Accessibility and Usability of Social Media: Convergence between Blind Users and Design Standards

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ABSTRACT
About 300 million people with vision impairments face significant access and usability barriers in interacting with social networking sites (SNS) to communicate, collaborate and enhance professional relationships. These barriers primarily result from the visuo-centric design of Web 2.0 technologies. Literature recognizes that SNS interaction with assistive technologies is problematic, but does not clarify: Where, how and why blind users face SNS interaction challenges? This paper reports the findings of an exploratory field study to answer this question. Think-aloud observations and verbal protocol analysis was used for a contextually-situated and experiential understanding of blind SNS users’ accessibility and usability problems. Results illustrate the nature of problems, identify problematic design elements, and explain character of these problems. Findings have implications for research on blind empowerment, human-computer interactions, and improving SNS accessibility and usability for all users.

Keywords
Accessibility; Usability; Blind User; Social Networking Site; Verbal Protocol Analysis; Design Principles

INTRODUCTION
Social networking sites (SNS) offer a great platform to communicate, collaborate and socialize – personally and professionally (Wentz and Lazar, 2011). There are 2.3 billion registered users of the ten most popular SNS (Socialnomics, 2011). SNS is used all over the world, by all types of users for numerous reasons. Government agency such as Central Intelligence Agency and Environmental Protection Agency use SNS as a productivity tool (USA.gov, 2010). Merchants such as McDonalds, Whole Foods, BestBuy and Zappos use SNS to sell their merchandise (Huffington Post, 2012). It is reasonable to expect that SNS will remain a mainstay of future information society. However, the myriad benefits of social media that the sighted world continues to enjoy are not available to people who are blind. This is primarily because Web 2.0 technologies are sight-centered by design and present significant accessibility and usability barriers in non-visual interaction (NVI). This paper presents results from an exploratory field study to conceptualize and frame approaches to answer these poignant questions that, inadvertently albeit, exclude this user group from the benefits and advances of the information society.

The blind are a significant user group comprising 45 million totally blind and 285 million partially blind (World Health Organization, 2012). In this paper, a blind user is one who does not have the sight necessary to see information on the computer screen. This includes users with partial sight who interact with information technology non-visualy. They access SNS and other web sites by listening to content read aloud by screen reader (SR) software. They conceptualize Web interactions differently than sighted users. Extant literature recognizes that SR-mediated SNS interaction is inherently problematic (Wentz and Lazar, 2011; Buzzi, et al., 2010). These problems may be attributed to design errors such as complex layout due to seemingly necessary content integration, no logical partitioning mechanism, no table summary, no descriptive label for form element, and an overall reliance on visual verification of content and control (Buzzi, et al., 2010). However, extant literature does not explain how interaction problems hamper goal accomplishment for blind SNS users. Nor does it answer critical questions like: What is the nature of accessibility and usability problems blind users face in SNS interaction?; and What can we do about these problems?
The overall goal of this research is to develop accurate, in-depth, contextually-situated, experiential knowledge of blind users’ accessibility and usability problems in SNS interaction so that we can begin to develop design guidance to alleviate these problems, and ultimately develop current and emergent technologies that are accessible and usable for all users. Specifically, we attempt to understand where, how and why blind users face problems in performing SNS interaction tasks. The research design employed is an exploratory field study with blind participants performing common everyday social media tasks. We use verbal protocol analysis to identify the significant challenges that blind users face in performing typical SNS functions that are commonplace for the sighted user population. These include searching for people, sending friend requests, posting messages and planning meets or other social or professional events. By employing text analysis of accessibility and usability principles, we found blind users are challenged in SNS interaction due to design ‘errors’ or oversights in interface elements necessary to perform specific functions. Our results throw new light on blind users’ cognitions, perceptions and actions in SNS interactions. Our findings have implications for research in Human-Computer interaction, Social Computing, Web 2.0 Portals, and perhaps more importantly, they are necessary to empower blind users to equal, independent and effective participants in social media.

**LITERATURE REVIEW**

This section defines key terms and presents a brief review of literature. Importantly, we first provide working definitions of key terms used in this research that are grounded in literature to contextualize the reader.

