

HCI and Aging: Improving Technology Adoption Among Older Adults

Kirk Thelen

Michigan Technological University

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Abstract

Digital devices are found in every aspect of our society surrounding us in an increasingly technological world. Although technology can bring many benefits to our lives, it is rapidly changing and often requires people to “keep up” with the latest models, commands, and user interfaces. One demographic in particular, adults over the age of 65, are often not considered when designing these devices and are subsequently “left behind” as technology advances. Even devices that we predict would be beneficial to older adults see the highest adoption rates among the youngest people. We identify different factors that represent barriers to technology adoption, and outline ways that we can work toward breaking these barriers and encouraging older adults to adopt new technologies. We outline plans for future work to address these factors in an attempt to increase overall technology adoption among older adults.

Introduction

Technology comes in many forms, and many people interact with technology every day. From entertainment to healthcare, technology can be used to enrich and improve peoples’ lives. In the last decade, the adoption of Internet of Things (IoT) devices has become mainstream, with 1 in 2 people owning at least one IoT device (Kumar et al., 2019). One such IoT device is a voice-user interface (VUI or “voice assistant”) such as Alexa, which can be used both hands-free and eyes-free. The accessible nature of VUI allows those who traditionally struggle with graphical user interfaces (GUI) to still operate an internet-connected device, which makes them particularly useful for an aging population.

Despite the popularity and benefits, older adults (ages 65+) are still generally resistant to adopting new technologies. For example, a 2014 study found e-reader adoption among adults aged 35-46 (“Generation X”) to be 26%, while e-reader adoption among all adults over the age of 46 (“Older Boomers,” “Silent Generation,” and “G.I. Generation”) to be a collective 27% (Quan-Haase et al.). As well, although 90% of all adults in the United States used the internet in 2016, only 67% of older adults were online in the same year (Anderson and Perrin, 2017). When it comes to VUI, even with its accessible nature, older adults still have more resistance to adopting it than younger people do (Yao et al., 2022).

The usefulness of technology as a whole is not in question, as we see it shape our ideas of communication, transportation, education, and more. Yet, the resistance that older adults show to adopting new technologies, regardless of the positive changes said technologies can make in their lives, is of concern. We want to explore why older adults are not adopting new technologies at the rates that younger people do, and what changes we can make to make technology more appealing to them. We first will identify how older adults feel about technology (“influencing factors”) and then identify ways to address the concerns.

Influencing Factors

There are many factors that contribute to older adults' reluctance to adopt new technologies. While some may believe that there is simply a lack of interest, both early research (Tobias, 1987) and recent research (Muñoz-Rodríguez et al., 2020) finds that older adults are interested in technology. Factors that have been found to influence technology adoption include technological anxiety, perceived usefulness, perceived ease of use, self-actualization (a motivation to make achievements), and perceived trustworthiness (Steelman et al., 2016; Yao et al., 2022).

We also consider how older adults are engaging with technology when they choose to do so. Although overall use of technology has improved among older adults in the last 20 years, most older adults limit their use to only familiar functions and tend not to try to learn new technologies on their own (Lai, 2018). From this, we can make some assumptions about the perceived usability of technology. For people who engage with some technology in a limited way, it's possible that they have anxiety or fear around trying "unfamiliar" functions. These people may lack skills in navigating or identifying commonly used symbols in graphical user interfaces. It's possible that these people learned how to perform these limited functions from close friends or family members who did not explain why they worked (e.g., "the hamburger button indicates that there is a list of navigation options available after you tap on it") but rather told them that they worked (e.g., "tap this button and then tap that option at the top").

Lastly, we consider other socioeconomic factors, such as education level and income, when assessing technology adoption among older adults. Higher levels of education and income are positively correlated with higher internet literacy among older adults (Hargittai et al, 2018; Hargittai and Dobransky, 2017). Older adults who believe they have strong internet skills ("high internet literacy") have been found to be more willing to adopt new technologies (Berkowsky et al., 2018; Anderberg et al., 2019), so it stands to reason that older adults with lower incomes or education are who need the most attention. Outreach programs, such as education offered at a library, have been found to be very effective with helping older adults learn new technology and keep using it (Lai, 2020), but it must be acknowledged that programs like this are not always offered in lower-income communities.

