”I’m stuck, too!” Revisiting Difficulties of Using Web Authentication Mechanisms for Visually Impaired Person

Yuya Ota
Waseda University
3-4-1 Okubo Shinjuku
Tokyo, Japan
ota@nsl.cs.waseda.ac.jp

Akira Kanaoka
Toho University
2-2-1 Miyama, Funabashi-shi
Chiba, Japan
akira.kanaoka@is.sci.toho-u.ac.jp

Tatsuya Mori
Waseda University
3-4-1 Okubo Shinjuku
Tokyo, Japan
mori@nsl.cs.waseda.ac.jp

Abstract
This work aimed to make the *repetition* of the experiment performed by Dosono et al [1], which studied how the current authentication interfaces pose significant burden to visually impaired persons. We revealed that previously found difficulties such as locating authentication area, verifying the success of authentication, and use of visual/voice authentication, were *reproducible* in a set of users with different demography. In addition, our participants enabled us to add another dimension – *age* – to our study. We found that younger visually impaired users can outperform elder non-visually-impaired users. The fact indicates that accessible design should address not only blindness factors but also aging factors.

Author Keywords
Visually impaired, accessibility, usabile security

ACM Classification Keywords
H.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interfaces; D.4.6 [OPERATING SYSTEMS]: Security and Protection

Introduction
In the modern web, authentication plays a vital role in securing transactions of various services, e.g., e-mail, banking, shopping, social networking, etc. At the same time,

authentication is one of the most complex and troublesome operations even for non-visually-impaired users. From the viewpoint of visually impaired persons, this situation becomes even worse. As a first step toward mitigating the difficulties for visually impaired persons to work with authentication interfaces, it is meaningful to understand the current difficulties and their sources through an actual user study. In [1], Dosono et al. recruited 12 participants and performed human studies to identify specific difficulties visual impaired users experience in various authentication scenarios. As they described, given the nature of the study, recruiting participants was a challenging task. Thus, we cannot conclude that the obtained observations were *reproducible* and/or representative to capture all possible variations.

Given these backgrounds, we contribute to the *replication* of their work by extending the human study to a new set of participants. Thanks to the cooperation of the Japan Federation of the Blind (JFB) [2], we were able to recruit 10 participants, including four low-vision users and six blind users. The demography of the participants is quite different from that of the participants studied by Dosono et al. The participants are of a different race (all Japanese), different age range (half of our participants were 30 years or younger while most of their participants were 50 years or older), and use different assistive tools. Furthermore, we also recruited nine *non-visually-impaired* participants so that we can study how the new dimension – *age* – affects the results.

Our contributions can be summarized as follows:

- We revealed that previously found difficulty such as locating authentication area, verifying the success of authentication, and use of visual/voice authentication, were *reproducible* in a set of users with different demography, i.e., different races, different languages, and use of different screen readers.
- We also revealed that the degree of difficulties is associated with the factor of *age*; i.e., for some tasks, younger visually impaired users outperformed elder non-visually-impaired users. This observation indicates that accessible design should address not only blindness factors but also aging factors; i.e., an accessible interface optimal for elder visually impaired users may not be necessarily optimal for young visually impaired users.

Methodology

We first asked the participants to choose their favorite places for inquiry. If they chose their home or office, we visited there and conducted the inquiries. In some cases, we conducted the experiments in university conference rooms or public buildings. We also asked the participants to prepare the computers or mobile devices they regularly use. Next, before starting the inquiry, we asked the participants if we could record audio/video during the inquiry process. If a participant approved, we collected audio/video data, which was used to generate a transcript of the interview and to analyze how they performed during the tasks. After the inquiry, we compensated the participants with JPY 3,000 (roughly USD 30).

Overview

With the aid of JFB [2], we sent out the invitation letter to the mailing list of JFB members. Several people responded to the invitation, and after a selection based on their self-descriptions and feasibility to perform contextual inquiry, we ended up recruiting six blind and four low-vision participants as shown in Table 1. While the subjects studied in [1] consisted of ten participants with the age of 50–60 and two participants with the age of 40–60, our participants were of

Table 1: Demographic information of visually impaired and non-visually-impaired participants. P1–P10 are visually impaired (marked with asterisk). P11-P19 are non-visually-impaired. 9 participants with bold fonts are labeled as *Elder users*.

ID	Gender	Age	Occupation	Self-description
P1	F	40–50	Housewife	Blind
P2∗	F	60–70	Retired	Low vision
P3	M	30–40	Public official	Blind
P4	M	30-40	Public official	Blind
P5∗	M	10–20	High school student	Low vision
P6∗	M	10–20	High school student	Low vision
P7	M	10–20	High school student	Blind
P8∗ PC–talker	F	40–50	Volunteer worker	
P9	M	20–30	Teacher	Blind
P10	F	20–30	Public officials	Blind
P11	F	40–50	Housewife	
P12	M	50–60	Self-employed	
P13	M	10–10	College student	
P14	F	20–20	Office worker	
P15	M	10–20	College student	
P16	F	10–20	High school student	
P17	M	30–40	Self-employed	
P18	M	20–30	Self-employed	
P19	F	30–40	Housewife	

ages, including three with ages of 10–20 and two with ages of 20–30. This distribution of age is suitable to study how the factor of age affects the results.