**Accessibility and Usability**

Accessibility and usability are two related but distinct concepts. Accessibility allows users access to system functionality (Goodhue, 1986). For users with disabilities, accessibility is treated as a technical construct that allows assistive technologies the necessary access to interface elements (Leuthold et al., 2008). Usability refers to how well a system conforms to users’ conceptualization of performing a task using it (Goodwin, 1987). It is a cognitive construct that depends on the task. A system that is not accessible is not usable; however, an accessible system does not guarantee usability (Di Blas et al., 2004). Accessibility problems prevent access to system features and functionality. Usability problems prevent the use of these features and functionality to meet objectives. Therefore, systems accessibility and usability are necessary for a user to derive the intended utility of a system.

**Blind User**

Blind users lack the sight necessary to work on a computer visually. They rely on assistive technologies to interact with computers and the Internet. Screen reader (SR) is the most common assistive technology employed by blind computer users (Lazar, Allen, Kleinman, & Malarkey, 2007). SR identify and present content in web applications and other IT through a synthetic voice (Di Blas, Paolini, & Speroni, 2004). Jaws, WindowEyes, VoiceOver and NVDA are commonly used. JAWS ([www.freedomscientific.com](http://www.freedomscientific.com)) is the market-leading, comprehensive screen-reader for blind users.

Web interaction for the blind is a listening activity. They perceive information on a Web page as a continuous and sequential stream of audio. This rendition becomes distracting when negotiating interface elements repeated across pages such as menus or navigation bar. Often, blind users stop the screen reader from narrating the page (Babu, 2011). They jump links using the Tab Key, or explore the content row by row using Up or Down arrows (Buzzi, et al., 2010). When it arrives on a new Web page, the screen reader announces the number of key interface objects, such as links, images, and tables, described in the HTML code to contextualize the page structure (Babu, 2011). This interaction method is exacerbated with dynamic content and new technologies. They require additional cognitive effort for interpretation (Buzzi, et al., 2010), and the blind user risks developing inaccurate mental models for interaction without a ‘clear view’ of the system and contents.

**Blind users and SNS**

Very little research investigates the experiences of blind users in SNS or other social media (Kelly, Nevile, Draffan, and Fanou 2008; Wentz and Lazar, 2011; Buzzi, et al., 2010; Meiselwitz and Lazar, 2009; Pakdeechote &
Tandayya, 2011; Leahy, 2009). The multi-layer interface of social media presents navigation challenges (Wentz & Lazar, 2011). Dynamic pages where page sections update intermittently can be disconcerting to the extent that blind users tend to avoid using dynamic web sites (Hailpern, Reid, Boardman, & Annam, 2009; Bigham, Cavender, Brudvik, & Wobbrock, 2007). Pakdeechote et al (2012) found that many typical social media features such as searching, adding friends and posting and reading messages are sight-centered by design. They present accessibility and usability challenges for blind users. Giraud et al (2010) found that a simple social media task that took sighted users less than a minute took more than an hour for blind users (Giraud, Colombi, Russo and Therouanne, 2010). Craven and Brophy (2007) found that blind users took two and half times longer than sighted users to search for information on the Web. Importantly, Correanni et al. (2004) found that blind participants are half as likely to complete a Web interaction task as their sighted counterparts. The SNS functionality we refer to are integral components of online social networking. Without access to these core functionalities, social media offers little utility to a blind user.

Prior research (Babu, et al., 2010) developed a cognitive, user-centered, task-oriented approach to understand user interactions on web sites. The task-orientation examined the tasks and goals of blind users in interacting with a Web site. It provided a contextually-situated understanding of their accessibility and usability problems in deriving the utility of the Web site. The user-centeredness focused on examining the needs, abilities, and challenges of blind users in Web interactions. It provided experiential understanding of their accessibility and usability problems in performing the Web interaction task. The cognitive approach focused on examining the thoughts, perceptions and actions of blind users in Web interactions. It provided an in-depth understanding of how they observed accessibility and usability problems in performing the Web interaction task. In this paper, we adopt a similar approach to develop accurate, in-depth, contextually-situated, experiential knowledge of blind users’ accessibility and usability problems in social media interactions.

