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Does Alexa Live Up to the Hype? Contrasting Expectations from Mass Media Narratives and Older Adults' Hands-on Experiences of Voice Interfaces

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Abstract

Voice user interfaces (VUIs) are advertised as easy to use and beneficial to older adults (OAs). Disparities between expectations and OAs' hands-on experiences with VUIs may discourage OAs' further use of VUIs and widen digital divides. To understand such disparities, we conducted two-week in-home field deployments of the Amazon Echo Dot with OAs. We interviewed participants before and after deployment on their perceptions of VUIs in relation to prevailing media-derived expectations about VUIs. Our analysis revealed mismatches between expectation and hands-on experiences with VUIs; namely, VUIs were found to be more primitive than expected, there were more limitations to VUIs than expected, more prerequisites were required to fully make use of VUIs, and the sources that VUIs drew from fell short in earning trust. Our findings contribute aspects to be considered to close the gap between expectations and experiences related to VUIs for older adults.

CCS CONCEPTS • Human-centered computing → Natural language interfaces; *HCI design and evaluation methods*

Additional Keywords and Phrases: Voice User Interfaces, Older Adults, Mass Media, Interviews, Sociotechnical

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1 Introduction

Voice user interfaces (VUIs) allow for interaction with computing devices through one's voice. This mode of interaction is hailed as being natural and easy to use [21], especially when compared to traditional interfaces, like graphical interfaces, which may pose visual, auditory, physical, and motor-based barriers to interaction [17, 33]. These aspects have encouraged the growing interest in the incorporation of VUIs into devices and the everyday lives of older adults (those 60+) for improved wellbeing and increase in their access to digital spaces [20, 27, 33]. VUIs are promised to become no longer only a gimmick, but also a provider of key services. For example, voice-enabled services offered

through the Amazon Alexa, a VUI in the form of a "smart speaker" that is connected to the internet, allow older adults to stay engaged in society by connecting with loved ones [5], consuming news, and even calling their government leaders [1].

However, despite the promise of VUIs' potential to improve older adults' ability to engage with essential life services in an accessible way that is hands-free and intuitive, VUIs are still a novel technology for many older adults, and the barriers and drivers of older adults' expectations and perceptions of VUIs are not yet fully understood [27, 30]. This knowledge gap becomes more relevant every day in the face of the ongoing market push for "voice-first" devices [35] that employ voice input and speech as the primary modes of interaction. Insufficient understanding of factors of adoption (e.g., the mass media) of VUIs may result in the design of VUIs that are not adopted by older adults. This can result in potential harm or marginalization by VUIs of this very user group VUIs are meant to benefit [27, 28].

Thus, we wanted to understand the impact of expectations on older adults' acceptance of VUIs. To do this, we conducted two-week in-home field deployments of the Amazon Echo Dot with older adults. We focused our investigation on mass media as the factor in the formation of expectations and subsequent adoption of novel technologies [3]. Previously, the mass media has been observed to influence adoption, perceptions, and expectations of technology in the case of smartphones [13] and television [34]. Some of mass media's messaging is made in an effort to sell technology but may also influence and reflect public discourse and expectations on a technology [3]. In terms of VUIs, the mass media pushes older adults as a viable target market for such devices [29]. Moreover, the mass media suggests that data privacy, trust in the organizations behind VUIs, fit into and benefits that VUIs can bring to their lives, and market and government actions are the main issues for older adults when it comes to VUIs. However, we do not yet know if what the mass media says about VUIs aligns with older adults' attitudes towards, perceptions, and expectations of VUIs. Since pre-adoption expectations have been shown to be linked to subsequent usage and perceptions of technology [37], the same may be the case with older adults' adoption of VUI devices. Mismatched expectations may become a barrier for older adults' use and adoption of VUI technology.

As such, we conducted a study to find out: what are older adults' perceptions of VUIs compared to media messaging before and after having hands-on experience using VUIs? We first asked participants to read news articles about VUIs in order to encourage them to form expectations about VUIs. Then, we interviewed participants on their perceptions of VUIs in relation to how the media represents VUIs. Finally, after the deployment period, we interviewed participants once more to gather their perceptions of VUIs based on their expectations and experiences. The interview transcripts were coded and analyzed for themes using inductive thematic analysis. Our analysis showed discrepancies between older adults' expectations and hands-on experiences with VUIs. Namely, the participants found that the VUIs were found to be more primitive than expected, there were more limitations to VUIs than expected, more prerequisites were required to fully make use of VUIs, and the sources that VUIs drew from fell short in earning trust.

The analysis shows that there is a mismatch in mass media expectations of VUIs and older adults' experiences with these devices. Moreover, the findings contribute aspects to consider with respect to the further research, design, and development of VUIs for older adults. Our work contributes to designers' understanding of broader sociotechnical factors, such as society's narrative of technology, on VUI adoption. It also adds to other work from the HCI community, such as [25] and [18], that have discussed the role of the media in technology adoption. The papers [25] and [18] are outside the field of voice- and conversational- user interfaces but demonstrate how, as the HCI community, we are interested in how the media affects issues related to technology.

