Making Sense: Socio-awareness and Assistive Technology

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# Abstract

In this study, we explore how people who are blind experience communication and awareness in public settings.  We aim to find implications for the design of a technology-based aid. In order to uncover vital information regarding the pre-design of a new assistive technology, we first sought out to understand how people who are blind currently use assistive technology. We also gathered information regarding how people who are blind communicate and stay aware within public settings. We conducted interviews, surveys, and observations to gain insight into the socio-environmental awareness of people who are blind. In this paper we discuss our methods, findings, and implications for further research.

# Author Keywords

# Communication; Awareness, Assistive Technology; Haptic Feedback; Blindness; Accessibility

# ACM Classification Keywords

K.4.2. [Computers and Society]: Social Issues – Assistive Technologies for Persons with Disabilities.

# General Terms

# Design; Human Factors

Introduction

**Introduction**

It is estimated that there are over 6.5 million people in the United States who experience vision loss [2], and approximately 1.3 million people in the U.S. are legally blind [8]. People who are blind or who have low vision must rely on their non-visual senses for navigation. While people can be trained to utilize their hearing to heighten spatial awareness [6], people who are blind may also use guide dogs or white canes to navigate through their surroundings. There has been much research aimed at creating technology-centric solutions for potentially providing an alternative to the white cane or guide dog [4,1,3]. While research into technology-based navigational concerns are laudable, we believe that the issue of social awareness has been overlooked; i.e. the importance of knowing who is around you has not been deeply explored. We believe that an enhanced perception of a social environment may give way to a variety of benefits for those with blindness or low vision.

While our current research was initially concerned with developing an assistive technology to aid navigation, we realized that much of the navigation-based technology in this field may be applicable to areas that extend beyond physical navigation. We redirected our focus to an issue that is perhaps less obvious, but possibly just as important as independent navigation: socio-environmental awareness. Although people who are blind interpret their surroundings through other senses, they are apt to miss out on a wealth of information communicated via non-verbal cues. For instance, eye contact can often be utilized as a way to let a person know that you are paying attention or desire to initiate conversation. In another example, a person could look down at their watch to signify that it is time to start wrapping up a current conversation [8]. Facial expressions and body language also provide information that is valuable to social settings. It is reported that less than 35% of social meaning is carried through verbal components within a social situation, while 65% is carried in nonverbal channels [7].

We believe that there is overlap between navigation-centric technology and socio-environmental awareness solutions. One piece of navigation-centric technology that may have alternative applications in socio-environmental awareness is the RoboGuideDog system.  This system utilizes a laser range device which gathers information about the surrounding environment and relays this information in an intuitive way to the user via speech and haptic feedback [4]. Similar technology could be used for interpreting movement within an environment, specifically human movement, and relaying the presence of other people in a given area.

There have been efforts to create technology capable of providing vibrotactile feedback based on sensing other people in a social environment. For example, Krishna and colleagues [10], utilized computer-based vision in conjunction with a vibrotactile belt in order to provide a new medium for a user to perceive the general location and distance of others within a user’s proximity. However, Krishna and colleagues’ device has multiple areas for improvement. Their device is limited to sensing only one other person who is in the user’s proximity. Also, the device requires a wired connection to a PC, limiting the user’s mobility.   Furthermore, the idea that mental maps can be created through various technologies (be it sonar, laser, or GPS) is proven to be valid for supplementing non-visual navigation as a compensatory sensorial channel for navigation [9]. However, this same technology has yet to receive proper attention regarding how it can be applied to social awareness - an area that is filled with opportunities for accessibility design solutions.

# In this study, we explored the social awareness of people who are blind within public settings. Specifically, we looked to gain insight into how people who are blind initiate conversation with others and “navigate” through social environments. While analyzing these findings, we considered the potential extraordinary capabilities of people who are blind, such as being able to understand ultra-fast speech at a rate of up to 25 syllables per second [5]. We also gathered information regarding current use of assistive technology relating to social-environmental perception. In the following sections, we present our methods, results and discussion.

#

# Methods

*Participants*

We recruited 12 people with low vision or blindness through contacting organizations for the blind, social networking, and the “snowball” method.

*Procedures:* Interviews

We interviewed our participants over the phone and through email. [CP4] The phone interviews were audio recorded. Our interview questions were based on awareness and communication and were organized in a conversational manner. The first section of the interview contained questions regarding communication, such as, where live communication usually takes place, how often live communication occurs, and whether or not assistive technology is used to assist in these processes. The second section of the interview contained questions regarding awareness, such as, how our participants sense when people are in close proximity, what methods people use to know when another person enters a room, whether engaging activities such as listening to music or books affects awareness, and if assistive technology is used to assist in these processes.