RESEARCH DESIGN

Here we present the results of an exploratory field study that intends to develop an in-depth, contextually-situated and experiential understanding of accessibility and usability problems blind users face in the effective use of SNS. We employed verbal protocol analysis to collect and analyze qualitative data on blind users’ interactions. We recruited five blind participants with the cooperation of organizations serving the blind. This sample size is appropriate for qualitative studies such as ours. As a representative context for social media use, we identified a typical SNS interaction task using Facebook’s standard website. We developed an observation study protocol to collect verbal reports of participants as they performed the task through think-aloud observations.

One of the first and simplest tasks that SNS users performs is to search for friends to interact with and process the search results. This task is accomplished through a search query on Facebook. The search query comprises three steps: locating the social media search field; typing appropriate search term(s) in the right place; and activating the search button. The search field is one of two search fields on the account home page; the first being the “Web Search” field. Appropriate terms to search for Facebook users include full name and email. The search button immediately precedes the search field. Successfully executing the search query generates a list of results. Each result consists of a link to the profile page of a user with matching name, and an “Add” button.

We analyzed verbal reports collected while blind users performed this task, using an integrated problem-solving framework to identify participants’ interaction challenges and existing Web accessibility and usability principles. We used concurrent verbal protocol analysis (VPA) to collect and analyze contextually-rich qualitative evidence of blind users’ social media interaction experiences. In this technique, participants work on a task and concurrently verbalize whatever they are thinking (Ericsson & Simon, 1984; Todd & Benbasat, 1987). Concurrent verbal reports contain evidence of information processing for the task being performed (Ericsson & Simon, 1984). This technique is suitable for in-depth examination of user-system interaction (Todd and Benbasat, 1987) and evaluates systems usability effectively (Cotton and Gresty, 2006). It entails think-aloud observations where participant verbalizations are captured in audio recordings. The audio recordings are transcribed and decomposed into segments. Each segment is categorized using a coding scheme (Ericsson and Simon, 1984). We adapted VPA and our coding scheme to develop contextually-situated experiential understanding of blind social media users’ accessibility and usability problems.

The observation study protocol included documentation to describe the research objective, explained the think-aloud method, instructed to practice thinking aloud for an online task, and instructed to log on to Facebook account and
complete the social networking task with concurrent verbalization. The Study laptop was equipped with three screen-readers—Jaws, NVDA, and SA2Go—and connected to the Internet. It contained the observation study protocol. The Recording laptop was equipped with the Real Gold audio-recording software.

We conducted the study in Summer 2012. The study included a familiarization session where we described our research objective to participants, explained the think-aloud technique and answered questions to ensure they understood the methodology. Each participant reviewed the observation study protocol document and practiced thinking aloud while performing the online task described in the protocol. They then logged on to their Facebook account and completed the social networking task while thinking out-aloud.

We recorded participants’ verbal protocols in the Recording laptop and transcribed verbal protocols, including participant verbalizations, participant-investigator conversation and screen-reader audio. We performed verbal protocol analysis on the transcripts and decomposed each participant’s transcript into individual segments to capture and represent single units of thought. We identified segments that represent social media interaction problems that hampered a participant’s ability to perform a task or sub-task effectively.

As analytical units relevant to the identification of accessibility and usability issues, we identified elements of dissonance and failure. Problems where the situation was not comprehensible to the participant due to inadequate system feedback were identified and labeled ‘Dissonance’. Problems corresponding to a situation where things did not work for the participant; an action did not yield expected outcome were labeled ‘Failure’. These analytical units were used to develop a contextually-situated, experiential understanding of blind users’ interaction problems in social media.

After identifying all instances of the dissonance and failure analytical units, we performed text analysis of WCAG (W3C Web Content Accessibility Guidelines) success criteria and usability principles/heuristics to determine the accessibility and usability character of the dissonance or a failure. To do this, we retraced each participant’s social media interaction paths to identify the design elements associated with the dissonance or failure. We mapped problematic design elements and the accessibility and/ or usability criteria that they violated. Together, the verbal protocol analysis and the text analysis provided a user-centered understanding of accessibility and usability problems – in terms of both the challenges it presents for users and the design issues and problems that are responsible. We employed this methodology to gather and analyze our data. The following section presents and discusses our results.

