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Studying Older People with Visual Impairments Using Mainstream Smartphones with the Aid of the EziSmart Keypad and Apps

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Abstract. This paper reports on a study of older people with visual impairments learning to use a mainstream smartphone with touchscreen. The aim of the study was to evaluate whether the EziSmart solution could facilitate the use of a standard off-the-shelf smartphone, and thus stimulate more social contact and digital participation for this group. The EziSmart solution consists of Ezi-Pad and Ezi-Smart Apps. The Ezi-Pad is a flip-casing with a receptacle for the smartphone. When the casing is flipped open it reveals an integrated keyboard with large ergonomic physical keys. The smartphone and the Ezi-Pad keyboard communicate via Bluetooth. The Ezi-Smart Apps is a set of Android applications including a startpage (launcher), an app organizer and several other features. Six visually impaired adults, aged 63 to 80 years received a five day course in using a smartphone together with the EziSmart solution. The participants were observed during the course. They were then followed up during a two month period. The participants and their relatives were interviewed about their smartphone use, experiences and expectations before the training started, and after the follow up period ended. We discuss challenges that older people with visual impairment face when trying to learn and use a smartphone. We then report on the usability and accessibility of the Ezi-Pad solution, describe the course and the experiences of the participants, and reflects upon how both the EziSmart solution and smartphone training could be improved with regard to this user group.

Keywords. Visually impaired, assistive technology, smart phone, older people

1. Introduction

Smartphones are becoming part of our everyday life. This study was conducted in Norway which may be interesting because Norwegians are early adopters of information and communication technology. 91 percent of the Norwegian population (9-79 years) had access to a smartphone in 2017 [1]. As we age, we face age-related changes (e.g., in hearing, vision, motor skills, speech and/or in cognitive skills) that may affect our use of smartphones. A survey conducted on behalf of the Norwegian Association for Blind and

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Visually Impaired (NABP), found that while 74% of the Norwegian population aged 60-80 years had a smartphone, only 21% of the visually impaired in the same age group had a smartphone [2]. Smartphones usually have touch screens which may be particularly difficult to use for older people with visual impairment (referred to as OPVI in this paper). Although mainstream smartphones comes with basic accessibility functionality, and improved speech recognition functionality, there are still many remaining usability and accessibility issues to be dealt with. This is in particular true for people with a combination of sensory, physical and cognitive impairments. OPVI may, of course, also have other impairments which increase in occurrence with increasing age, such as reduced dexterity, hand tremors or reduced cognitive abilities, and even speech recognition fails with the onset of speech impairment. Functional impairment can lead to reduced mobility and reduced participation in social life [3].

A recent survey among people with visual impairment in Norway (N=736) found that 50 percent of the respondents could be considered lonely, where 20 percent had a high degree of loneliness. The incidence of feeling lonely is substantially higher than in the general population, in all age groups. They also found that many visually impaired people avoid seeking help because they find it shameful not be able to manage on their own [4].

Other studies suggest that participating in digital arenas can be extra important for people with disabilities, such as people with impaired vision and reduced mobility [5,6] and for older people [7]. It allows for social contact, information sharing and gaining insight into the circumstances of family and friends. One survey found that around 40% of older people (61-100 years) with disabilities believe they have an extra benefit from using internet-based services due to their disability [8].

A sense of mastery has been found to reduce adverse effects of disability and poor subjective health [9]. Experiencing a low degree of mastery gives a greater risk of experiencing loneliness five years later [10]. In this research it is pointed out that new technologies allow for varied opportunities for social contact for people with disabilities, and that supporting mastery may be of particular importance for this group.

2. The EziSmart Solution

The EziSmart solution developed by EziCare Tech[2] is an assistive device designed to be attached to and hold a smartphone. The target groups for the solutions are people who have trouble using a touch screen and/or have problems with the complexities of the smartphone user interface.

