

# Blind Users Searching Digital Libraries: Types of Help-seeking Situations at the Cognitive Level

Iris Xie<sup>1</sup>, Rakesh Babu<sup>1</sup>, Wooseob Jeong<sup>1</sup>, Soohyung Joo<sup>1</sup> and Paige Fuller<sup>1</sup>

<sup>1</sup>School of Information Studies, University of Wisconsin-Milwaukee

## Abstract

Universal access is the objective of digital library development. However, it is a challenge for blind users to search information effectively in digital libraries because of their dynamic design and multimedia collections. Serving as the preliminary study of a large scale project, this study focuses on the identification of types of help-seeking situations unique to blind users at the cognitive level. Based on the analysis of 15 blind users' pre-questionnaires, pre-interviews, think-aloud protocols, transaction logs and post-interviews, the authors identified blind users' typical help-seeking situations in relation to cognitive overload, comprehension and reasoning. Implications for how to design better help features for blind users to overcome these situations are also discussed.

**Keywords:** human information behavior, information retrieval, quantitative research methods

**Citation:** Xie, I., Babu, R., Jeong, W., Joo, S., & Fuller, P. (2014). Blind users searching digital libraries: Types of Help-seeking Situations at the Cognitive Level. In *iConference 2014 Proceedings* (p. 853-857). doi:10.9776/14272

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**Contact:** hiris@uwm.edu, babu@uwm.edu, wjj8612@uwm.edu, sjoo@uwm.edu, pfuller@uwm.edu

## 1 Introduction

Blind users interact with information retrieval (IR) systems, including digital libraries (DLs), in entirely different ways from sighted users. In this study, "blind users" refers to individuals who lack the functional sight to see information presented on a computer screen. They predominantly rely on text-to-speech software called screen-readers (SRs) to interact with computers and the Internet (Lazar et al., 2007).

DLs are defined as digital content created by libraries and cultural heritage institutions excluding the digital content purchased from publishers. As multimedia DLs proliferate, more difficult situations for blind users occur, and help mechanisms play an essential role in assisting them in effective information searching. Help mechanisms are defined as overall help systems that facilitate users to use an IR system (Xie & Cool, 2009). In this study, the help-seeking situation is characterized by a person needing help in the context of an information search including browsing within a DL in order to achieve his/her tasks/goals.

This poster focuses on blind users' help-seeking situations at the cognitive level. Through literature review, we identified multiple cognitive constraints of the blind in information use on the Internet: 1) avoidance of pages containing severe accessibility problems, such as dynamic content (Craven, 2003; Bigham et. al, 2007); 2) problems understanding page/site structure when browsing as well as difficulties with the serialized-monolithic presentation of SRs (Salampasis et al., 2005); 3) sequential nature of interaction, meaning at any given point a blind user perceives only a snippet of the content, and loses all contextual information (Lazar et al., 2007); 4) mere translation of text content with a synthetic speech, and not a complete narration of information presented (Babu, 2011). Important cues embedded in color, images and videos that aid in navigation and interpretation are lost (Leuthold et al., 2008); 5) cognitive overload from spending cognitive resources in trying to understand the browser, the web site, and the SR simultaneously as well as being forced to hear repeated information across pages (Chandrashekar, 2010; Theofanos and Redish, 2003); 6) improper labeling causing significant confusion, frustration, and disorientation, particularly for interface objects such as buttons and input fields (Lazar et al., 2007).

However, previous literature provides neither in-depth discussion of how and why help-seeking situations arise for the blind in IR interaction, nor insight into their unique cognitions, perceptions and actions. A closer examination of their cognition and behavior in DL interactions is demanded. This study investigates the research question: What types of help-seeking situations do blind users face at the cognitive level in using a DL?

## 2 Methodology

This study was designed to explore blind users' help-seeking situations in gathering information from a DL. Fifteen blind adults from the Greater Milwaukee area were recruited through regional blind associations with \$100 per person as compensation for his/her time and transportation expense. Qualifications for participation included reliance on screen readers to interact with computers and at least three years of experience in Internet use. Each experiment session was conducted at the usability testing lab in a state university. Each session comprised a pre-interview, a think-aloud observation, and a post-interview lasting a total of three hours. These participants represent blind users of different ages, genders and search skills. Detailed demographic data are omitted because of space limitation.

A laptop with Internet Explorer 10, JAWS 12 and Morae 3.1 was used for this study. JAWS is the most popular SR in the blind community, and Morae software captures participant verbalization, screen video, and transaction logs. The American Memory Digital Collections was selected for this study because of its popularity and diverse help features. The pre-search interview included questions seeking perceptions about help mechanisms and help-seeking behavior in Internet use. The participants were instructed to first perform a 10-minute familiarization task to explore the DL and its functionality, and then to conduct three 30-minute search tasks while thinking aloud: 1) known-item search (Find the Letter written by Alexander Graham Bell to Helen Keller dated March 23, 1907); 2) specific information search (Find when and how Presidents Lincoln and Garfield were assassinated); and 3) exploratory (Identify some U.S. immigration policy issues using multiple sources). The post-search interview solicited feedback on interaction experiences with the DL and its help features, as well as participants' overall assessment and help-seeking situations faced during the searches. Interviews were audio-recorded and transcribed in their entirety, including participant verbalizations, SR announcements, and investigator observations.

