It may be noted that we did not postulate web accessibility or vision impairment level to moderate the hypothesized relationship between social influence in UTAUT. This is because neither web accessibility nor vision impairment level changes the social pressures felt by the disabled to use websites or engage in other typically non-disabled activities. Clearly, the feeling of exclusion has always exerted a social pressure on people with disability, including the visually impaired, to fit in with the non-disabled and to be part of the general society (Milian, 2011). Hence, these users would always want to engage in some of the activities of the non-disabled, including technology usage. Such effect is independent of the accessibility of a website or the vision impairment level of a disabled user, and is included in our research model as a main effect. However, this effect is not unique to the disabled population, is not related to the new constructs introduced in our study, and is therefore not postulated as a formal hypothesis.

RESEARCH METHOD

This research will utilize the facilities of the Tampa Lighthouse for the Blind, a non-profit, voluntary, vocational service center that serve the visually impaired community in Tampa, Florida. The center provides technological services such as computer training for the visually impaired, as well as provides technology access and support to visually impaired users interested in accessing web-based content. We will choose a random sample of 100 visually impaired users who are registered to receive services at this center. Study participants will be shown an accessible website, and asked to record their perceptions about that website and their intentions and behavior regarding using that website using a survey questionnaire. Given their limited visual acuity, we will enlist the services of a center staff to read out the questionnaire items to study participants, and record responses on a paper form on their behalf. Their responses will be analyzed using structural equation modeling techniques.

In addition, given the newness of the web accessibility scale, we will validate this scale prior to our survey study using a small pilot study of visually disabled users, who would not be part of sample in the main study. Participants will be read out individual items of this measure and their opinions on its appropriateness, wording, and adequacy will be sought. This process will allow us confirm the face validity and content validity of the web accessibility measure. Additionally, we will seek the opinions of the pilot study respondents and the service center staff on what aspect of web accessibility is not adequately captured in the WAI guidelines, in an attempt to improve upon WAI as a design artifact. Convergent and discriminant validity will be examined using confirmatory factor analysis following the survey data collection.

Survey Website

The website we chose for our study is www.bbc.co.uk. This website is unique in that it offers many accessibility options for users with different disabilities (see Appendix A). Clicking on the "accessibility help" link at the bottom of the page (http://www.bbc.co.uk/accessibility/) directs users to a page that allows them to select their specific type of disability, and then customize the website to their specific needs. For instance, a partially visually disabled user may select the "I can't see very well" link, which will then display additional accessibility features such as font size, font colors, font style, screen magnification, mouse pointer, background color, and so forth (see Appendix A). There are also options for reading text aloud and using screen readers for users who click the "I am blind" link. Given the above web accessibility features, this website is particularly appropriate for our study.

Measures

Most of our constructs are measured perceptually using multiple-item, seven-point Likert scales ranging from "strongly disagree" to "strongly agree." Construct measures are adopted from Venkatesh et al. (2003), after modifying them to fit the context of our study. For instance, one of the performance expectancy measures in the original study referred to getting a raise in the workplace. Since "getting a raise" is not an objective of most of our visually impaired users, this item was dropped from our study. Likewise, items related to the workplace environment were also dropped, since the target organization was a community-based service provider rather than a professional work environment. All of these constructs had a minimum of three items in order to meet the minimum norms of convergent and discriminant validity, and subsequent data analysis. Usage behavior is measured using two self-reported categorical items extended form Davis (1989) that measured the frequency of use and number of web pages viewed. Actual construct measures are presented in Appendix B.

Two constructs were unique to our study: web accessibility and vision impairment level. Vision impairment is measured using Dandona and Dandona's (2006) classification, which in turn is derived from the International Statistical Classification of Diseases (ICD). This measure captures visual impairment level on a six-level categorical scale based on actual visual acuity: mild visual impairment (< 6/12), moderate visual impairment (6/12 - 6/18), blindness (6/18 - 6/60), severe blindness (6/60 - 3/60), very severe blindness (3/60 - 1/60), and total blindness (no light perception).

