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# Web Accessibility for Visually Impaired Users: Extending the Technology Acceptance Model (TAM)

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## **ABSTRACT**

The Technology Acceptance Model (TAM) is one of the most widely used models in the MIS literature. Verified by many studies, TAM asserts that the *perceived ease of use* and *perceived usefulness* of an information technology is instrumental in its adoption. While previous research has been valuable in explaining how and why the perception of *ease of use* and *usefulness* develops, this research does not include a growing number of users, namely the disabled. The large number of disabled technology users calls for scientific examination of ways to improve technology acceptance and usage in this population. Our study will address this need by extending TAM to include visually disabled users. Moreover, our study will expand TAM by examining *information accessibility* as a potential key determinant of *ease of use* and *usefulness* of web usage for people with and without visual disability.

## **Keywords**

Accessibility, Information Accessibility, Website Accessibility, Technology Acceptance, Visual Disability, Visually Impaired Users.

## **INTRODUCTION**

Many organizations develop their websites as a way to reach a broader audience. To drive more traffic to their websites organizations employ many methods, such as being "search engine friendly" (Elges, 2002). However, organizations often ignore website accessibility, which can attract a growing number of disabled users (Loiacono, 2004, Loiacono and McCoy, 2004). For example, most of the Fortune 100 companies do not provide fully accessible home pages (Loiacono, 2004). Visual impairment, defined as low vision as well as blindness, is a disability that sharply increases with age (West and Sommer, 2001). Visual impairment, however, is not limited to the aging population (West and Sommer, 2001). This disability affects 161 million people around the globe and is growing

(Resnikoff et al., 2004). A decline in vision has a profound impact on an individual's personal and social life. The World Wide Web can serve as an effective tool to break the social isolation of the visually impaired by enabling them to better fulfill their purchase, information, and communication needs.

Web usage will be a particularly appealing alternative for the elderly, who in addition to the declines in vision also experience declines in their physical mobility. Since "a sizable, aging, and affluent middle-aged population" is one of the powerful demographic trends that will soon dramatically increase the number of visually disabled users (Loiacono, 2004), it is reasonable to argue that paying attention to this group of users can potentially influence organizations' business success. The economical and social benefits of web usage for both the visually impaired and organizations, create a pressing need to examine ways to improve acceptance and adoption of web usage by people with a visual disability.

## **THEORETICAL FOUNDATION**

This section provides a brief review of the two major theories used in our study: *technology acceptance model* (Davis, 1989) and *perceived accessibility* (Culnan, 1984, Culnan, 1985).

### **Technology Acceptance Model (TAM)**

Technology acceptance has been the focus of many studies in the MIS literature (Szajna, 1996, Venkatesh and Davis, 2000, Venkatesh et al., 2003, Davis, 1989, Davis and Kottemann, 1995, Morris and Dillon, 1997, Venkatesh, 1999). This literature, however, has largely ignored the growing population of disabled users. Our study will address this shortcoming by extending one of the most influential acceptance models, the Technology Acceptance Model (TAM), to include visually impaired users. TAM was developed by tailoring theories in the psychology literature to examine individuals' reactions towards adoption of a technology (Szajna, 1996, Venkatesh and Davis, 2000, Venkatesh et al., 2003, Davis, 1989, Davis and Kottemann, 1995, Morris and Dillon, 1997, Venkatesh, 1999). According to this model, the usage of an IT is influenced by users' beliefs about the *perceived usefulness* and the *perceived ease of use* of the IT. *Perceived usefulness* (PU) is defined as the degree to which a person believes that use of a system would improve his or her performance. *Perceived ease of use* (PEU) refers to the degree to which a person believes that using a particular system would be effortless. While both PU and PEU are significantly correlated with usage, TAM suggests that PU is influenced by PEU. The predictive validity of this model has been verified by many studies (Szajna, 1996, Venkatesh and Davis, 2000, Venkatesh et al., 2003, Davis, 1989, Davis and Kottemann, 1995, Morris and Dillon, 1997, Venkatesh, 1999).