Table 2 summarizes the tasks we asked participants to perform. The essence of these tasks is consistent with the tasks in [1] where participants were asked to log into their PC/smartphones, their primary email account, their online banking account or an e-commerce site they use, and their social media network of choice.

Key Findings

Table 3 shows the experimental results for the tasks T1 and T2. Across all the participants, roughly half of them did not set passwords to protect their PC. The reason against setting password was mainly due to the convenience. Also, the results for visually impaired participants exhibited differences from the results shown in [1] where the mean time spent for logging into devices was 177 seconds. We infer that the difference is associated with age. In our study, all elder participants did not set passwords for logging into their PCs while many of participants in [1], where all the participants were elder, did set password. We also note that none of the participants experienced difficulties in logging into their phones.

To summarize, in the real life, visually impaired participants did not experience severe problems in logging into their devices. They have become familiar with the authentication interface or have decided to skip the authentication process by not setting passwords. For those who are familiar with the authentication process, the performance was comparable to non-visually-impaired participants.

The experimental results for tasks T3 and T4 (tables are omitted) indicated that there was a clear performance difference between the two classes, visual impairment and non-visually-impaired. This observation is consistent with the previous work [1]. While the performance of non-visually-impaired participants was stable, the performance of visually impaired participants exhibited large variances. Although we have to omit the details due to space limitation, some difficulties the participants experienced originated from the combination of websites and assistive tools; e.g., how a screen reader retrieves dynamic content. We also notice that website W3 tends to cause bad performance for visually-impaired participants across the three tasks. We manually inspected the site and found that the authentication interface was not carefully designed for visually-impaired persons. Lastly, we also noticed that the age factor is correlated with performance. Of the visually-impaired

Table 2: Authentication tasks.

ID	Task	Target	Description	Metrics to measure performance
T1	login	device	login into a PC	success or fail, overall time spent to login (sec.)
T2	login	device	login into a smartphone	success or fail, overall time spent to login (sec.)
T3	login	web	login into a website	success or fail, overall time spent to login (sec.)
T4	locating	web	locate an area of authentication	time to locate the area (sec.)
T5	verification	web	verify success authentication	time to verify success authentication after login (sec.)
T6	account management	web	create a new account on a website, change a password, and remove the account	time spent for each task (sec.)
T7	authentication interface 1	web	authentication interface with image recognition.	success or fail, overall time spent to pass (sec.)
T8	authentication interface 2	web	authentication interface with radio button selection	success or fail, overall time spent to pass (sec.)

Table 3: Results of tasks T1 and T2. Timed attempt at authentication (seconds). All the participants used their own devices. "n/a" stands for cases where no authentication passwords were set to the devices. "–" stands for cases where participants did not own their own devices.

(a) Visually impaired

ID	PC	Smartphone
P1	n/a	4
P2∗	n/a	5
P3	n/a	6
P4	n/a	6
P5∗	3	–
P6∗	5	4
P7	3	–
P8∗	n/a	–
P9	n/a	–
P10	n/a	–

(b) Non-visually-impaired

ID	PC	Smartphone
P11	n/a	–
P12	3	5
P13	n/a	2
P14	2	2
P15	n/a	–
P16	n/a	3
P17	n/a	2
P18	3	2
P19	n/a	3

participants, only elder participants (P2 and P8) failed the tasks. It is somewhat surprising that the three youngest participants P5, P6, and P7, who were high school students, even *outperformed* elder non-visually-impaired participants.

Due to the lack of space, we omit the results for tasks T6–T8 and interviews. A takeaway is that account management tasks were difficult for elder visually impaired participants. Also, selecting the radio button was difficult for visually impaired participants.

Summary

The chief aim of this work was to make the *repetition* of the experiment performed by Dosono et al [1]. Due to the nature of the study, it is difficult for a research group to collect many participants or to perform analysis many times. Therefore, it is crucial that different research groups make replications of the study and test *reproducibility*, which is one of the main principles of the scientific method. We revealed that previously found difficulties such as locating authentication area, verifying the success of authentication, and use of visual/voice authentication, were *reproducible* in a set of users with different demography. In addition, our participants enabled us to add another dimension – *age* – to our study. The fact that younger visually impaired users outperformed elder non-visually-impaired users indicates that accessible design should address not only blindness factors but also aging factors. We hope that our findings are useful in improving the design of the accessible authentication interface of websites and assistive tools.

Acknowledgments

We would thank Mr. Takayuki Suzuki and Mr. Toshikazu Ogawa, the Japan federation of the blind, for their support in conducting this study. We also would thank all the participants who kindly accepted our invitation and shared their experiences and invaluable insights and opinions. Special thanks are to the Bryan Dosono, Jordan Hayes, and Yang Wang for sharing the pioneering work with the research community.

REFERENCES

1. Bryan Dosono, Jordan Hayes, and Yang Wang. 2015. "I'm Stuck!": A Contextual Inquiry of People with Visual Impairments in Authentication. In *Eleventh Symposium On Usable Privacy and Security (SOUPS 2015)*. Ottawa, 151–168.
2. Japan Federation of the Blind (JFB). 2016. (2016). `http://nichimou.org/`.