

An exploratory study of people with vision impairments adjusting to new environments

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ABSTRACT

For people who are blind or visually impaired, adjusting to a new physical environment can be a difficult but important step towards living independently. In this project, we investigated how a small sample of people who are blind perceived physical surroundings and common obstacles they encounter. We used a multi-methods approach which included a literature review of related work and interviews with four people that had visual impairments. Major findings include: 1) how people with visual impairments define a “new environment”; 2) how they rely on their hearing; 3) the source of difficulty in setting up the space; 4) causes of different levels of self-recognition; 5) available assistive techniques for their daily life; and 6) wrong assumption from average people. We believe that insights presented in this paper will be helpful to the design of future products aimed at people who are visually impaired.

Author Keywords

Vision impairment, universal design, new adjustments

ACM Classification Keywords

Design, Human Factors, Theory

INTRODUCTION

In the United States, there are approximately 10 million blind and visually impaired people [1]. Among the 10 million people, 1.3 million people are legally blind. People who are blind are underemployed; it is estimated that only 55.3% of working age adults are employed. Additionally, more than three million people have low vision and

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approximately 12 million people have some form of vision impairment that cannot be corrected by glasses [2]. Research intended to make the Internet, computer use and computer games accessible for people who are blind or visually impaired are aimed at improving the quality of their lives. However, there is very little literature investigating how people who are blind navigate novel physical spaces.

Our project is an exploratory investigation which was meant to inform the ideation of technology which could help people who are blind or visually impaired adjust to a new physical environment independently. Specifically, we performed the study to get a better understanding of (1) how people with limited vision perceive the surroundings, (2) obstacles they encounter when accomplishing their everyday tasks, (3) difficulties they might have in their work, and (4) current assistive techniques they use.

Literature review and background

Our literature review included some psychological research, various research methods and current technology related with our research topic. We tried to understand what the psychological phrase they have been through and how the society wrongfully made assumption from time to time that formed this malfunction relationship between average people and the blind society. These prejudice and misunderstanding from society affected the self-esteem and self-identity of people who are visually impaired [3]. They are more eager to prove their ability of living independently than admitting they might need different source of help or rehabilitation from others during different physical or psychological stages [4]. Therefore, it is essential to provide an encouraging environment for people with visual impairments.

Several research have been conducted to figure out how people with visual impairments perceive the world, how to illumine the potential of using other senses and the possibility of applying technology to more efficiently help users adapting their lives. One of the researches that came to front is that, by providing physiological and biologic bases, it is possible to developing a virtual reality system that is applicable for people with visual impairment to

perceive and interpret visual information from real environments [5]. Using virtual reality is an applicable method to aid people who are visually impaired to form a cognitive mapping system that helps them navigate in an unknown space [6, 9]. The concept of applying virtual reality has also been approved to be an efficient and effective application in a virtual training system [6, 7, 8]. The common place in those systems is that they all replace the visual stimuli with auditory channels and they provided interaction between users and system.

METHODS

Participants

We interviewed four participants who have vision impairments. Participants were recruited through the Anixter Center, a non-profit organization that helps people with disabilities in Chicago, Illinois. All participants were male and between 35~65 years old. All participants currently all work in the packaging business for Anixter Center. Table 1 gives out the detail information of our four participants.

Participants	visual status	Other disabilities	Working type	Age range
Participant 1	Low vision	n/a	packaging	35 - 45
Participant 2	Low vision	n/a	packaging	55 - 65
Participant 3	legally blind	hearing lost	packaging	45 - 55
Participant 4	low vision	cognitive impairment and motor impairment	n/a	55- 65

Table 1: the situation of our participants

Procedures

Interviews were conducted in the Literacy Library, on the 3rd floor of Anixter Center located on 2032 N Clybourn Ave, Chicago, IL 60614. Our interviews took about 30-40 minutes. The interviews began by providing the participants with informed consent (which had to be read aloud) and acquiring verbal permission to audio record the sessions. We got assistance from an Anixter center employee (the participant's supervisor) for the informed consent process: first, the supervisor wrote the printed name of the participant and then placed her initials. Second, the supervisor guided the participants hand to the signature line; all the participants were then able to sign the forms.