### **Perceived Accessibility**

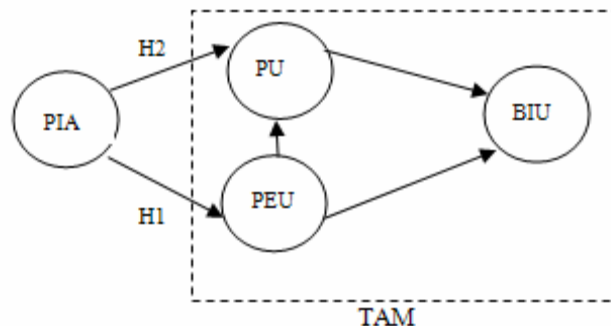
*Perceived accessibility* can be defined in terms of *perceived physical accessibility* and *perceived information accessibility* (Culnan, 1985). *Perceived physical accessibility* (PPA) refers to the extent to which an individual has physical access to the system while *perceived information accessibility* (PIA) refers to the ability to retrieve the desired information from the system (Culnan, 1984, Karahanna and Straub, 1999, Karahanna and Limayem, 2000). *Perceived accessibility* has been argued to be related to communication technology usage (Culnan, 1985, Rice and Shook, 1988, Kerr and Hiltz, 1982, Karahanna and Straub, 1999).

## **RESEARCH MODEL**

Literature suggests that *perceived accessibility* can impact communication technology usage (Culnan, 1985, Rice and Shook, 1988, Kerr and Hiltz, 1982, Karahanna and Straub, 1999). For example, there has been evidence that *perceived physical accessibility* can impact email usage ((Culnan, 1985, Rice and Shook, 1988, Kerr and Hiltz, 1982, Karahanna and Straub, 1999). However, there has been no attempt to examine the impact of *perceived information accessibility* (PIA) on web usage. Moreover, the above discussed studies do not include disabled users in their models. Our research addresses this shortcoming by examining the impact of *perceived information accessibility* (PIA) on the *perceived ease of use* (PEU) and *perceived usefulness* (PU) of web usage for people with and without a visual disability. Given the explanation that all else being equal, the easier the system is to interact with, the less effort will be needed to use it (Davis, 1989), it is reasonable to argue that *perceived information accessibility* of a website can have a major impact on its *perceived ease of use*. Since providing information is a major function of websites, it is also reasonable to argue that *perceived information accessibility* of a website can have a major impact on its perceived usefulness. Thus we hypothesize that:

H1) *Perceived information accessibility* (PIA) will have a significant impact on *perceived ease of use* (PEU) of a website for users with and without visual disability.

H2) *Perceived information accessibility* (PIA) will have a significant impact on *perceived usefulness* (PU) of a website for user with and without visual disability.  
The following figure displays our hypothesis and research model:



**Figure 1: Research model including users with and without visual disability**

For our investigations we use the career website <http://jobs.fidelity.com>. The original version of this website was only partially accessible to the visually impaired. Using the principles of universal design, we have improved this website to be more accessible for both visually impaired and sighted users. We will test the hypotheses of our study by comparing the career website <http://jobs.fidelity.com> before and after it was improved.

#### **PRELIMINARY STUDY**

This preliminary study verifies the accessibility improvements that were made to the website. It also examines the appropriateness of the tasks (e.g., whether tasks can be completed within a reasonable amount of time). This preliminary study was conducted at Fidelity's usability lab. The experiment was conducted as a series of individual sessions (one session per subject). Each session was recorded for further analysis.

#### **Participants and Design**

Eight visually impaired (four blind and four low vision) users were recruited to participate in this preliminary study. These subjects were recruited through the Easter Seals organization. The participants evaluated both websites (website A: the website before its information accessibility was improved and B: the website after its information accessibility was improved). Subjects evaluated these websites in random order (half of the subjects evaluated website A and then B, the other half will evaluate website B and then A). The tasks were also presented to the subjects in a random order.

