

Hey Alexa, How Do You Help Blind Customers?

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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The Amazon Alexa system, released in 2014, has taken the world by storm. Many millions of people have benefitted worldwide from the use of this technology or from its cousins Apple's *Siri*, Microsoft's *Cortana*, or Google's *Ok, Google*. What about people with disabilities? Especially people who are blind? Do they experience similar benefits to everyone else or are we subconsciously and unintentionally excluding people who could benefit the most from these types of systems in our race to build the technological future? The goal of this project is to answer the question "have voice assistive technologies, like the Amazon Alexa system, improved the lives of blind people?" I want to show that blind users are benefitted by the adoption of this technology, even though this technology is not designed optimally for them. I will examine specific benefits that blind users enjoy and specific problems that blind users experience when dealing with voice activated personal assistants, so that future product developers might take these factors into account and so that the rest of us can be a little more aware of the people around us and the ways they use technology. This topic is chosen to facilitate building technologies in the future that attempts to include as many types of people as possible.

Systems such as Amazon's Alexa, Apple's Siri, Microsoft's Cortana, and Google's OK Google are known as Voice Activated Personal Assistants or VAPAs. Throughout this project, I will use the term voice assistant to refer to them. Lucasz Osowski, one of the original creators of a polish speech synthesis system named Ivona, which later became Alexa, walked through the history of his system in an interview with reporter Monika Redzisz. Lucasz recounts that he was inspired by the 1968 film, *2001: A Space Odyssey*, in which a computer could converse with humans. As a master's student of Electrical Engineering at Gdansk University of Technology in Poland, Lucasz together with Michael Kasczuk in 2000, decided to develop a speech synthesizer for his thesis project, which allows a computer to speak out loud in a natural human sounding voice. This thesis project turned into a small startup company that eventually achieved full synthesis in 2006, in which there was very little perceivable difference between the recordings of a voice actor and the recordings synthetically generated. In a global competition, Lucasz's company outperformed research teams from IBM, Microsoft, University of Tokyo, University

of Beijing, and University of Barcelona and as a result, was approached by Amazon in 2010 to develop what is now the Alexa. (Redzisz)

The process of research for this project involved searching through many Academic journals such as the ACM (Association for Computing Machinery) Library, the IEEE (Institute of Electrical and Electronics Engineers) Xplore library, and the Web of Science, to find articles that talk specifically about voice activated personal assistants, like the Amazon Alexa system, and their impact on people with disabilities and especially blindness.

In the article “Reading between the Guidelines: How commercial Voice assistant guidelines Hinder Accessibility for blind users” by researchers Stacy Branham and Antony Rishin Mukkath Roy, the authors searched through the guidelines posted by Google, Amazon, Microsoft, Apple, and Alibaba concerning their voice activated personal assistant systems and the principles by which they developed their systems. The authors collected these guidelines and organized them into five categories, namely having the goals of making conversations between the user and the device more human, personal, efficient, relational, and controllable. It appears that all of these companies employ a Human-to-Human conversation model as the target, but this might not be the best target model for disabled users (Branham, 2019). A Human-to-Human conversation model means that the ideal for how information is delivered to the customer mimics a conversation between friends. This is not the only possible model for auditory information transmission, and this axiomatic choice ought to be questioned in multiple scenarios. According to this article, the goal of accessibility for the disabled is notably absent from any of the observed guidelines. This article references other studies which claim that some blind people, who are used to complex screen reader technology, can be far superior to sighted users in serial memory tasks and comprehending fast speech (Branham, 2019). In this case, the slow and conversational nature of the commercial voice assistants can be infuriatingly slow. To make this voice assistant technology better designed for blind users, the authors recommend being able to set a large variety of defaults and custom voice commands. These defaults might include properties like rate of speech, pitch, session timeout, list length, and complexity of words.