The concept consists of the Ezi-PAD smartphone case with a tactile keypad and the accompanying Ezi-Smart App (for Android). The smartphone is inserted into the Ezi-PAD case and the integrated solution becomes a flip phone (see Figure 1). The smartphone and the keypad communicate via Bluetooth. When the case is open, the screen and the keypad are available, and when flipped shut it becomes smaller and more portable, and can be placed into a charging dock. There is a window through which one can see who is calling when the case is closed. On the outside of the case, below the window, there is an SOS button that is covered by a lid. The SOS functionality in the Ezi-Smart App will start if the SOS button is pressed.

[2] https://ezicaretech.com/ezicaretech/

Figure 1. The EziSmart solution: To the left, the Ezi-Pad case is flipped open, providing access to the smartphone screen and the Ezi-Pad keypad. To the right, the case is closed and placed in the accompanying charging dock.

The keys on the keyboard are large, square and concave. The large size and the concave form make them easy to identify. The keys are designed to stabilize the finger if the hand is trembling. By pressing and tilting or rocking towards each of the four sides of the key, a corresponding number or letter will be activated. The layout of the numbers and letters is based on the familiar T9 keypad used in feature phones. There are also keys for navigation and dedicated functions, such as answering and ending a phone call and opening the contact list.

The Ezi-Smart Android application consists of functions to make the smartphone more accessible and easy to use for the target groups. It contains a set of functions, including startpage, app organizer, SOS and GPS functions. The startpage and the app organizer allow for personal customization of the interface on the smartphone. The user can start with a few basic functions and then add more functions and apps as he or she becomes familiar with the technology and feels ready to learn more. When activated and depending on the chosen settings, the SOS function can send an SMS to or call one or more contacts. With the GPS function the user can easily share the current location with pre-programmed contacts, regularly, on demand or when requested by the contact, or if the user has pressed the SOS button.

3. Related work

Traditional phones have many features that benefit OPVI, such as tactile keypad with familiar physical interface and ease of answering and placing phone calls [11]. The introduction of smartphones with touchscreen makes the user highly dependent on vision and touch. This caused a decrease in accessibility for people with visual impairment. As many as 68 accessibility issues were identified in one systematic review [12]. Examples of accessibility issues are the absence of screen readers in local languages, and the inability to adjust speech speed, text size, colour and contrasts. This together with the lack of physical buttons makes these devices hard to use for people with visual impairment (ibid.). Getting worse is the currently professed design ideology of removing all physical buttons except for the indispensable on/off button.

It is possible to enable the screen reader functionality that is built into mainstream smartphones (e.g. TalkBack on Android and VoiceOver on IOS). With this enabled, the interface will change the mode of interaction, and the interface will be more based on voice/audio. By moving the finger around the screen, the screen reader will read aloud the element that is touched. This combined with specific interaction patterns (e.g. touch and swipe with one or more fingers) makes it possible for people with visual impairment to orient themselves on the screen and to enter text. However, this mode of interaction is known to slow down the typing speed [12]. It also requires good dexterity and ability to orient oneself in a two dimensional space. Entry and editing text on a smartphone can therefore be particularly time consuming and difficult for OPVI. Substantial time and assistance is required to learn the use of smartphones for OPVI, preferably in dedicated classes for this group, with ongoing training and support, and one-on-one help from an instructor [11].

The EziSmart solution was previously tested in a study with older people with various disabilities [13]. The target group in this study was home-dwelling seniors who, at the start of the study, did not have a smartphone. The aim of the study was evaluate how the EziSmart solution could encourage seniors to start using a smartphone and to enable senior smartphone users to continue using a smartphone in spite of increasing motoric or visual impairment. Five out of nine participants used the system for 2 months. The authors concluded that the solution made the smartphone easier to use for the participants, especially for those with motoric or vision impairment. The solution could also make it easier to adopt a smartphone if required for health technologies. Based on the very positive feedback from the one visually impaired participant in this study, it was desirable to test the solution with more visually impaired older persons.

4. Approach / method

The aim of this study was to evaluate whether the EziSmart solution, together with a training scheme could make it easier for OPVI to use a smartphone, and whether this could stimulate to maintain and/or increase social contact for this group. The definition of visual impairment is based on WHO-ICD 10, category 1 Moderate visual impairment to category 5 Blindness.