#### **Procedure**

The experiment was conducted over the course of two weeks at Fidelity's usability lab. The experiment consisted of eight individual sessions (one session per subject). Each session was recorded. All participants were assisted by the same moderator. At the beginning of each session, the participants were given a brief description of the objective and the procedure of the study. Before starting the task, participants were asked to configure the screen reader to their personal preference. The tasks were read to the blind participant by the moderator. The moderator, however, did not read the tasks to the low vision users. Instead, low vision users were given the tasks on a sheet of paper written in a large font. The low vision subjects were asked to read the task out loud before beginning the task. All subjects were asked to think out loud while completing the task. They were asked to describe out loud the methods they were using to complete the task. Upon completion of each task, the participants were asked to summarize their experience and explain any difficulties they encountered. They were also asked to give feedback and/or recommendations regarding the layout of the website.

#### **Task**

The task for this study consisted of 10 subtasks. These subtasks were developed through recorded observations (both video recordings as well as text logs) of previous studies at Fidelity's usability lab. These subtasks required users to navigate and search the website for information. The tasks were designed in way to prevent learning effects (learning to do something in the first website and then apply this knowledge to the second website).

## Measurements

To measure the accessibility improvements made we collected information such as task completion rate (the number of tasks completed during a session) and task completion time (the amount of time required to complete a task). We also included qualitative methods of analysis such as interviews as well as observing users' reactions while completing the tasks (e.g., questions, statements, explanations, methods used to complete a task, facial expressions, gestures, frustration, etc.).

## Results

Although we have not fully completed our analysis of the rich set of data that were collected, our initial examinations show that the improvements made to the website were indeed effective. For example, on the average, users were able to complete more tasks when using the improved website (i.e., task completion rate increased from 77% to 81%). Similarly, they were able to complete their tasks faster (i.e., task completion time decreased from 19 to 15 minutes). The improvement in task completion rate and time were particularly noticeable for low vision users (20% more tasks and 37% faster). These results were consistent with data collected from observations and interviews.

## MAIN STUDY

The purpose of this study is to examine the impact of *perceived information accessibility* (the ability to retrieve the desired information) on *ease of use* and *usefulness* of a website. This study includes users with and without visual disability. Thus, this study extends TAM in two ways: 1) by including visually disabled users and 2) by examining the impact of *perceived information accessibility* (PIA) on *perceived ease of use* (PEU) and *perceived usefulness* (PU) for users with and without visual disability.

## Participants and Design

Fifty senior undergraduate students and fifty visually impaired users will be recruited to participate in this study. These subjects will be randomly assigned to either the Fidelity career website before it is improved or to the one after it is improved to be more accessible. Thus, this experiment will have a 2 (visual disability: present vs. absent) X 2 (web accessibility: low vs. high) design.

## Task

Five subtasks will be used in this study. These subtasks will be selected from the set of tasks in the preliminary study. Thus, as in the preliminary study, these five subtasks will require users to navigate and search the website for information.

## Measurements

We will measure *perceived ease of use* (PEU), *perceived usefulness* (PU), and *behavioral intention to use* (BIU) using TAM's verified scales. To measure *perceived information accessibility* (PIA) we will use the scales developed by Culnan (1984).

## Procedure

Subjects will be recruited via email. The undergraduate subjects will be recruited via university email and the visually impaired subjects will be recruited through the Easter Seal organization. The email will contain the URL for the online experiment. Subjects will first complete a general survey which collects demographic information (e.g., subjects' gender, age, experience, visual acuity, whether they use corrective lenses or assistive software, etc.). Subjects will be then randomly assigned to the websites (half of the subjects will be assigned to the website before it was improved and the other half to the website after it was improved. The URL for the websites is coded as website A and website B). Each subject will complete five tasks. The order of these tasks will be randomized for each subject. After completing the tasks, subjects will complete TAM and *information accessibility* questionnaires. After completing the questionnaires, subjects will be directed to the final page, which will thank the subjects for their participation one more time and will remind them that their names will be entered in a drawing to win \$100 gift certificate.

## Contributions

This study has important theoretical implications since it extends TAM by examining *information accessibility* as a potential key determinant of *ease of use* and *usefulness* for both users with and without visual disability. The importance of *ease of use* and *usefulness* in adoption of IT and the growing number of visually disabled users make the contributions of this study to the acceptance and accessibility literature particularly significant. This study has

also potentially important practical implications since its results can provide organizations with additional information to increase their website traffic. This study can be extended to include users with a different type of disability. By including a broader group of users such extension would add greater depth to the current research.

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