Various Sociodemographic Factors and User Privacy Awareness

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Abstract

As technology advances, many people with visual disabilities take advantage of emerging technologies (e.g., Seeing AI, TapTapSee, and BeMyEyes apps) to gain better access to information. Yet, there is a likelihood that those with visual disabilities are vulnerable to privacy threats as they are less likely to adequately read visual cues and software notifications that are designed to help users to protect themselves and their data from privacy invasion. Unfortunately, little is known about how they perceive privacy policies of the assistive apps, especially depending on sociodemographic backgrounds. To address the knowledge gap, this study invited 30 individuals with visual disabilities to measure their understanding level of privacy policies of the apps but also their tendency level to adopt the apps after being educated on the privacy policies. Individual differences were found, depending on their sociodemographic backgrounds (i.e., vision, age, education, health conditions, race/ethnicity, and living conditions). Given the results, this study suggests that educational interventions are needed to properly inform users with visual disabilities about how their personal information are used, shared, and protected while using the assistive apps, which is anticipated to contribute to safe practices of use.

Keywords

Digital Privacy, Visual Impairment, Blindness, Independent Living, Assistive Apps.

Introduction

Today, a great number of people with visual disabilities take advantage of mobile assistive technologies that enable users to obtain better access to information through a mobile phone camera. Seeing AI, TapTapSee, and BeMyEyes apps are the mostly commonly used camera-based assistive technology apps among people with visual disabilities (Dockery and Krzystolik). For example, Microsoft's Seeing AI app is equipped with artificial intelligence technology to enhance the capability of reading texts, identifying people/objects, and audibly describing them to users who have visual disabilities. The TapTapSee app takes advantage of an Image Recognition Application Programming Interface (API) in recognizing images. In contrast to the TapTapSee and Seeing AI apps, the BeMyEyes app runs with supports from online volunteers who read and recognize various information in real time when people with visual disabilities share information via a mobile phone camera.

Yet, users may reveal their personal information (e.g., credit cards, bank statements, medical bills, and so on) while using the assistive apps. That personal information would then be shared with the app companies, their third party, and/or other users online. It is reasonable to argue that users with visual disabilities are more vulnerable to being exposed to privacy threats and privacy invasion as they are less likely to fully benefit visual cues and software programs that are designed to help users to notice potential cybersecurity threats (Inan et al.). As we are living in a data-driven world, data breaches could significantly affect a great number of people. Cybersecurity concerns are on the rise around the world. Over 2,000 Internet crime complaints were reported per day in 2020 (Federal Bureau of Investigation). The well-known digital security company, Norton pointed out that more than half of all customers experienced a cybercrime, i.e., nearly one in three falling victim in 2020 alone.

However, little is known about how users with visual disabilities perceive the privacy policies of the camera-based assistive apps as well as whether they are more (or less) likely to adopt the apps after being educated on the privacy policies, especially depending on users' sociodemographic backgrounds. To address the knowledge gap, this study conducted interviews with those apps' users with visual disabilities.

Methods

Participants

Inclusion criteria were English speaking, 18 years old or older, visual acuity equal to or poor than 20/70, and user experience with Seeing AI, BeMyEyes, and TapTapSee apps (named "experienced users"). This study also included "prospective users" who have not used the apps but are interested in using the apps in the future. A convenience sample of 30 individuals with visual disabilities were invited, accounting for 24 experienced users and 6 prospective users (see Table 1).

Table 1a. Characteristics of the Participants – Vision Loss.

Vision Loss (visual acuity level)	Experienced Users (n = 24)	Prospective Users (n = 6)
Visual Impairment (from 20/200 to 20/1200)	7	3
Blind (from 20/1200 to no light perception)	17	3
Duration of vision loss (years)	29.17 ± 21.46	35.17 ± 22.75

Table 1b. Characteristics of the Participants – Onset of Vision Loss.

Onset of Vision Loss (years)* *Participants with early-onset had lost their vision before 11 years of age (Voss et al.).	Experienced Users (n = 24)	Prospective Users (n = 6)
Early onset	n = 7 (2.14 ± 3.08)	n = 2 (0.00 ± 0.00)
Late onset	n = 17 (39.29 ± 20.63)	n = 4 (47.00 ± 29.54)
Age (years)	57.63 ± 18.43	66.50 ± 15.08

Table 1c. Characteristics of the Participants – Gender.

Gender	Experienced Users (n = 24)	Prospective Users (n = 6)
Male	9	4
Female	15	2

Table 1d. Characteristics of the Participants – Race/Ethnicity.

Race/Ethnicity	Experienced Users (n = 24)	Prospective Users (n = 6)
African American	9	4
European American	14	1
Others	1	1

Table 1e. Characteristics of the Participants – Head of Household.

Head of Household	Experienced Users (n = 24)	Prospective Users (n = 6)
Living alone	10	4
With family, relatives, or friends	14	2

Table 1f. Characteristics of the Participants – Education.