These factors combined lead us to believe that we can increase the acceptance and adoption of technology among older adults by: (1) improving access to educational resources, (2) building confidence using technology, (3) providing information about the usefulness of specific technologies, and (4) increasing the usability of technology in general (i.e., addressing the "perceived ease of use" of technology).

Improving Access to Educational Resources

While it's hard to get a definite measure of how many communities are lacking libraries entirely, it is possible to assess the services that libraries offer. While libraries are community resources, there are specific factors that influence their ability to help older adults such as: staff training, information services of use to older adults, programs of interest to older adults, appropriate technology, appropriate outreach programs, accessible facilities, and funding (Lenstra, 2019).

Libraries are not the only location that these programs can be offered. Public schools, for example, have been known to host after school programs that serve their communities much in the same way that libraries have. Although it's expected that community outreach programs in public schools will have similar difficulties as those in libraries (such as a lack of training in working with this age group), there is the possibility that having teacher involvement could lead to an environment closer to one-on-one tutoring than a library could typically offer on its own. Outreach programs in schools can also be an opportunity for students to volunteer in their community while assisting older adults with technology.

Building Confidence Using Technology

We can study a specific example of a digital literacy program that occurs in Houghton, Michigan as an example. A group of faculty and students at Michigan Technological University known as BDB (*Breaking Digital Barriers*) has run an outreach program called BASIC (*Building Adult Skills in Computing*) since 2011 at the Portage Lake District Library. This program pairs Michigan Tech students ("tutors") with local adults in the area ("patrons") and aims to provide one-on-one tutoring sessions where technical questions can be answered. BDB defines a set of obstacles, similar to the influencing factors outlined in this paper, that they seek to help patrons overcome. These obstacles include technological anxiety, a fear of online danger, troubles with cross-device functionality, and understanding applications with obscured functionality (e.g., generalized "services" such as Google Workspace versus traditional one-use software such as Microsoft Outlook) (Steelman et al., 2016).

Feedback from patrons that have participated in the BASIC program also describes new, more personal obstacles that they feel could not be addressed with their own resources. Some of these personal obstacles mention things like transitioning from using a Windows device to a Mac device, properly utilizing search engines, finding an appropriate technology for specific problems, and updating the software on devices. Patron testimonials indicate that many older adults do try to utilize their own resources before asking for help, but often are unable to answer their questions via books such as *Windows 10 For Dummies*. While many patrons recognize that their problems could be answered by utilizing a search engine such as Google, they often feel as

though they don't know how to properly type their questions in order to get the results they need (Steelman et al., 2016).

Although it's simple to say that offering educational services such as BASIC will assist older adults in improving their digital literacy (and subsequently, adoption of technology), there is more nuance to an outreach program than simply providing tutors. As Lenstra mentions, many libraries do not have staff that is properly trained to assist older adults in learning technology, and Steelman et al. found that older adults are used to having answers provided for them (e.g., "just do this") but benefit far more from having patient tutors actually teach them how to answer their own questions (2020; 2016). BASIC describes their program as one that helps to develop "digital flexibility, problem solving abilities, and self-efficacy" (Steelman et al., 2017).

These ideas combined allow us to hypothesize that older adults value learning in a more personal setting as opposed to an independent one. When we consider that older adults tend to experience anxiety and fear when using new technologies, it makes sense that they would feel more confident when they have someone to help them gain familiarity with it. Community outreach programs are not perfect, however, and are subject to the socioeconomic factors mentioned previously (e.g., some libraries may not offer similar programs or some communities may not have libraries). Even programs like BASIC have not gone without their share of difficulties, such as when COVID-19 caused the Portage Lake Library to close indefinitely. This meant that the community of older adults in the Houghton area that had come to rely on this service were "stranded" and forced to return to their own resources.