4.1. Criteria for participation

The course was announced through the member magazine of NABP. The preconditions for participation, that it was part of a research project and the aim of the project were explained. The following inclusion criteria was used to select the participants in the study; 60 years or older, visually impaired, not working, living at home, and have little or no previous experience with a smartphone.

The participant should also involve at least one relative or friend, preferably a younger person familiar with smartphones. Their task was to send messages every day during the EziSmart course, and continue to send messages regularly during the follow-up period of two months. The course, including the EziSmart solution and a Samsung Galaxy S6, were free for the participants. If they did not complete the full training, including the two month follow up period, they would have to return the smartphone and the EziSmart solution to the project. Both participants and friends/relatives were required to sign an informed consent form with information about the study before participating.

4.2. The participants

Four women and two men were recruited. Their ages were 63, 69, 72, 73, 79 and 80. One participant was born with reduced vision, while the other five had lost their vision, one of which had become completely blind. Three of the participants lived alone, while three lived with their spouse. Two of the participants had tried special phones for visually impaired, but both had bad experiences with this and had given up. Among the challenges mentioned were poor usability, inaccessible instructional materials and technical challenges.

Five out of the six participants had some prior experience with a smartphone. They had primarily used the phone for making phone calls and sending SMS. All participants had experience in reading SMS messages, while two participants were unable to write SMS messages.

Several mentioned that an important motivation for learning to use the smartphone was to have contact with children and grandchildren on their premises, and to be able to use the same functionality and services that their seeing peers are using.

Four of the six recruited relatives/friends were children of the participants and between 30 and 40 years old. They were all experienced smartphone users. Further, there was one sibling and one spouse in the mid 70's, who were not so proficient users of the smartphone.

4.3. The course and follow up period

NABP has extensive experience in providing training in use of technology for people with visual impairments. The EziSmart course was based and adapted from their iPhone course. They have a maximum of six participants per course to ensure enough time for individual follow up. The five day course focused on the following main functions; calling, SMS, how to connect to Wi-Fi, voice assistant, speech recognition, use of WhatsApp and Messenger, and where time permitted, installing and using apps and using e-mail.

The instructions took place in small groups and in a one-on-one setting. At the last day of the course a digital group for the participants were created in WhatsApp. Both participants and their relatives/friends were also encouraged to join a common digital

support group in Messenger. The purpose of the digital support groups was to provide a common place for asking questions and sending social messages. Additionally, the participants had the opportunity to call for support.

4.4. Data collection and analysis

The participants and their relatives/friends were interviewed before the course, and at the end of the follow-up period. The semi-structured interviews were based on an interview guide and conducted over telephone. In addition to background information, they were asked questions about their telephone habits, experience with technology, and social contact. In the final interview they were also asked questions about their experiences and satisfaction with the EziSmart solution, the course and whether or not it had influenced their social interaction patterns.

On the last day of the course, each participant answered a simple course evaluation questionnaire. In addition, notes from observations during the course, questions posed during the follow up period and in the digital support group, were collected. The qualitative data material was analysed using thematic analysis, with the aid of the Open Code 4.0 software [14].

5. Results and discussion

5.1. Course evaluation

All six participants answered a short course evaluation questionnaire with responses on a scale from 1 to 5, where 5 represented very good, 4 good, 3 satisfactory, 2 less good, and 1 bad. It was possible to give free text comments for each question. Here are the questions and the results:

1. What overall rating would you give the course? All six participants answered 5
2. How satisfied are you with the teaching methods? All six participants answered 5
3. How satisfied are you with the content of the course? Five participants answered 5 and one answered 4

The teachers were described as calm, skilled and good at explaining. Although participants were very satisfied, they pointed out that even more one-on-one training would have been optimal. It should be mentioned that the participants were very motivated and positive, and that the fact that they knew that they were part of a study may have contributed to the positive answers (the Hawthorne effect).

5.2. The follow up-period and the digital support groups

Five participants completed the whole training program, and were very satisfied. *"Very good whether it's with or without the new case. It's very nice to learn more about all these apps and what to do and not"* and *"I feel confident that I have received the training that I needed and I'm brilliantly satisfied"*.

