Seniors' Perception of Smart speakers: Challenges and Opportunities Elicited in the Silver&Home Living Lab

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Abstract. As the European population is getting older, there is an increasing need in maintaining older adults living independently at home. Vocal assistants may offer various services that can be beneficial for senior citizens. In the context of the Silver&Home living lab, we tested the Google Home Smart speaker connected to smart lighting installation with 7 people to understand the strengths, weaknesses and possible usage for improving the quality of life of older adults. The test and the questions asked to participants were framed according to the Unified Theory on Acceptance and Use of Technology (UTAUT2). Participants generally appreciated the interaction with the smart speaker, although they also identified some barriers, such as the "OK Google" wakeword or the assistant speaking too fast for some answers. Finally, they considered it particularly adapted to people living alone.

Keywords: First Keyword, Second Keyword, Third Keyword, Forth Keyword, Sixth Keyword.

1   Introduction

As the European population is getting older, there is an increasing need in maintaining older adults living independently at home. Vocal assistants integrated in smart speakers may offer various services that can be beneficial for senior citizens. Although smart speakers are nowadays particularly affordable and voice interaction is particularly robust, these devices were not built with seniors in mind as target users [1]. This might lead to many services that are not appealing for older adults and to a mismatch between the mental model needed to interact with the device and the mental model that seniors actually adopt. On one side, as vocal interaction is a natural communication manner for seniors, they may adopt a mental model typical of human-human conversation, which brings to higher expectations compared to the conversation that vocal assistants can actually manage. On the other hand, when considering vocal assistants as a computer, seniors might borrow a mental model from the more familiar Graphical User Interfaces, which provide a more consistent and seamless experience (one icon

corresponding to one outcome), compared to vocal assistants, which, conversely, may still suffer from speech misrecognition [2].

In the context of the Silver&Home Living Lab in Switzerland, we conducted 4 test sessions to understand the appropriateness of this solution for older adults. During each test, each participant had the possibility to explore several features of the Google Home Smart speaker, including the possibility to control a smart lighting system. Our paper sheds additional light on opportunities and pitfalls of such devices.

To position our work, we report in Section 2 previous studies with commercial smart speakers. Then, we detail the testing methodology, in particular explaining the test environment of the Silver&Home living lab and the testing framework based on the UTAUT2 model [3]. Finally, in Section 4 we report the results of the tests, which are discussed in Section 5.

2 Related Work

2.1 Smart speakers

First commercial release of Smart speakers dates to 2015, when Amazon release the Echo. Shortly after, in 2016, Google launched the Google Home (renamed as Google Nest in 2019) and, in 2018, Apple announced the HomePod. All these smart speakers rely on the respective proprietary conversational agent technology, which is also available in the smartphones. Worldwide adoption of smart speakers did not happen until 2018, when proper language models were trained for each country. As Switzerland has three national languages and its market is quite fragmented, Amazon Echo is still not officially available in this country. Smart speakers are actually mostly unknown by the older Swiss population. Since commercial smart speakers are targeting the very large public, their design may have forgotten the special needs of older adults. To better address older adults' needs, El Kamali et al. [4] co-designed a smart speaker and the underlying conversational agent together with older adults from four European countries. This device is still currently under test. In the next subsection, we discuss the insights collected by previous research on commercial smart speakers.

2.2 Previous tests of smart speakers with older adults

Conversational agents for assisting older adults have been developed and tested since several years by the research community. However, smart speakers are nowadays proposing a mature technology to the mass at an affordable price and they open new interaction scenarios also for older adults. In order to assess the usability and usefulness perceived by older adults, recently, several researchers tested the Amazon Echo or Google Home with older adults.

Trajkova and Martin-Hammond [5] interviewed 36 seniors that were enrolled for testing the Amazon Echo in USA for over 1 year. Most of the users used seldom the device and only 18% used it daily. The authors reported that most common uses of the Echo were listening to music/radio, setting alarms/timers/reminders, asking for the

weather and latest news. In general, non-adopters complained with the lack of useful functions, considering the device "a toy" rather than a device that can be beneficial for their life and well-being. Indeed, they wished that it could promote prevention plans and that could better integrate with health data (at the same time they were also scared by privacy issues). They also considered the Echo particularly useful for people with disabilities.

After testing the Amazon Echo Dot with 7 older adults with low technology proficiency, Pradhan et al. [6] analyzed the users' perception of the Alexa assistant in terms of social companionship. They found that Alexa was never clearly *personified* or *objectified*, but rather a mix between the two. Although users referred to it as "she" and as someone to talk to, they also considered Alexa often as a machine rather than as a person. Nevertheless, they often used politeness forms, for example for thanking Alexa. In a later article,[2] the authors reported that the most interesting features for the users were the possibility to look for health-related information and to set reminders for supporting memory (although this latter was seldom used in the end). Although participants had difficulties in identifying the right keywords for interacting and the experience was not faultless, they were still willing to continue using the device after the testing period.