BDB has set out to expand access to their BASIC program both to patrons outside of the Houghton area and to patrons inside the area who may be unable to visit the library. To do this, they've been working on a project called Illuminated Devices which aims to bring the benefits of the in-person tutoring experience to an easily accessible digital platform (Wallace, 2021). This project could be one step in expanding access to educational resources to older adults outside of the Houghton area, helping them build their confidence using technology.

From this study, we can conclude that older adults who participate in community outreach programs do believe that it benefits them. It would be beneficial to run further studies expanding BASIC (or similar outreach programs) to other areas outside of Houghton to gauge community interest and involvement. It's hypothesized that many older adults from communities all over the United States would participate in these programs and express similar remarks about them. Programs like these could lead to an overall increase in technological acceptance and a decrease in technological anxiety among older adults, which may encourage technology adoption.

Addressing Usefulness

It's not the case that older adults overwhelmingly find technology useless to their everyday lives. A survey of older adults (N = 1037) living in Switzerland had 58% respond that they could not imagine life without technological devices. Of those surveyed, the majority believed that the older generation should be using the internet and, even among those who did not use the internet, there was a positive attitude toward it (Seifert & Schelling, 2018). Other research into the opinions of older adults on technology include TechPH, an instrument for measuring attitude and enthusiasm based on a trait called "technophilia" (a strong enthusiasm and love for technology). TechPH takes into account both a user's technological anxiety and a user's technological enthusiasm, and the research found that a higher level of technological enthusiasm did not necessarily correspond to a lower anxiety score (Anderberg et al., 2019).

We can conclude then that older adults overall do find technology useful in its current state, but this does not necessarily mean they will adopt it. Older adults' tended to perceive technology as easier to use if they held positive beliefs about it and its trustworthiness (Anderberg et al., 2019). We hypothesize that the perceived usefulness of technology is not a strong predictor of whether an older adult will adopt technology, as it is related closely with other influencing factors (ease of use and trustworthiness). Instead, we want to focus on improving those other factors by making technology easier and more secure, and we hypothesize that higher adoption rates will follow.

A future study could survey older adults specifically on what technologies they use in their daily lives (TV, mobile phones, IoT devices, etc.), how long they've used these devices, what they use them for, and how easy they perceive them to be. These adults could then be surveyed again at a later time, and be asked these questions again as well as asked if there were any technologies that they had since abandoned. It's likely that older adults with "new" technologies would respond that they do not use them "fully" (e.g., an older adult only using an Alexa to ask about the weather) and that they are difficult to use (e.g., an older adult who says that Alexa does not understand their requests). As well, it's expected that many adults who responded in this way to the first survey would then have abandoned these technologies fully by the second survey. For those who did not abandon technology, it's expected that they would respond that it had become easier to use and that they are using it more frequently.

Addressing Ease of Use

Technology rapidly changes, and a concern of older adults is often that it's difficult to "keep up" with updates (Anderberg et al., 2019). To effectively "keep up" with these changes, one must learn unique skills to identify patterns in software (e.g., a hamburger style icon often indicates a list, a magnifying glass indicates a search feature, etc.). As well, different underlying

structures of software can be formatted in an accessible manner for people with disabilities, such as websites using semantic HTML for those who use screen readers. Unfortunately, these patterns are not always adhered to, meaning that (1) learned skills become outdated or inapplicable and (2) people with disabilities are unable to use applications entirely. As people are more likely to develop disabilities with age, it's important to consider how accessible design contributes to the ease of use of technology.

Some of the specific technologies we've mentioned that we believe should be of particular interest to older adults include VUI and e-readers. VUI are very accessible, making them great tools for older adults with disabilities, and e-readers, which are effectively highly portable "mini-libraries," are great for older adults with more leisure time for reading and travel. However, it's been mentioned that these devices do not actually see the levels of adoption that we expect. We can hypothesize then, based on our review of other influencing factors, that these devices have usability issues that could be addressed to make them more likely to be adopted.

Addressing Ease of Use: Voice-User Interfaces

Interviews with older adults using voice assistants for the first time found that first impressions tended to be positive based on the premise that the speech-based interaction was simple and easy. However, follow-up interactions revealed less positive impressions as users had difficulties structuring commands, incorrect assumptions about how the voice assistants work, and privacy concerns (Kim, 2021).