After the interviews were transcribed, we inductively coded the interviews for common and salient themes using the Saturate web application. We then grouped the codes in order to construct categories. We utilized the information gathered from the interviews to guide the development of survey questions.

*Procedures:* Surveys

We constructed an eighteen-question survey. The survey was broken up into three sections. The first section contained questions regarding communication, such as, how often verbal communication occurs within their home, how frequently technologically-aided communication occurs, tendency and methods for initiating conversations, and satisfaction of current methods of initiating conversation. The second section contained questions regarding social awareness, such as, methods for discovering other individuals within the same room, feelings towards being in close proximity to strangers, and how current use of AT affects socio-environmental awareness. Lastly, we collected demographic information about each participant, such as level of vision impairment, types of assistive technology used, satisfaction of those devices, mobile operating system, age, employment status, and length of assistive technology use. The survey was administered through Google Forms and was sent to participants via email. We took advantage of Google’s built in survey response summary in order to gain further insight into our responses.

*Procedures: Direct Observation*

Three direct observations were performed, each lasting between 20-30 minutes. We observed how people with low vision navigate through a coffee shop. The participants were simply asked to follow their normal routine in ordering and consuming their beverage. We used the AEIOU framework to track and record our observations. We then collaboratively sorted our comments into homogenous groups via the Stormboard web application.

# Results

*Interviews*

We interviewed a total of three people. After qualitatively analyzing the data, we discovered four overarching themes.

*Finding #1: Awkward Silence*

It was strongly preferred to avoid silence when in close proximity to a stranger. Individuals with low vision would much rather the stranger either initiate a conversation or remove themselves from the general area. Our participants reported that an uncertainty of who is in close proximity, coupled with silence, makes for an uncomfortable situation.

*Finding #2: Enhanced non-visual awareness*

Interviewees explained their methods of sensing others in their environment. This overarching theme emerged due to the variety of methods that our interviewees described to be useful. It was common that our participants utilized the sound of environmental features to stay aware of their surroundings such as verbal communication of others, automobiles, doors, foot steps on a hardwood floor, or the sound of pets reacting to visitors. However, sound was not the only method of staying aware. Our participants noted that they can smell certain people or feel their body heat when they are in close proximity. One participant in particular (P2), noted that she can feel the “vibe” of a person in close proximity, even if she cannot hear them. She said “It’s like that feeling you get when you just know someone is behind you, you can just feel that person...it is like that on all sides.”

*Finding #3: Difficult to approach*

All interviewees mentioned that they felt that the reason many sighted individuals hesitate to initiate a conversation with them is due to a lack of commonality which to base a conversation.

*Finding #4: Strong inclination towards information and communications technology (ICT)*

Unanimously, interviewees claimed to frequently use texting, e-mail, social networks such as Facebook, Twitter and other ICTs. It was also noted that it may be useful if future assistive technologies incorporated social media to some extent.

*Surveys*

We received a total of six survey results. Admittedly, this is a low number of participants - but we feel that we were still able to some gain valuable insight from the responses. We pulled two main findings from our surveys.

*Finding #5: Feelings towards being in the same room as a stranger*

Fifty percent of participants mentioned a feeling of indifference towards being in the same room as a stranger, as long as they know that they are there. The other fifty percent described themselves to feel guarded, nervous, and overwhelmed when they do not know who is in close proximity to them.

*Finding #6: Current and preferred socio-awareness detection methods*

All survey participants stated that they currently form a mental map of who is around them via noise / speech. It was found that five of six participants rely on hearing alone to know who is occupying the same room as them. Furthermore, four of six participants noted that their current use of assistive technology does not help increase their awareness of people in their environment

*Direct Observations*

We identified two cardinal findings based on our observational data.

*Finding #7: Possible difficulty socializing*

In most cases, after placing the order, the participant was somehow instructed or prompted by the barista that their drink will be available at X side of the counter. This task-driven process looked to be quite simple for our participants to complete. However, non-task-oriented interactions, such as acknowledging or socializing with others seemed scarce compared to our own expectations. Further research into the implications of this finding may be warranted as our expectations for how socialization should occur in this type of public space may be biased.