After an icebreaker ("Tell us about yourself.") we asked about their daily routines. This was followed by a question about what they find difficult in their daily routines. Next, we asked several questions about their work and whether they think their work is difficult for them. Finally, we asked their thoughts about the possibility of using 3D sound

stimulation to help them navigate and explore new environment.

We coded the response from the audio recording and used a shared word document to input our findings after the interview sessions. We concluded the results into several major topics, and started to interpret the results that helped us to finalize our recommendations.

RESULTS

We gained the following results from our literature review and interviews.

Definition of "new environment"

The definition of "new environment" also applies to a familiar space but with different layout. When we asked the participants how they define a new environment, we found that the same space with a different layout inside would also mean new environment to them. For example, even they had been in tone room for plenty of times, this room with a different layout of furniture would still mean "new environment" to them.

Differentiation of Sounds

People who are visually impaired get sense of surroundings by the direction and the meanings of the sounds they define through their experience. They are "trained" to understand how every sound represents. However, it is still hard to distinguish sounds under complex environment (e.g. windy day waiting for subway), or tell the difference between the sounds that are similar to each other (e.g. bus and truck).

Difficulty with setting up spaces

Our participant addressed that the most challenging part for him is to set up the space at first place. The participant described that setting up an environment was hard and time consuming. Due to his disability, in order to familiarize with the environment, he needed to set himself a starting point at the beginning and navigate through the environment by touching the objects one at a time. When arranging his furniture, he needed to memorize where everything was and where everything is going to be.

Different levels of self-esteem

Participants demonstrated a range of attitudes toward assistive technology. While two of them agreed assistive technology would largely assist them in their daily lives, one participant thought he could accomplish everyday tasks independently without the help of other people or technology. This participant used to work in a hospital before his vision aggressively deteriorated. He can still sense some shape and shadow of objects nowadays, which gives him confidence of living independently and believing in his own capability.

Usage of available technology

One participant use regular cell phone without accessibility mode. He sets different ring-tones for the incoming calls from different contacts and makes use of the speed dialing function in the cell phone to make phone calls. Although he could not be able to take advantage of other featured services a cell phone could provide, he figured out a way of making phone calls and answering calls.

Wrong assumption from average people

Average people either are unfamiliar with or tend to underestimate the capabilities of people with vision impairments. The unfamiliarity or prejudice makes them assume that people with vision impairment are not capable of living independently. From our interviews, participants proved that, with substitution of other sensory, they can perform daily tasks just like most people do but in different ways of doing them.

Limitation of daily activities

Due to the limitation of assistance they can obtain, our participants have very limited daily activities. All of their activities are limited to home or Anixter Center. They depend on the pick-up service provided by CTA or the bus which transports between their home and Anixter Center. They rarely have chances traveling to other places.

Limitation of assistive technology

The current available assistive technology designed for people with vision impairments adjusting to new physical environments are very limited or unaffordable. Therefore, organizations provide several training services to help people with visual impairments to take care of them or to work. Those services include providing guide dogs on the street, providing mobility teachers who use vocal instructions to train participant navigate their way to work by public transportation during a two or three weeks period, and providing job coaches to help participants master skills that apply to their work.

DISCUSSION

The result might be helpful. However, it might be more beneficial for new adjustment because for those who already lost their sights for a long time or for those who already established their daily routine, it would be harder to break their daily pattern and explore other place by using this design.

During our interviews, there were three major issue we encountered, 1) participants spoke too fast for us to understand, 2) participants lisped while speaking due to his lost of hearing and 3) one of the participants seemed mentally challenged and had obvious change of his emotion. Therefore, we repeated everything they said to confirm that we understood the information they were providing. Unfortunately, for the one that seemed mentally challenged and upset, we ended the interview earlier than designated time.