Kowalski et al. [7] tested the Google Home speaker with seven older adults with good ICT skills in a living lab in Poland. The smart speaker was connected to a smart home setup composed by a lighting system, a TV and a fan connected to a Wi-Fi relay. Participants were particularly enthusiastic of the interaction possibilities enabled by the smart speaker and found that it increased the accessibility of smart home technology compared to screen-based interfaces.

The results of previous studies are often discordant and may depend on the users' ICT literacy level as well as on the way participants were interviewed or prompted in focus-group discussions, where ideas may converge towards stereotyped considerations for "other older adult end-users", rather than for themselves [8]. In the next sections we present our methodology, and we discuss how our results relate to previous studies.

3 Methods

3.1 Living Lab and installation

Silver&Home is a living lab in Fribourg, Switzerland, aiming at sensitizing senior citizens and healthcare professionals to the opportunities that gerontechnologies can offer for increasing the seniors' quality of life. A 3.5-room apartment was furnished to recreate a senior's home environment and about 40 devices that can be used for improving the quality of older life were installed in this apartment. We invited senior citizens to visit this showroom with the purpose to discover such technology and to test some of the devices installed in the apartment. In particular, for this study, a Google Home Smart speaker was connected to the Homey home automation controller, to a Spotify account and to a Samsung smart TV. The Homey box controlled the ceiling lights through the Qubino wireless relays and a floor lamp through a smart plug. The lighting system could be controlled also with a wireless button (double click to switch

on all lights and long press to switch off all lights) as well as with a smart frame able to recognize swipe gestures. Lights were associated to the different rooms in the apartment (bathroom, living room, kitchen, etc.) and configured in the Google Home app prior to the test. Finally, a *routine* was configured in the Google Assistant: when prompted with "Good Morning", Google Home switched on the lights, spoke about the weather, reminded about the next appointments in the calendar and, as final action, played music from a local radio. In order to avoid confusion and unwanted answers during the discussion with the participant, the smart speaker was configured as to not listen for new commands after the vocal assistant reply.

3.2   Testing Framework

After introducing the device with a commercial video by Google, we asked visitors to interact with the smart speaker and we interviewed them to understand the factors that might influence the adoption of such device in their daily routines. The questions were inspired by the UTAUT2 framework for technology acceptance and use [3]. This framework is used for all the tests in the Silver&Home living lab, in order to understand which are the factors that can affeect technology acceptance and use. Tests and questions are adapted for each product but reflect a similar structure in order to explore all the factors of the UTAUT2 model, namely: Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value, Habit, Behavioral Intention [3].

After a visit of the Silver&Home showroom, participants filled in a consent form and a questionnaire about personal information and previous knowledge of technology (Habit factor). Participants were introduced to the device with an official advertisement video of the product. Then, users had the opportunity to test different features of the smart speaker, namely: T1) asking for generic questions such as a recipe, weather and transport information; T2) asking for music, such as a preferred song or artist; T3) turning on lights in the apartment; T4) triggering Google Home Routines. 21 questions framed according to the UTAUT2 model were asked to the participants. The detailed steps and questions of the test are reported in the following list (in parenthesis are reported the corresponding factors of the UTAUT2 model):

- *V1. Product presentation video*
- Q1. Does this product seem useful to you? (Performance Expectancy)
- *T1. Please, ask a question about a recipe, the weather or transport information for nearby city*
- Q2. Was it easy to speak with the Google Home assistant? (Effort Expectancy)
- Q3. Do you think that the "OK Google" wakeword is natural/convenient? (Effort Expectancy)
- Q4. Do you think that the assistant voice was clear? Do you prefer a male or female voice? (Hedonic Motivation)
- Q5. Are you satisfied by the assistant answer? Was it coherent with your question? (Performance Expectancy)
- *T2. Please, ask to play a song or a music genre that you like, then try to increase or decrease the volume*