In a few cases problems were solved by home visits to the participants. This was greatly appreciated. Examples of issues that were resolved at home visits were; connecting to the wireless network and reconfiguring the phone to using Norwegian letters (æ, ø and å) after a software update on the phone. Participants appreciated that

they were "forced" to answer messages from relatives/friends from the very beginning. "*It was very ok, for then I had to answer, so I sat and struggled until I got it*". The digital support groups were also appreciated, because answers to questions were often useful for several participants.

The one blind participant withdrew during the follow-up period. The stated reason was that the solution was too challenging to use. It is difficult to judge whether EziSmart is suitable for people who are blind on the basis of this study. Because it is particularly challenging to use a smartphone for people who are blind, the use of voice control will be extra important. While the speech interpretation of Norwegian is quite good on both IOS and Google, it seems that Siri on iPhone allows the user to issue more spoken commands. For example, it is possible to compose a message by spoken commands with both Google Assistant and Siri, but only Siri reads the message back to you for verification before sending.

5.3. Involvement of relatives/friends

The relatives were not particularly active in the digital support group. Both participants and relatives were asked about views on the degree of involvement in the training scheme and whether help from relatives the relatives were necessary. Neither participants nor relatives thought that the relatives should have been more involved. The answers may indicate that both participants and relatives think that the training is best taken care of through an organized arrangement rather than informally at home. It was also mentioned that it may be challenging for relatives to learn assistive technology, and that the "learner" may be more frustrated and impatient in a training situation with people that they know well, particularly with close family.

Several participants mentioned that young people, especially the youth may be too quick, and may not fully understand or take into account the visual impairment in an informal help situation. *"You cannot ask children and grandchildren. They are doing it so fast, I cannot follow what they are doing.", "They are unable to understand the problems of having a visual impairment".*

5.4. Accessible instructional materials

The project created text-only versions of the EziSmart instructional materials but describing all images as text is very extensive and elaborate work. We realized that describing everything would produce a quite thick and complex manual. Instead, several mini-instructions were made for key features. Several participants mentioned that they had benefited from the mini-instructions, but in the long term, more instructional materials may be desirable.

5.5. The EziSmart solution

One of the objectives of the study was to evaluate to what extent the EziSmart solution is suitable for OPVI. Five out of six respondents answered that the solution was good and that they would continue to use it. They also responded positively to whether they would recommend the solution to others: "*Yes, certainly, I have advertised and recommended it to others. I think there are many visually impaired who may be interested.", "Yes, if they have at least as good vision as me, preferably better, then it's very good"*. They felt that the keypad made it easier to learn and use the smartphone, and

liked the fact that one can answer a phone call without flipping it open. They were pleased with the startpage and thought that it was convenient to have the most used contacts on the first page. They were also very satisfied by being able to use various apps, such as, GPS, map and weather apps, and in particular being able to communicate with young relatives through WhatsApp, Messenger and Skype. They expressed joy of mastery and mentioned examples of how this made them more independent and led to more contact with grandchildren. The huge benefit is that they get to communicate using the same apps and tools that the young people communicate with.

Participants also mentioned some areas for improvement. Some would like better battery capacity. They would have preferred a smaller and slimmer solution, but not at the expense of the large physical keys. One mentioned that the keys were slightly shiny, which can be bothersome for those who are sensitive to light.

6. Conclusion

The training program was well received and the study confirms that thorough training and follow-up are very important elements when teaching older people with visual impairments to learn to use smartphones. The participants pointed to the following elements as contributing to a successful training; that relatives were instructed to send messages to the participants from the very first day, the digital support groups and easy access to telephone and remote support. It seemed that the two-month follow-up period was appropriate. The participants with reduced vision considered both the EziSmart keypad and the EziSmart App to be useful and instrumental for their mastery of the smartphone. The increased mastery contributed to more contact across generations and more independence. Some areas for improvement were also identified, both in the EziSmart solution and in the training scheme.

We conclude that the EziSmart solution can lower the threshold of learning to use a smartphone for older persons with reduced vision. It is not possible from this study to conclude on whether the solution is also suitable for older people who are blind. This will be investigated in future work.

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