Rachel Cericola, a technology journalist for Wirecutter, wrote an extensive review of smart home devices available on the market, and she focused especially on how these devices can enhance independence for people with disabilities and mobility needs. She specifically looked at devices that allowed for remote control from anywhere in the world, that required a stable Wi-Fi connection, that provided the opportunity to schedule events based on specific times or actions, that supported integration with voice activated personal assistants like the Amazon Alexa, and that were relatively simple to operate. The part of Rachel's work that is relevant for this discussion is the section about smart speakers and smart tablets, specifically the Amazon Echo Show 8 (2nd Generation), the Apple iPad (8th Generation), and the Amazon Echo (4th Generation). She mentions that these systems allow for defining routines and shortcuts which can help blind users accomplish often repeated tasks very easily (Cericola, 2021). For the Amazon Echo Show 8, Rachel stresses the high quality 13 megapixel camera which automatically zooms, pans, and frames the user in view, which allows for crisp video calls, as well as features like *Alexa's show and tell* and the *Be My Eyes* app, which can greatly help blind users identify items in their surroundings. For the iPad, she stresses the convenience and portability as well as the seamless connection to the Apple HomeKit system. For the Echo, she emphasizes much lower cost compared to the smart tablets with many of the same features and the possibility of linking together many speakers throughout the house to create an effective intercom system. According to Rachel's research, it seems as though voice activated personal assistants are a definite improvement in the lives of people with blindness. This is an example where blind users are benefitted by the adoption of voice assistant technology, when paired with the right smart home device.

Researchers Kevin Storer, Tejinder Judge, and Stacy Branham explored the advantages and disadvantages of integrating a Voice Assistant into the home of mixed visual ability families. They interviewed six families where one only person in the couple used a screen reader as the primary method of interacting with a digital device and the family owned a Voice Assistant system. In the interviews, the authors discovered that the blind person in the couple generally had a greater motivation to use and learn about the voice assistant and the variation of uses of this technology can be primarily attributed to the

differences between couples and not to differences within a family (Storer et al., 2020). This helps to show that blind users do benefit from a voice assistive system, and that their sighted partners tend to follow along even if it does not benefit them as highly. The authors grouped the specific uses and tradeoffs of adopting this technology into three broad categories: interpersonal relationships, domestic labor, and physical safety. In the category of interpersonal relationships, the authors found positive results such as many of the families invented audio only games to play with the voice assistant that included the blind member in contrast to board games or card games, which generally excludes blind users from participating. Some families mentioned increased interpersonal tensions due to the technology such as a child playing around with the device while the Blind user wishes to do something productive with it. In the category of domestic labor, the authors found that having a voice assistant around greatly helped the blind users in performing tasks like setting timers, quickly looking up information and helping children with their homework as well as peripheral tasks like listening to music or a podcast while performing a domestic task. The problems cited in the interviews in this area were related to parental concerns about raising respectful and helpful children in an environment where they could be mean and condescending and the voice assistant still responds as if nothing is wrong (Storer et al., 2020). In these categories, it seems clear that the voice assistance adds great benefit to the blind user in their daily routine and it allows them to do things that they could not before. It also appears that this technology does not change the need for families in general to remain healthy and communicate their needs, values, and boundaries with each other regularly and honestly. It only adjusts the specific topics that need to be talked about. Five of the six couples interviewed mentioned safety and security as a primary reason for owning a voice assistant, because it could allow the blind user to access things like house lights and security cameras as well as remote oven and toaster controls for fire safety. Together with this major reason for owning a voice assistant comes many of the participants' biggest fear, that some malicious actor could hack into the system and compromise the family's safety by recording and selling private information, by remotely unlocking the door, or by remotely controlling lights and appliances without the owners' permission or control (Storer et al., 2020). In this category of safety and security, it is difficult to say whether blind

users benefit significantly from the addition of this technology into their lives, because while there are some definite advantages when a security threat does not occur, and it probably will not occur, but if it does, then any prior advantages are instantly negated by this huge new problem.