Education	Experienced Users (n = 24)	Prospective Users (n = 6)
High school or equivalent	10	2
Associate	4	3
Bachelors	4	1
Masters	6	0

Table 1g. Characteristics of the Participants – Health Status.

Health Status	Experienced Users (n = 24)	Prospective Users (n = 6)
Chronic illness	8	1
Healthy	16	5

Materials

A quiz was employed to assess the degree to which users are knowledgeable about user privacy policies. The quiz consisted of 42 true-or-false statements that were extracted from the homepages of the assistive technology apps' companies. The selected policies covered comprehensively various aspects, such as "information the company collects", "sharing of the collected information", "storing of the collected information", and "user capabilities to access and control their personal data."   Users' tendency to adopt the apps was assessed using the inquiries developed by Gao et al., yet this study chose particularly seven inquiries relevant to trust in privacy and security.

Procedures

Participants were individually invited to interviews (~60 minutes) by phone. The quiz was administered with experienced users to measure the degree to which they were aware and understood the user privacy policies of the apps they have used. An interviewer read out loud each quiz question, and participants responded verbally by indicating either true or false. Participants were allowed to ask the interviewer to repeat the quiz questions as needed. There was no time limit, such that participants could spend as much time as they need. After completing the quiz session, participants were informed of correct answers. An interviewer provided additional explanations as needed, which was an opportunity for participants to be educated about user privacy policies of the apps.

The adoption inquiries were administered twice – before and after quiz – to assess the degree to which the quiz-based education changes participants' tendency to adopt the apps. In addition to experienced users, prospective users were instructed to participate in the same quiz-based education session as we were interested in exploring the degree to which they change

their tendency to adopt the apps after being educated. Non-parametric statistics (e.g., Mann-Whitney test and Spearman's rho correlation) were used to analyze the data as they were not normally distributed.

Results

This study found individual differences associated with the quiz scores and the tendency to adopt the assistive apps, depending on sociodemographic backgrounds (e.g., vision conditions, age, educational backgrounds, health conditions, race/ethnicity, and living conditions).

Quiz for User Privacy Policies

Quiz scores of experienced users were analyzed with a Mann-Whitney Test. The quiz score of participants with late onset of vision loss (i.e., one who lost vision after 11 years of age, (Voss et al.)) was higher (0.85 ± 0.15) than that of those with early onset (0.64 ± 0.28), $U = 27.5$, $r = -0.42$. Spearman's rho correlation showed that the duration (years) of vision loss was negatively correlated with the quiz score, $p = 0.002$, $r = -0.61$.

Tendency to Adopt the Assistive Apps

Both experienced and prospective user groups showed significant differences in adoption tendency, depending on age, education, and health conditions.

Experienced Users

Age. A Mann-Whitney Test showed that the tendency to adopt the assistive apps was greater in younger participants (6.86 ± 0.31) than older participants (6.68 ± 0.26) after the quiz-based education, $U = 34.50$, $r = -0.44$.

Educational Background. A Mann-Whitney Test showed that the tendency to adopt the assistive apps was greater in participants without higher education (6.92 ± 0.15) than participants with higher education (6.62 ± 0.37) after the quiz-based education, $U = 33.00$, $r = -0.48$.

Health Conditions. A Mann-Whitney Test showed that the tendency to adopt the assistive apps was greater in participants with health conditions (6.96 ± 0.10) than healthy participants (6.71 ± 0.33) after the quiz-based education, $U = 30.00$, $r = -0.44$.

Prospective Users

As shown in Figure 1, a descriptive statistic helped to compare the data of prospective users by demographic backgrounds. After the quiz-based education, the greater tendency to adopt the assistive apps was found in the following prospective user groups: older participants, participants living with others, European American participants, and participants with blindness.
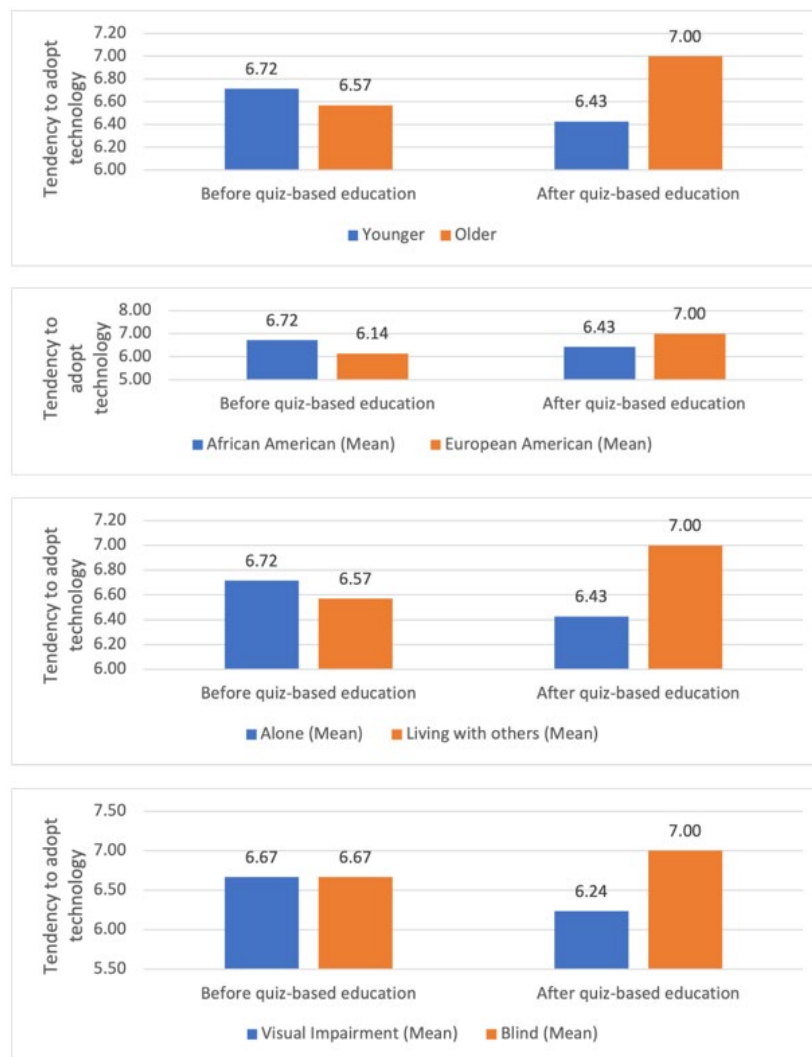
Fig. 1. Mean values of tendency to adopt the assistive apps among prospective users.