- Q6. Do you think that playing a song and adjusting the volume was easy? (Effort Expectancy)
- Q7. Are you satisfied by the assistant answer? Was it coherent with your question? (Performance Expectancy)
- Q8. How do you consider the music/audio quality? (Hedonic Motivation)
- *T3. Please, ask to switch on/off the lights of the apartment or of a specific room*
- Q9. Was it easy to switch on/off the lights? (Effort Expectancy)
- Q10. Are you satisfied by the assistant answer/action? Was it coherent with your question? (Performance Expectancy)
- *T4. Please, say "Good Morning" to test the preregistered routine*
- Q11. Do you think that this routine could be useful for you? (Performance Expectancy)
- Q12. Which information would you like to get at the beginning of the day? (Performance Expectancy)
- Q13. Do you like the physical design of the Google Home? (Hedonic Motivation)
- Q14. The price of the Google Home is about 150CHF. Do you think that this price is reasonable for the features that it offers? (Price Value)
- Q15. In order to benefit of all the music selection, you will need an additional abonnement to Spotify of 12.95 CHF per month. Do you think that the price of this service is appropriated? (Price Value)
- Q16. In order to equip an apartment like this with voice-controlled lights you need additional equipment for around 600 CHF. Do you think that the price is adequate for the functions offered? (Price Value)
- Q17. Do you think that the speaker sound is loud enough? (Effort Expectancy)
- Q18. In order to set up the system, a couple of apps and accounts should be configured. Do you think that somebody could help you with this task? (Facilitating Conditions / Social Influence)
- Q19. How often would you use this product? (Behavioral Intention)
- Q20. Would you recommend this product to your acquaintances? (Behavioral Intention)
- Q21. Do you have any suggestions or improvements for this product?

3.3   Participants

7 participants (4 female) volunteered for the test. 6 participants were 50+ (2 of them were 80), while 1 participant was a caregiver working with older adults affected by memory problems. All participants lived in couple, or in a house with more than 3 people. 6 participants had a smartphone or tablet, the other person had a computer. All participants used these devices at least once per day. 4 participants use from time to time the vocal assistant integrated in the smartphone. Even if all participants are acquainted with technology, about 1/3 of participants were rather skeptical about technological innovation, whereas the others were rather interested in the new technologies. All participants were native French speakers and interacted with the Google Home Smart speaker in this language.

4   Results

4 participants considered the Google Home very useful after watching the advertisement video, only 2 not so useful (Q1). The skeptical participants perceived the Google Home rather as a technological gadget. One person suggested that the device could be useful for people with mobility impairments whereas another thought that the device would be helpful for people living alone.

During the first test, 2 people had trouble interacting with the vocal assistant, having to repeat the questions before getting the correct answer. They judged the easiness of the interaction as average, saying that it would require some time in order to get used to the device, while most of the other people considered the interaction easy or very easy (Q2). All participants considered the speed of the voice during the first interaction (a recipe) too fast (Q4), but appreciated the possibility to receive the link to the recipe in the smartphone. 3 people regretted that the assistant did not reply to thanking with a "you're welcome". 3 people considered difficult the "OK Google" wakeword. All participants considered the voice very natural (Q3). Female participants said that they would have preferred a male voice, considering it more reassuring, while males appreciated the current female voice (Q3). While some answers to the first questions did not satisfy completely all the users (Q5), reply to the music questions (T2) were very satisfying, most of them being surprised of the capability of the assistant to find their songs, being them not so popular (Q7). 6 people found the quality of the sound excellent, while 1 person, an audiophile, found it just about good (Q8). All people found intuitive giving commands for the musique and adjusting the volume (Q6). However, one participant noted that one should know in advance the exact name of the song, which could be difficult in case of memory troubles.

Participants found very intuitive also the interaction with lights (T3), although more than one person remarked the need of preparing the right question in advance, as the speaker interpret the question as soon as the user stop speaking (Q9). The fact that the exact name of the room should be spelled out in order to switch on the lights of this room was considered as a limiting factor as synonyms of the room names were not recognized (Q10). One user also suggested that the device should understand the user location and habits in order to facilitate this task. Considering the test about the Google Routine (T4), only one person found this feature not so useful (Q11). Nevertheless, two participants highlighted the difficulty to use this feature when living in couple, as each person would have different routines, concluding that this feature would be particularly useful for people living alone. In general, participants would include in the routine the weather information (5 people), reminders about calendar appointments (5), news (4), other reminders (2), automatic lighting (2) and nearby events, festivals, or new films at the cinema (1) (Q12). The physical design of the Google Home was also appreciated, being discreet and modern (Q13) and the sound volume was considered satisfactory by all participants (Q17). They thought that it could blend well in the living room or kitchen, whereas they generally would not install it in the bedroom. The price of the Google Home was considered adequate by all participants, because of all the features offered without any additional monthly fees (Q14). A participant complained about the fact that it is generally not possible to test these kinds of products in the shops and that