In the article “‘Siri Talks at You’: An Empirical Investigation of Voice-Activated Personal Assistant (VAPA) Usage by individuals Who Are Blind” by researchers Ali Abdolrahmani, Ravi Kuber, and Stacy Branham, the authors interviewed fourteen legally blind adults about their experience using a voice assistant and the problems they encountered. Many participants in this study reported struggling with session time out, in which the user is given a specific number of seconds to state a query. This is because many blind people, when formulating a complex command, prefer to state all the necessary information in one continuous line of text, rather than participating in a conversation with the computer (Abdolrahmani et al., 2018). Users reported that the voice assistant often misinterpreted complex commands, colloquial language, or names, and the process of noticing and correcting such mistakes is significantly harder being blind. This study found that many of the blind users felt that the conversational nature of the voice assistant systems to be verbose and irrelevant and would prefer an option to simplify responses down to the basic information. They also found that many of participants would prefer to have much more fine control over the voice output depending on the task currently being performed (Abdolrahmani et al., 2018). These problems indicate a picture that the developers of voice assistants do not consider blind users and the challenges with this technology.

The last article I wish to examine is the article titled “Blind Leading the Sighted: Drawing Design Insights from Blind Users towards More Productivity-oriented voice Interfaces” by researchers Ali Abdorahmani, Kevin Storer, Antony Roy, Ravi Kuber, and Stacy Branham, which builds upon the findings in the previous article. The three observations about the design of voice assistants that these researchers arrive at are that voice assistants need to support a greater variety of personas with different specializations, that voice assistants need to maintain continuity of voice interaction, and that blind voice assistant expert users should be consulted in the design. The researchers built upon the prior interview study by analyzing 28 podcast episodes in which blind users described their reactions to voice assistive

technologies. Some problems identified in the first study were that commands were often misinterpreted and fixing errors proved challenging, that the voice assistant would respond in a manner inappropriate to the particular social situation, that the system either failed to activate when the wake word was spoken or misfired unintentionally, and that many voice assistants have some amount of visual information, that is inaccessible to blind users (Abdolrahmani et al., 2019). Many of these problems, while not unique to blind users specifically, are unique to blind users in the effect that they have. This is because the blind person is more dependent on the information provided by the voice assistant. Also sighted users can easily identify when a mistake has been made as they can usually just look at the screen or the indicator lights. In the second study analyzing the podcast episodes, the authors collected all of the recommendations made by the blind users to improve accessibility into a table and most recommendations have to do with greatly increasing the number of customizable features and options as well as providing extensive auditory walkthroughs, tutorials, and menu selections (Abdolrahmani et al., 2019). Based on this table, it appears that the lack of customizability in current voice assistants hinders the ways in which blind users would prefer to operate. In four separate episodes, blind users mentioned that the physical layout of a device like the Echo is poorly designed for blind users, because the buttons are flat and only visually identifiable (Abdolrahmani et al., 2019). Many users also mentioned that the Alexa companion app developed by Amazon is extremely clunky to use with a screen reader. On the positive side, many users recounted that voice assistants are useful for work tasks like email, that often a voice assistant is faster than the traditional method through the app, that they provide a sense of empowerment and independence to blind users, and that they are an affordable system that promotes platform integration (Abdolrahmani et al., p. 20-24). From these observations it does seem that blind users are included, and their lives are improved, but the system is not optimized for blind users due to the limited customizability.

As we build technological systems to improve the lives of people all over the world, it is crucial to remember that not everyone has the same abilities or needs. It is incumbent on a moral society to include, if in any way possible, as many types of people as possible when designing and building

technological systems. The goal of this project is to understand specifically how voice assistant systems like the Amazon Alexa have provided benefits to or introduced problems for blind users. In this project, we found that generally blind users can effectively use a voice activated personal assistant, but problems like lack of system customization prevents blind users from using the technology optimally. There are several possible extensions to this project. For example, one could investigate the impact of voice assistants on people with different degrees of Autism, who might not be able to comprehend or formulate speech as naturally as someone else might. Additionally, it might be possible to look at how voice assistants paired with home automation systems help wheelchair bound users accomplish things they could not otherwise. Lastly, someone could look at how voice assistants have helped increase the autonomy of elderly users, who might be naturally adverse to trying a new and confusing piece of technology. It seems that Alexa does greatly improve the lives of blind people and there is room for improvement.

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