*Finding #8: Tight-knit movement challenges*

From standing in line and moving in small increments towards the cashier, to moving towards the area designated for picking up your drink, all three participants seemed to exhibited challenges in tight-knit movement.  It was noted that the participants appeared to mostly respond to the cashier’s speech - “Next” or “How may I help you?” - to determine whether or not the line was moving. This phenomenon seemed to be dependent on the amount of people in line at the shops. There were two instances where people in line informed the participant when it was time to move in line, but this type of instruction was not made available in one instance.

# Discussion

Despite a relatively small sample size of 12 participants, we believe our research serves as a valuable stepping-stone for future research. We collected rich data through a variety of mediums. We were able to use this data to construct thematic conclusions that warrant further research into this field of study. In the future, we would like to expand on these research topics with a larger sample size.

*Theme #1: Interaction type*

Drawing upon the data in findings #1 & #5, we believe that the sometimes-troublesome process of socializing with strangers in a public atmosphere stems from two issues. The first issue is that blind-to-sighted first-time interactions sometimes lack a non-task driven common ground (as mentioned by all interviewees in finding #3). We make this distinction between task driven interactions and non-task driven interactions because the former (such as in finding #8, where other people standing in line at the coffee shop would inform the participant when it was time to move forward) may stem from a feeling of obligation rather than desire.

*Theme #2: Lack of visual social cues and the social gap*

Natural, free-flowing social interaction is quite different than the aforementioned task driven interactions. For example, sighted individuals may initiate a conversation with strangers based on environmental surroundings. People with low vision lack the ability to leverage visual environmental aspects as a utility to socially connect with others. The interviewees mentioned on several occasions that, if the stranger at least knew their first name and could address them directly, this social barrier might be different. As finding #7 suggests, the second issue in initiating a social interaction is the inability to pick up on non-verbal cues, such as making eye contact or waving your hand – this was an issue we observed during all three direct observations. Our findings shed light upon the social gap between the people who are sighted and people with low vision.

Finding #2 describes the various adaptations that occur in order to compensate for a visual impairment). Rather than focusing on a *limitation-based* design solution, we believe that the extraordinary adaptations of people with low vision warrant an *ability-based* design methodology. We believe that the findings of our study warrant future research within this subject. Furthermore, we postulate that the data gathered in this study highlights potential room for technological innovation, specifically, an ICT-based socio-environmental awareness solution.

**References**

1. Akita, J., komatsu, T., Ito, K., Ono, T., & Okamoto, M. *CyARM: Haptic Sensing Device for Spatial Localization on Basis of Exploration by Arms.* Advances in Human-C. (2009), 24-81.

2. *Blindness Statistics*. (2014, August 6). Retrieved November 8, 2014. https://nfb.org/blindness-statistics. (2014).

3. Cardin, S., Thalmann, D., & Vexo, F. *"Wearable Obstacle Detection System for Visually Impaired People"*, VR Workshop on Haptic and Tactile Perception of Deformable Object. (2009).

4. Gomez, J. V., & Sandnes, F. E. *RoboGuideDog: Guiding Blind users Through Physical Environments with Laser Range Scanners*. Procedia Computer Science, 14, (2012), 218-225.

5. Hertrich, I., Dietrich, S., Moos, A., Trouvain, J., & Ackermann, H. *Enhanced speech perception capabilities in a blind listener are associated with activation of fusiform gyrus and primary visual cortex*. Neurocase (Psychology Press), 15(2), (2009), 163-170. doi:10.1080/13554790802709054

6. Kish, D. FlashSonar: *Understanding and Applying Sonar Imaging to Mobility*. Retrieved November 9, 2014. https://nfb.org/images/nfb/publications/fr/fr30/1/fr300107.htm. (2011), 50-75.

7. Knapp, M.: *Nonverbal communication in human interaction*. Holt Rinehart and Winston Fort Worth (1992).

8. Krishna, S., Colbry, D., Black, J., Balasubramanian, V., & Panchanathan, S. *A Systematic Requirements Analysis and Development of an Assistive Device to Enhance the Social Interaction of People Who are Blind or Visually Impaired.* Workshop on Computer Vision Applications for the Visually Impaired. (2008), 43-72.

9. Lahav, O., & Mioduser, D. *Haptic-feedback support for cognitive mapping of unknown spaces by people who are blind*. International Journal of Human-Computer Studies, 66, 1, (2008), 23-35.[CP7]

10. McDaniel, T., Krishna, S., Balasubramanian, V., Colbry, D., & Panchanathan, S. *Using a haptic belt to convey non-verbal communication cues during social interactions to individuals who are blind*. (2008), 13-18.