RESULTS AND DISCUSSION

Our analysis shows that a task that most sighted users take for granted and have come to consider simple, proved problematic and was perceived as vexing for blind participants. These difficulties were linked to several design ‘errors’ in the task environments of Facebook that challenged the ability of blind social media users to accomplish the objectives of the task. We call these problematic controls and content presentation design ‘errors’ since they presented dissonance or resulted in failure for the blind user. So, for the blind user, these design controls did not accomplish their purpose – hence, they were in ‘error’. Each design error represents violation of extant accessibility and usability principles based on the W3C Web Content Accessibility Guidelines. Based on normative design principles, we suggest design improvements to the task to alleviate blind users’ interaction challenges, and facilitate their effective participation in online social networking. In the following, we describe and discuss the results of our analysis.

Difficulty Searching for People

Our analysis shows that blind users face difficulty searching for people on a social networking site. Their problems include confusion about relevant search field, ambiguity about appropriate search term, and inability to understand reason for failure. We present evidence of this multi-faceted problem using verbal reports of a blind participant’s SNS interaction. This evidence comprises participant utterances and SNS responses. The SNS responses include screen-reader announcements (enclosed in angular brackets) and system-generated non-verbal sounds (enclosed in square brackets). In order to help the reader better appreciate the problem, we indicate participant pauses (reflecting additional information processing and cognitive effort) and screen-reader silences (representing lack of system feedback). We first present evidence of the confusion about relevant search field. The scenario is the participant has logged on to her Facebook account and intends to search for one of the author’s Facebook profile.
I am on my facebook page. I want to search for you. I go to the top of the page by pressing Control Home.

I am going to the edit field by pressing E.

I am going to try searching you by your name. I type in your name.

I am going to try searching you by your name. I type in your name. <John Doe >

Press Tab

It takes me to Search Button. Press Enter.

It says “Search Editable Text Blank”. That means it took me back to the Edit Field. I am going to the top of the page by pressing Control Home.

That indicates that we are on the facebook search results. Now I am going to try pressing n to go to next text. Hopefully it takes me to the results.

I don’t think that’s the one. So I’m going to press Down Arrow to see another result.

Pressing Down Arrow to see if I can find matching names.

I am going to click one other link that I see here that would possibly help. I am going to press Up Arrow till I get “Show All Results”.

“All Results”. I press Enter on it.

I press Control Home to go to the top of the page.

I press N to see if I can find something here.

I am going back to my home.

The name that I entered did not come up. So I am going to try pressing E.

But we tried that already, and it didn’t work. I am going to press E one more time. Hopefully, that will take me to another edit box where I can enter information into.

I think this is where I enter stuff. I don’t know.

Figure 1. Evidence of Search Difficulties from Verbal Protocols

The evidence in figure 1 captures the participant’s confusion about which search field to use to find a friend. The evidence indicates that the home page contained at least two search fields -- one for a regular Web search and another for specific search in social media. As the participant browsed down this page from the top left corner, she...
first came across the Web search field and could not “see” that there was another search field, due to the sequential nature of non-visual interaction. The Web search field lacked a descriptive caption to communicate its purpose. Consequently, the participant assumed that web search was the relevant search field and was baffled by the failure to obtain relevant search results.

In figure 2, we present evidence of ambiguity about appropriate search term. The scenario is the participant has located the relevant search field, and is about to type in the search term to find the author.

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<Enter email or name. Editable text>
This edit box is where I think I can enter the name of the result. It read “Enter name or email”. This is a different edit box. I am going to type the name again.

<John Doe> Press Enter

And it took me back to “Editable Text”. So I am going to see if this works. Hopefully it will work. I am going to press control home again to go to the top of the page.