Given that there are no accepted measure of web accessibility in the literature, we constructed our own measurement scale for measuring this construct for visually impaired users. Specifically, we selected the key priority 1 guidelines from W3C's (2008) WAI guidelines to create five items, which will be assessed perceptually by the study's participants using seven-point Likert scales. These guidelines are:

1. Availability of alternative text: appropriate alternative text must be provided when the images are turned off or through the ALT function.

2. Color suitability: the color scheme of the website should be adequate for the different visually impaired users.

3. Font size: the visually impaired should be able to use browser controls to vary font-size.

4. Navigation: Without using the mouse, the visually impaired should be able to use the keyboard, using the "*Tab*" key, to navigate through the links.

5. Language: the language of the website should be easily understood by the visually impaired; the simplest and clearest language should be used appropriate to the site's content.

Because these five factors are easily identified and understood by the visually impaired population, a five-item scale was created to represent each of these five factors. Actual scale items are provided in Appendix B .

CONCLUSION

Our research has several implications for research and practice. First, this study will attract attention to disabled IT users, a population that has been largely ignored in prior academic research in general and IT usage research in particular, and how to design websites that meets the needs of this underserved community. People belonging to this group can benefit a great deal from scientific research that can help them enjoy the benefits of modern technologies, which are an integral part of today's communication, knowledge, and self-expression.

Second, this paper extends the Unified Theory of Acceptance and Use of Technology (UTAUT) to the vision impaired population by presenting two new constructs, web accessibility and vision impairment, and postulating how these constructs moderate the effects of previously known UTAUT predictors. In doing so, we seek to provide an improved understanding of the behavioral intentions and actual website usage behavior among visually impaired users.

Third, our research will capture user perceptions of websites and their accessibility, which can be used to improve our understanding of the little understood web accessibility construct. Moreover, this understanding will help web developers to design websites that are more accessible to the vision impaired population.