There are other factors that are unique to VUI that Kim does not consider. Consider how language differs generationally, e.g., the way an elder talks to a close child relative vs. the way two adult strangers communicate. The language and tone of voice used in conversation varies depending on the people involved, the environment, and even the context of the conversation itself. In this regard, it's possible that voice assistants use language that older adults are not familiar with. Similarly, although voice assistants often have configurable voices (e.g., voices of different genders or that recognize different accents), it's possible that the lack of "old-sounding" voice assistants is a barrier to adoption. There's a possibility that "young-sounding" voice assistants are interpreted by older adults as more difficult to understand, even when speaking the same words.

We should also consider the concept of anthropomorphism (applying human characteristics to non-humans) and think about how it applies to VUI. For example, many people "thank" their digital assistants, even though the digital assistants are not people and do not need to be thanked. It's possible that older adults anthropomorphize virtual assistants and this leads them to format their commands in a way the VUI does not accept, e.g., "Alexa, please put on *Can't Help Falling in Love*—it's my favorite" versus "Alexa, play *Can't Help Falling in Love* by

Elvis Presley.” People who anthropomorphize digital assistants might also be led to believe that these assistants are “smarter” than they really are, or assign a level of trust (or distrust) to them as though they were human. Based on research that shows the positive correlation between trust and technology adoption, it’s likely that anthropomorphization is a major barrier between older adults and VUI adoption.

Future research should look into the ideas of (1) voice assistants whose voices and language are modeled on an older population, (2) more intuitive/comprehensive voice commands or a simpler way to teach voice commands to older adults and (3) a way to address and de-anthropomorphize peoples’ views about voice assistants.

Addressing Ease of Use: E-Readers

Research has found that there is little difference in reading outcomes between people reading on paper versus reading via digital technologies such as e-readers (Hou et al., 2017). This same research, however, found that participants reported stronger feelings of fatigue when they were asked to read digital text using a “scrolling” method versus when using a method that more closely simulated turning a page. This same research also found that participants with technophobia spent longer to read the texts and reported higher levels of fatigue after reading digital texts compared to their non-technophobic peers.

While this is only one study, it opens up room for future studies that focus on the design of e-readers. Based on the reports of fatigue being related to technophobia and the “scrolling” method of navigating digital texts, it’s possible that skeuomorphism (designing graphical interfaces in a way that mimics real-life objects) is a helpful design technique for assisting older adults with technologies. A study could be run on this theory by having older adults read digital texts from two kinds of e-readers: one that is an LCD tablet with text on the screen (e.g., an e-book on an iPad that users scroll vertically through) and one that attempts to resemble a physical book as closely as possible (e.g., an electronic ink device such as a Kindle that users scroll through horizontally with “page flipping” animations). It is hypothesized that older adults will find the skeuomorphic device to be easier to use because its feeling and controls remind them of physical books.

Conclusion

Technology adoption among older adults is a difficult challenge that has no single answer. Because there is such a wide array of devices, there is no “one size fits all” solution to increasing technology adoption in general. There are, however, multiple factors that create barriers to adoption that can be individually addressed on a case-by-case basis. We have explored different ideas for addressing these barriers, such as increasing educational resources through the

implementation of community outreach programs. These programs help inform people of new technologies and build confidence in technology while reducing their technological anxiety (technophobia). As well, ideas about how to make devices easier to use have been explored, such as implementing skeuomorphic designs and addressing the anthropomorphization of devices.

It's likely that these separate ideas could be combined into a single useful community outreach program. We propose a research project that focuses on creating an outreach program at a local library that (1) helps adults learn about new technologies, (2) helps adults answer questions about technologies they currently use, (3) helps adults explore alternate options for technological solutions (e.g., Kindle vs. iPad for reading e-books), and (4) teaches adults about the pitfall of anthropomorphizing their devices. This outreach program, based on the documented success of BASIC, is expected to see high levels of community engagement while providing older adults with a resource that aids them in adopting technology.

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