Interpretation of results

Redefinition of “new environment”

Before we start designing things for people with vision impairments, we need to rethink whether there is another definition for them on the same issue. We need to exclude the impact of vision when we retreat the surroundings. For average people, we see the surroundings in macroscopic way. We define a new environment depending on whether the geometric location of a space has been changed. We do not worry about what is happening in this space. However, for people who are visually impaired, every single change within the space will cause a sense of unfamiliarity about the environment and the space would be defined as a “new environment” to them. Therefore, we need to take into consideration of what a new environment means to people with vision impairments

Difficulty with setting up spaces

Unlike average people who interpret the surroundings from references to a point, people with visual impairments start from a point to its reference in order to get an idea of the surroundings. That is the reason why they have challenge setting up the environment. When they want to move a subject in an environment, they need information of other subjects to be taken as reference. If they need to relocate multiple subjects, they have to memorize multiple locations of each subject they have already moved, which makes this process extremely complicated for them.

Differentiation of Sounds

At the beginning stage of adjusting, people with visually impairments still have difficulty in differentiating similar sounds. They can tell the direction of where the sound came from, but they might still get confused with sounds having close frequency. They might be more sensitive to the sounds as we thought, but we should not over-rely on their capability of hearing.

Wrong assumptions and self-recognition

Self-recognition was formed from our experience and the reflections from others in the society. From Shinazi’s paper, he described the wrongful assumptions that average people made lead to the malfunction relationship between average people and blind society [4]. Due to the problems in orientation & mobility, problems in social contact, problems in conversation, blind-isms, and psychological problems [3], people with visual impairments have different levels of self-recognition to reflect what they’ve perceived from the society.

Replacement stimuli

While average people assume some tasks could not be accomplished without the help of vision, people with visual impairments usually use other sensory to replace visual stimuli. They gain information through audio or haptic channels. So they are able to use the regular cell phone to

make phone calls or answering incoming calls in their own ways.

Limitation of activity with limited assistive technology

Because of the limitation of available assistive techniques provided to people with visual impairments, extra human resources (mobility trainer, job coaches and etc.) are required to help visually impaired people go through the new adjustment procedure. Those human resources are not always available if people with visual impairments require more flexibility in activity. So their daily routines are limited to a certain types of activities.

Recommendations

Based on our insights derived from results, we concluded several recommendations which will be helpful to the design of future products aimed at people who are visually impaired.

Stimuli replacement

The design of future products for people with vision impairments could make advantage of other stimulus including auditory and haptic channels to replace visual stimuli. Adding audio and tactile stimulus in virtual reality could be an option to give users 3D simulation of their surroundings[.

Use sound properly

When we use sound as stimuli for people with visual impairment, we need to more rely on the directional feature of sound to guide them not the frequency feature. The direction of sound will be helpful for people to compose the spatial concept of the surroundings.

Training system

We recommend integrating the techniques above in a training system which will save the expenses on human resources. A training system will also provide a safe and comfort learning environment for people with vision impairments adjusting new environments more efficiently and effectively [7].

Future work

Our research was based on a small sample of our target population. In future, it will be good to get more participants with variety of background. So we could get a more comprehensive understanding of the needs of our target population.

For further exploration, research can be done focusing on 1) the possibility of recognizing items and providing verbal

descriptions for the users (e.g. A truck in approaching with the speed of 20 mi/hr from your right side.); 2) the strategy for organization to adopt that makes the design more affordable to the designated groups (e.g. rental service); and 3) the technology that can ensure the accuracy.

ACKNOWLEDGMENTS

We thank the staff and participants in Anixter Center that helped us conduct our study and all the professional researchers who wrote and provide academic insights that related to our topic. Finally, special thanks to our instructor Dr. Cynthia Putnam from DePaul University, who tirelessly gave us comments and advice that guided us through this study.

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