An open coding method was used for analyzing the transcripts. Five independent coders participated, and any disagreement was resolved by group discussions. Types of help-seeking situations were identified by analyzing both transcripts and transaction logs. The identified help-seeking situations were classified into three categories: shared by sighted users, unique to blind users at the physical level, and unique to blind users at the cognitive level. Due to space limitation, only preliminary findings on main blind users' help-seeking situations at the cognitive level are reported in this poster. Table 1 presents the data collection and data analysis plan.

Research question	Data collection	Data analysis
Types of help-seeking situations	Pre-questionnaire, pre-interview, think aloud protocols, log analysis and post-interviews	Open coding, taxonomy of help-seeking situations

Table 1: Data collection and data analysis plan

### 3 Results

This section reports our preliminary results on help-seeking situations unique to blind users at the cognitive level in DL searching. We illustrate these results with evidence captured in participant utterances, SR announcements (enclosed within < >), and investigator observation (enclosed within {}). Due to space limitation, we discuss only three help-seeking situations--cognitive overload, comprehension and reasoning.

Cognitive overload refers to the amount of information and interactions that must be processed simultaneously. In this study, it specifically refers to the difficulty in processing a large volume of information needed for a DL search at the same time. We observed this kind of situation when participants tried to interpret the information conveyed by the DL site, the browser, and the screen reader simultaneously. They were unable to clearly distinguish the three programs from each other, thereby failing to determine the appropriate course of action. The following illustrates the disoriented state of a participant who thought she was on the American Memory site but was actually trapped in the browser's address bar.

Why didn't that . . . The Jaws search didn't provide anything for Lincoln. I wasn't expecting that.

<Compatibility checkbox not checked. Title list AMLC dash Browse by Category. Windows Internet Explorer. Escape.>

{Sigh}. Well, we're in the right spot.

< Escape. Compatibility check box not checked.>

I seem to have gotten out of browse mode somehow.

<Tool bar refresh left parenth f5. Toolbar. Compatibility check box not checked. Escape.>

I'm in some kind of a menu system I don't like. I'm getting out of there by hitting escape. Using the h button I was expecting to go back to the headers.

And it's not.

<Escape. PC Curser>

How did I get out of my browse mode?

...I'm stuck in a tool bar.

Comprehension refers to the ability to understand the purpose of a DL function from its label and arrangement. We observed that participants had difficulty understanding DL functions that were either unfamiliar or did not accompany a description. For instance, they could not understand the utility of browsing category items, hyperlinks, and search result organization criteria due to improper labeling. The following illustrates the frustration of a participant for failing to understand the utility of an unlabeled decorative graphic.

<Link Abraham Lincoln. The Stern Collection. Blank. Link heading level 3 today in history. Heading level 3 July 18. Link graphic images slash underline icon.>

Those things, I hate those. They don't make any sense. It tells me it's a graphic, but it doesn't tell me what it is.

Reasoning refers to making sense of different structures within DLs based on logical thinking. Participants faced a help-seeking situation when they could not make sense of interface structures, browsing categories, and organization of search results in DLs. They could not logically understand structures as they could perceive only a small fraction of the content at a time provided by SR. The following illustrates such a situation, where a participant was navigating down a long list of browse categories, but could not understand them.

I very seldom use categories like this, because they're too slow. You have to read too much, and you don't know what their categories are, so then you have to go through a whole bunch of extraneous stuff ...It sounds to me like instead of broadening the collection, you could probably go up to that link where it says, "browse the entire collection" and maybe they'd give you basic categories instead of subcategories. That might be . . . I don't know.

#### 4 Discussion and Conclusion

This study has both theoretical and practical implications. Cognitive overload situations occurred when participants had to simultaneously process information from the DL, the browser and the SR. The confusion prevented from adopting the right course of action. This situation could be overcome by 1) announcement of keyboard focus location, 2) shortcut keys to exit out of the current cursor location, and 3) virtual integration of all into one. Comprehension situations were caused by improper labeling, which could be resolved if content and controls of a DL function include meaningful labels supplemented with descriptive instruction. Reasoning situations happened when participants could not make sense of structures of an interface, browsing categories, a page, a category or search results. One solution could be presenting a descriptive summary that explains the current location with respect to the overall structure. Another solution would be a virtual tactile surface that affords the feeling of a 3D model structure (Jeong, 2008).

This experiment is a pilot study for a large scale project, and its goal is to identify a comprehensive list of help-seeking situations at both the physical and cognitive levels with corresponding help mechanisms comprising a variety of explicit and implicit help features. We will experimentally validate the utility and usability of these help features using an application programming interface after incorporating them into existing DLs.

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## 6 Table of Tables

Table 1: Data collection and data analysis plan .....854