Discussions

Quiz for User Privacy Policies

Experienced users with shorter duration of and late onset of vision loss were those who lived with sight for a long period of time in early life. Thus, they did not have any limitation in terms of reading texts and seeing images associated with user privacy policies as well as having actual hands-on experiences with a variety of technologies before losing vision. They might have a number of opportunities to gain deep understanding of user privacy policies about various technologies. Such prior learning might have helped them to understand the user privacy concepts and policies of the assistive technology apps. On the other hand, it also infers that their counterparts who have lost their vision in early life and in the recent past might struggle with comprehensively understanding user privacy policies. There is an urgent need to offer them an adequate means to be well informed of user privacy policies. Thus, they could better protect themselves from security threats and privacy risks.

Tendency to Adopt the Assistive Apps

Experienced Users

Age. Younger participants showed stronger tendency to adopt the apps after the quiz-based education. It may suggest that user privacy education is more effective to younger people with visual disabilities, leading to greater trust on the assistive apps, while older people with visual disabilities might have been more cautious to protect them from being exposed to privacy risks. The age-related individual differences in online privacy awareness are well documented in the literature (Bellman et al.; Mittal and Ilavarasan; Zeissig et al.). For example, Cho et al. conducted a study with 1261 Internet users and found older individuals were more concerned about privacy issues as compared to their younger peers.

Educational Background. Participants without higher education were more likely to adopt the assistive apps. The result infers that participants with higher education might have been more likely to be equipped with conservative attitudes toward using the assistive apps. They might have had more opportunities to be informed of privacy breaches via news media or personal research, probably leading to lower trust on privacy policies. Similar results are also found in the literature (Ojala Burman). Cho et al. also found that Internet users with a higher educational background were more concerned about privacy issues as compared to their counterparts.

Health Conditions. Participants with health conditions were more likely to adopt the assistive apps after the quiz-based education. They might have perceived that the apps would be safe to use and/or willing to compromise their privacy in order to have access to information that were not accessible to them previously. That information might be beneficial to their health conditions and self-care practices, probably leading to more motivation to keep using the assistive apps. Patients' willingness to accept the privacy breach to obtain access to health information was well documented in the literature (Hale and Kvedar).

Besides technology adoption, the results also provide important insights into teaching and learning in user privacy and security domains. For example, the results infer that the quiz-based education works for those who are younger, without higher education degrees, and with health issues. On the other hand, the results also infer that there is a need to redesign the way of teaching their counterparts. Future research will, thus, refine the education contents to address unresolved privacy-relevant concerns of those counterparts. As this study did not consider individual differences in learning styles, e.g., active/reflective, visual/verbal, sensing/intuitive, and sequential/global (Felder and Silverman), future research will also find adequate education

delivery methods to accommodate different learning types of people with visual disabilities.

Prospective Users

Among the prospective users, those who were blind, older, living with others, and European Americans showed greater tendency to adopt the assistive apps. The results infer that the current quiz-based education is an effective teaching and learning style suitable to those prospective user groups while that style is less effective to their counterpart groups. There is a need to refine the educational contents and teaching method that should work for those counterpart groups. By doing so, more people with various sociodemographic backgrounds could feel safe to use the assistive apps, ultimately contributing to technology adoption and enhancement of quality of life and independence.

Conclusions

This study found evidence that, depending on sociodemographic backgrounds, certain users with visual disabilities had a lower level of understanding of privacy policies of mobile camera-based assistive apps as well as a lower level of tendency to adopt the apps. Given the results, this study recommends that educational interventions be adequately designed to teach users with visual disabilities how to safely use the apps to keep personal information secure.

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