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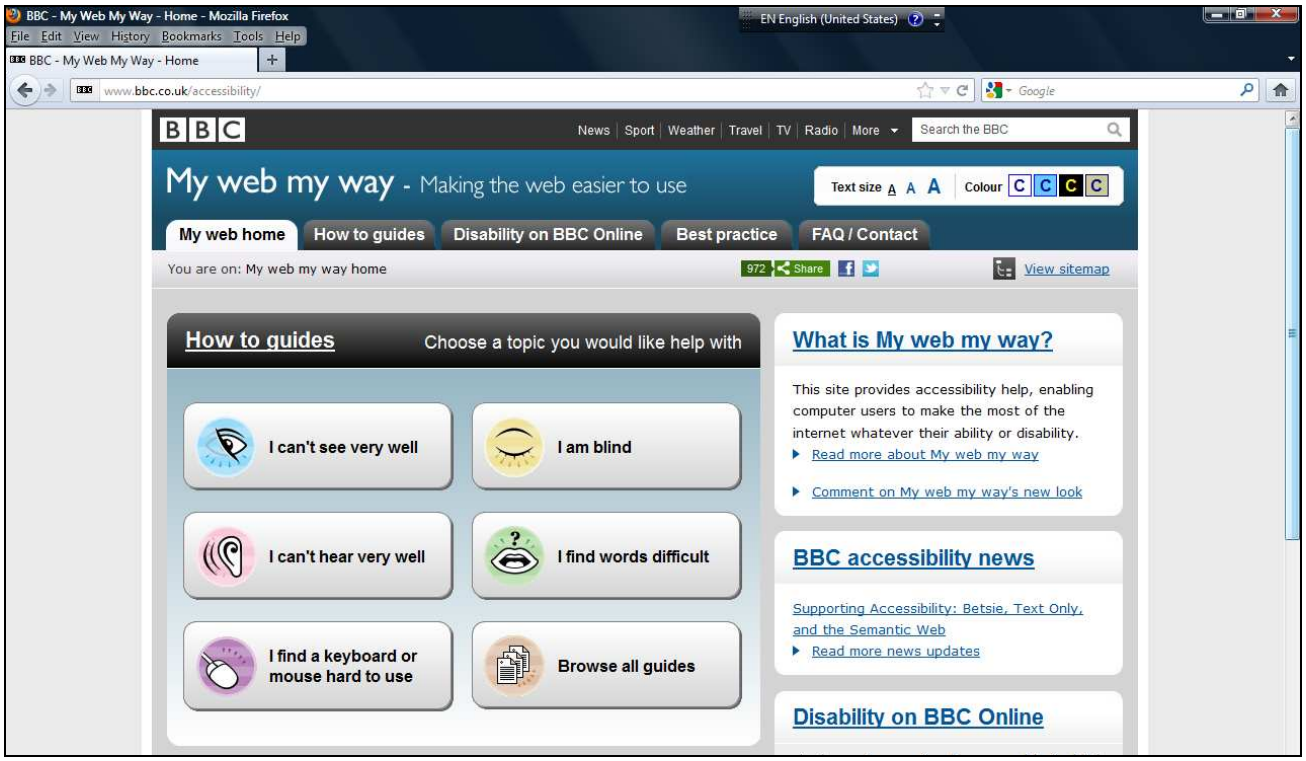
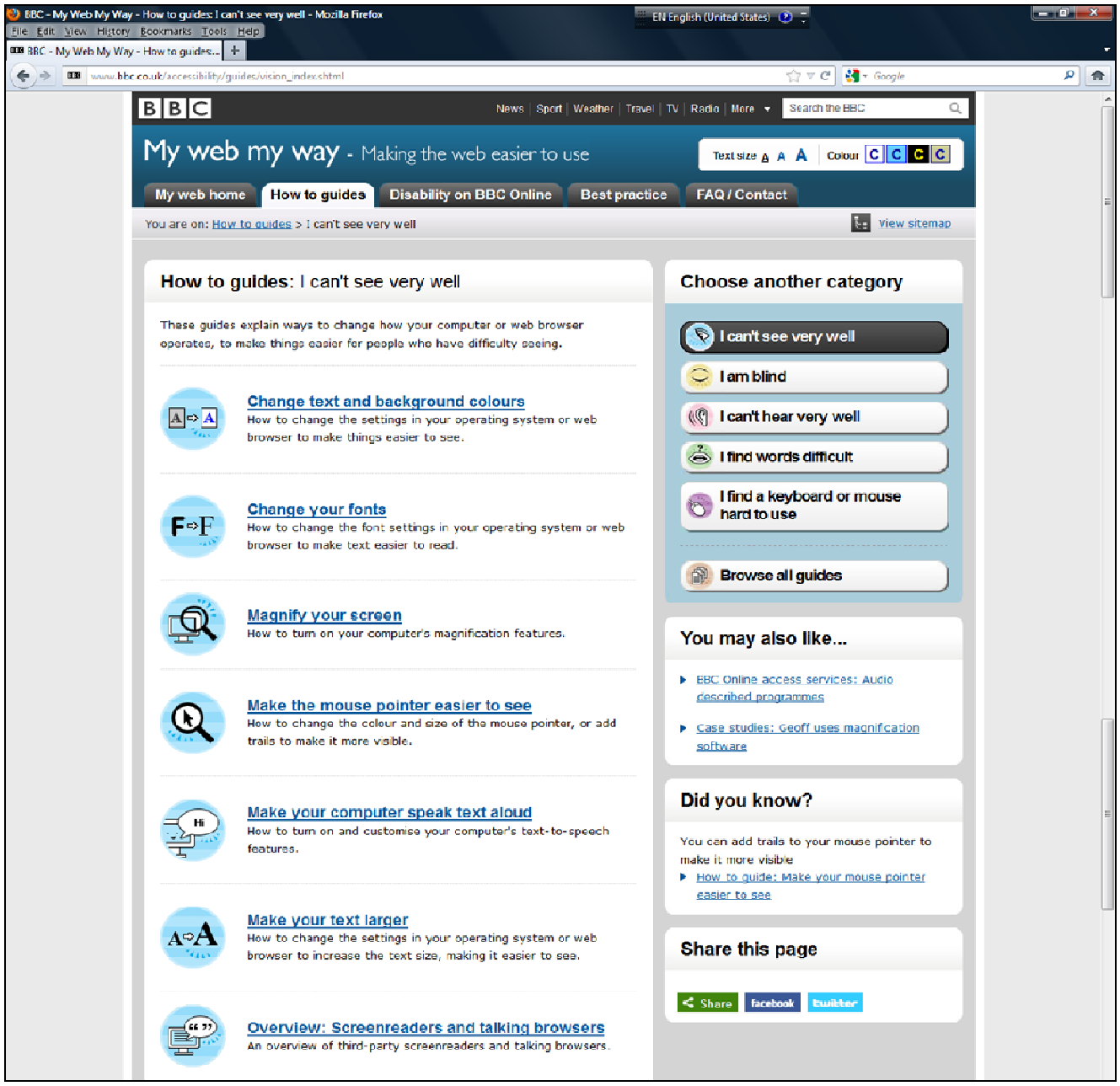
APPENDIX A: SURVEY WEBSITE