they are available only in specialized consumer electronics shops. Conversely, most participants found inadequate the monthly fees for services like Spotify (Q15). Besides the price for a feature that might not be interesting for them, they were particularly worried about the additional burden of managing all the subscriptions. One participant suggested that it would be much easier for the seniors if all these services were included in a unique offer from a trustable provider (for example, their Internet provider). The additional price for the lighting system was considered as reasonable by all participants (Q16). However, while one participant said that it would be good especially in future perspectives of reduced mobility, another said that most peoples in their 70s were not used to spend money on non-essential goods. Participants also shared their concerns about the risk of sedentariness that the lighting system could introduce, considering it really useful only for people with reduced mobility. Concerning the difficulty for configuring the Google Home, all participants said that they could easily find help from their family or friends (Q18). After the test session, 5 participants said that they would use the device daily, about once per month the others (Q19). Most participants considered that they would particularly appreciate such kind of interactions if they were living alone, since it could decrease the sense of loneliness. All the participants would also recommend the product to their acquaintances, although some people noted that they might still not need it at this stage (Q20). Among the suggestions for improvements (Q21), participants highlighted the importance of personalizing the wakeword and of having a detailed user manual with the possible questions and keywords. One also suggested to use the speaker to send daily reminders to people with cognitive problems.

5 Discussion and Conclusion

Although smart speakers are still considered by some older adults as tech gadgets, they offer services that might be useful for older adults. The participants to our test considered that Google Home would be particularly useful for people living alone, since the vocal interaction could partly relieve the sense of loneliness. Although interacting with Google Home was generally intuitive for most participants, many improvements are still required for increasing the device accessibility. The "OK Google" wakeword is often difficult, especially for non-English speakers, and, in the case of the recipe, the speech was too fast to be remembered by the users. For some participants, it was difficult to figure out how to properly formulate a question. They eventually had a pause in the middle of the question to think about the next part of the phrase, and Google Home interpreted just the first part, without giving time to the participant to finish the phrase. A participant advocated the need of a more advanced artificial intelligence, able to better understand their wishes and context of use, such as the user location and habits. The ambiguous feeling of the assistant being neither "human" or "object" highlighted by Pradhan et al.[6] was probably present also in our participants, although never explicitly expressed (in French there is no neutral pronoun). However, participants highlighted the importance of adding politeness forms, to give it an additional "touch of humanity". In the end, although most of them said that they would use the device daily, they also highlighted possible conflicts in usage in couples. Therefore, although the

answer to our question on Behavioral Intention to use the device was generally positive, we think that an important gap between intention to use and actual adoption still exist.

Finally, a professional highlighted the potential benefit of continuous reminders of daily activities for people with short memory troubles. Unfortunately, the Google Home smart speaker cannot address the needs of these people, because it cannot speak out reminders without being prompted first by the user. This feature was clearly avoided by Google in favor of a less intrusive device for the majority of the population.

Acknowledgments

References

1. Sayago, S., Neves, B.B., Cowan, B.R.: Voice assistants and older people: some open issues. In: Proceedings of the 1st International Conference on Conversational User Interfaces, pp. 1-3. (2019)
2. Pradhan, A., Lazar, A., Findlater, L.: Use of intelligent voice assistants by older adults with low technology use. ACM Transactions on Computer-Human Interaction (TOCHI) 27, 1-27 (2020)
3. Venkatesh, V., Thong, J.Y., Xu, X.: Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS quarterly 157-178 (2012)
4. El Kamali, M., Angelini, L., Caon, M., Khaled, O.A., Mugellini, E., Dulack, N., Chamberlin, P., Craig, C., Andreoni, G.: NESTORE: Mobile Chatbot and Tangible Vocal Assistant to Support Older Adults' Wellbeing. In: Proceedings of the 2nd Conference on Conversational User Interfaces, pp. 1-3. (2020)
5. Trajkova, M., Martin-Hammond, A.: " Alexa is a Toy": Exploring Older Adults' Reasons for Using, Limiting, and Abandoning Echo. In: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, pp. 1-13. (2020)
6. Pradhan, A., Findlater, L., Lazar, A.: " Phantom Friend" or" Just a Box with Information" Personification and Ontological Categorization of Smart speaker-based Voice Assistants by Older Adults. Proceedings of the ACM on Human-Computer Interaction 3, 1-21 (2019)
7. Kowalski, J., Jaskulska, A., Skorupska, K., Abramczuk, K., Biele, C., Kopeć, W., Marasek, K.: Older adults and voice interaction: A pilot study with google home. In: Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems, pp. 1-6. (2019)
8. Pradhan, A., Jelen, B., Siek, K.A., Chan, J., Lazar, A.: Understanding Older Adults' Participation in Design Workshops. In: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, pp. 1-15. (2020)