<Facebook search. Start of page>
I am going to press N again to see if I am at the right place

<Can’t find what you are looking for? Search for people by email. Editable text>
Okay that’s not it. So I keep pressing down arrow

<Facebook. Start of page>
Now I am going to press E again.

And it takes me to the search box. I am going to the other search box by pressing E again.
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Figure 2. Evidence of Search Difficulties from Verbal Protocols
query did not yield any result for either term; she consistently heard the message “no results found for …”. The participant suspected she may have made a typo and tried to rectify this unknown error. She could not tell what search terms could possibly generate the desired result.

Figure 3 presents evidence of inability to understand the reason for a failed search. The scenario is the participant tried to search the author by name and by email without luck; the search query did not yield any result. She is about to give it one more try.

As the evidence in figure 3 shows, the search query using email did not yield any result. Nor did the participant receive any explanation as to why the query failed. She just heard the message “Check your spelling or try another term.” However, the participant had spelt the name and the email correctly and was appropriately baffled by the failure.

In summary, blind users face problems searching on the current design for social media. Problems include confusion about which search field to use, ambiguity about what search term is appropriate and an inability to tell why a search query failed. These problems correspond to three design errors: improper labeling of the Web search, lack of clarity about appropriate search term, and incomprehensible explanations for a failed search query. According to the Web Content Accessibility Guidelines, these design errors represent accessibility and usability problems. The improper labeling of the Web search field represents violation of the WCAG Success Criteria that requires the field to have a descriptive label conveying its purpose to a screen-reader user. The lack of clarity about appropriate search term represents a violation of two relevant WCAG success Criteria which require the search field to be accompanied by clear instruction to guide users on what search terms to use and how to avoid making mistakes in searching for people. WCAG criteria require that blind users have access to context-sensitive help instructing how to perform an SNS search effectively in a manner that does not distract them from the search task. The explanations provide represents a violation of Success Criteria that require the system to generate a text message explaining the exact nature of the error on activating the Search button. In addition, WCAG requires that this text message include suggestion on how to rectify the error.

Blind users’ evidenced problems in searching for people on social media can be reduced if the design provided (1) a descriptive label for the Web search field that explicitly conveys its purpose to the user; (2) instruction accompanying the SNS search field that clearly identifies appropriate search terms and common mistakes in searching for people; (3) context-sensitive help that describes the process of effective SNS search; (4) complete, accurate and continuous feedback about SNS response to a search query; and (5) text message describing an error, and suggestions to rectify it following a failed search query. Our on-going research examines the feasibility of this claim through interviews with web developers first and then the development of a prototype system to validate this.
CONCLUSION

Social networking sites are indispensable in the modern information society. Social media offer a valuable tool to communicate, collaborate, and enhance professional relationships. Effective use of social media is needed for education, profession, commerce, recreation and socialization. As the ubiquity of social media is set to rise in future, it is critical to examine and ensure their accessibility and usability to avoid the marginalization of users with different abilities. This paper reported the findings of our research on blind Facebook users. We investigated the question: What is the nature of accessibility and usability problems blind users face in performing common social networking tasks? We adopted a cognitive, user-centered and task-oriented approach (Babu, et al., 2010) to develop an accurate, in-depth, contextually-situated and experiential understanding of the problem. The context of investigation demonstrated an exemplar social networking task to illustrate the nature of problems, why users face them and what we can do about it. The exemplar shows that blind users cannot search for people effectively on Facebook. Specifically, they cannot tell which search field to use, what search terms would be appropriate, and why a search query failed. These three challenges correspond to three design errors -- improper labeling of the Web search field, lack of clarity about appropriate search term, and random explanation for a failed search query. Problem searching for Facebook users could potentially reduce with following design modifications: Clearly labeled Web search field to distinguish it from the search field; information about appropriate search terms and common mistakes in conducting search; context-sensitive help on effectively performing search with a screen-reader; complete, accurate and continuous feedback for SNS response to search query; and text message explaining why a search query failed, and suggested remedial measures. These suggested design improvements may be evaluated are under evaluation through an experimental design in our future work. We believe these design improvements are simple and straightforward if we have a good understanding of the problem from blind user’s perspective.

REFERENCES