BBC - My Web My Way - How to guides: I can't see very well - Mozilla Firefox
File Edit View History Bookmarks Tools Help
BBC - My Web My Way - How to guides...
www.bbc.co.uk/accessibility/guides/vision_index.shtml
EN English (United States)
Google
BBC
News | Sport | Weather | Travel | TV | Radio | More
Search the BBC
My web my way - Making the web easier to use
Text size A A A
Colour C C C C
My web home
How to guides
Disability on BBC Online
Best practice
FAQ / Contact
You are on: How to guides > I can't see very well
View sitemap
How to guides: I can't see very well
These guides explain ways to change how your computer or web browser operates, to make things easier for people who have difficulty seeing.
Change text and background colours
How to change the settings in your operating system or web browser to make things easier to see.
Change your fonts
How to change the font settings in your operating system or web browser to make text easier to read.
Magnify your screen
How to turn on your computer's magnification features.
Make the mouse pointer easier to see
How to change the colour and size of the mouse pointer, or add trails to make it more visible.
Make your computer speak text aloud
How to turn on and customise your computer's text-to-speech features.
Make your text larger
How to change the settings in your operating system or web browser to increase the text size, making it easier to see.
Overview: Screenreaders and talking browsers
An overview of third-party screenreaders and talking browsers.
Choose another category
I can't see very well
I am blind
I can't hear very well
I find words difficult
I find a keyboard or mouse hard to use
Browse all guides
You may also like...
BBC Online access services: Audio described programmes
Case studies: Geoff uses magnification software
Did you know?
You can add trails to your mouse pointer to make it more visible
How to guide: Make your mouse pointer easier to see
Share this page
Share
facebook
twitter

APPENDIX B: CONSTRUCT MEASURES

Performance expectancy (Venkatesh et al., 2003)
- I find this website useful in my daily life.
- Using this website enables me to accomplish personal tasks.
- Using this website makes me more productive.

Effort expectancy (Venkatesh et al., 2003)
- It is easy for me to become skillful at using this website.
- I find this website easy to use.
- Learning to use this website is easy for me.

Social influence (Venkatesh et al., 2003)
- People who influence my behavior think that I should use this website.
- People who are important to me think that I should use this website.
- My peers think that I should use this website.

Facilitating conditions (Venkatesh et al., 2003)
- I have access to the resources needed to use this website.
- In general, this facility has supported the use of the website.
- People are available for assistance if I need help with using this website.
- Guidance/instructions are available to me for using this website.

Behavioral intention to use website (Venkatesh et al., 2003)
- I intend to use this website a lot over the next 1 month.
- I predict I would use this website significantly over the next 1 month.
- I plan to use this website heavily over the next 1 month.

Usage behavior of this website (Davis, 1989)
- How frequently do you use this website: Not at all / Less than once a week / About once a week / Several times per week / About once each day / Several times each day.
- How many pages do typically view on this website in one week: 0 / 1-2 / 3-4 / 5-6 / 7-8 / 9-10 / More than 10

Web accessibility (Designed based on W3C, 2008)
- I can read the text description of all the images on this website.
- The colors used on this website are adequate for me.
- I can enlarge the font size to my needs on this website.
- I can navigate the website using the keyboard.
- I can clearly understand the language on this website.

Vision impairment level (Dandona et al., 2006)
- Mild vision impairment (< 6/12)
- Moderate vision impairment (6/12 - 6/18)
- Blindness (6/18 - 6/60)
- Severe blindness (6/60 - 3/60)
- Very severe blindness (3/60 - 1/60)
- Total blindness (no light perception)