2 Background and Related Work

2.1 Older adults and Voice User Interfaces (VUIs)

The use of VUIs is continually increasing [17], especially when it comes to their applications by older adults (those 60+) [24]. The growing interest may be motivated by perceptions that VUIs have lower visual, auditory, physical, and motor-based barriers to use and provide improved accessibility [11, 33] when compared to commonplace graphical user interfaces. However, benefits conferred to older adults are only available should the technology be designed to maximize benefits for these users [15, 16, 19, 32, 36] and also not digitally marginalize them by design [28]. In addition, we do not

yet know how to design and evaluate VUIs in a manner that maximizes their benefits for older adults, in particular the perceptions and barriers to use of VUIs and how VUIs should be designed to interact with older adults [27].

2.2 Older Adults' Perceptions of Voice User Interfaces (VUIs)

Studying older adults' perceptions of VUIs can help with understanding the factors of adoption with regards to their use of VUIs. Some work has been conducted in this regard. For example, older adults have found voice-based technologies less convenient or favorable than younger people [14]. Older people have also been found to hold more negative attitudes towards electronic voice response systems when compared to younger people [14]. Yet, older adults have still been found to be receptive using VUIs and found them easy to learn [16] even if they were low in tech literacy [20], and have found them to be empowering when used alongside caregivers [38].

2.3 Mass Media and Technology Adoption

Recent work has investigated mass media portrayals of VUI use by older adults as a means of taking a sociotechnical approach to research [29]. It was found that mass media portrays older adults as a viable target market for voice-activated devices, but that factors that play into its ultimate adoption pertain to issues of data privacy, trust in institutions behind the VUIs, the potential for VUIs to be embedded in their lives, perceived benefits, and greater market trends and government policies and practices. While these themes may speak towards factors of VUI adoption by older adults, we do not yet know how they compare to older adults' actual perceptions of VUIs. Mass media messages both influence and reflect older adults' perceptions and willingness to adopt new technologies [4,13,31].

Table 1: A summary of all of the participants, by demographic details.

Participant ID	Age	Gender	Education	Retired?	Lives With...
1	74	Female	Bachelor	Yes	Husband
2	72	Female	Masters	Yes	Husband
3	70	Male	College Diploma	Yes	Son
4	62	Non-binary	PhD	No; Self-employed	Alone
5	64	Female	College Diploma	Yes	Husband
6	70	Female	High School	Yes	Son
7	65	Male	Masters	Yes	Wife
8	85	Female	Masters	Yes	Alone
9	67	Female	High School	No; Part-time	Husband
10	90	Female	College Diploma	Yes	Alone
11	81	Female	Bachelor	Yes	Husband

3 Methods

3.1 Participants

The study was conducted virtually over videocall. Participants were required to have sufficient command of English, enough to be proficient in daily social interactions and to understand and sign the consent form. Participants were recruited through distribution on mailing lists of the research team and advertisements placed on research study recruitment portals. Participants were scheduled based on their availability to attend the study. Participants were compensated $30 for their participation in the study and allowed to keep the Echo Dot device used in the study. The study was deemed low-risk and approved by the university's research ethics board.

Table 1 shows a summary of the demographics of the participants (age 60+; two male, eight female, one non-binary; average age 72.7). All of the participants were comfortable enough with technology to send emails to schedule meetings and to meet over video call, although not all of them could do so independently. Some participants required support from family members in order to attend Zoom calls.

3.2 Procedure

The study was divided into three parts. During the first part, participants were asked to read some news articles and then participate in a 1-1.5 hour interview on their first impressions of VUIs based on the news articles. Then, participants were sent an Amazon Echo Dot device. A check-in session was arranged to take place after the scheduled delivery date. After the check-in session, participants tried out the Alexa on their own for deployment periods of two to three weeks. Finally, participants participated in one final 1-1.5 hour interview on their experience and final impressions.

3.2.1 Articles Chosen for Participants to Read. The participants were each asked to read the same five news articles prior to and in preparation for the first interview session. This was meant to give participants a basis on which to reflect upon aspects of VUIs. The total reading time of the five articles as estimated to be 30 minutes (the average time spent reading daily for this age group, based on [39]), based on 4551 total words as reading material at a rate of 150 words per minute (based on [2] for this age group).

News articles were selected from among the papers used in [29] (with the reading list generously provided by the authors of that paper). The five articles were chosen to ensure coverage of each of the four themes appearing in [29]. The articles that participants were asked to read were on the topics of:

1. **"What is a Smart Speaker?"** [26]. This article provided a definition of smart speakers and listed a number of uses for them. This article addressed the third theme of "Changes that VUIs Can Bring to Older Adults' Lives" from [29].
2. **"Voice-activated technology can help you live better"** [7]. This article covered some of the perceived benefits of VUIs for older adults. This article addressed the first theme of "Perceptions of Adoption of VUIs by Older Adults".
3. **"Dr. Alexa: Amazon's Alexa will soon provide health advice in the UK"** [22]. This article discussed the use of VUIs by a government body to provide healthcare information to the general public. This article addressed the fourth theme of "Impact of Trends Towards VUIs".
4. **"Which smart home product you should get your grandma, child, and everyone in between"** [10]. This article discussed various "smart" devices and provided some ways in which this technology can be integrated into older adults' lives. This article addressed the second theme of "Embeddedness in Older Adults' Lifestyles.
5. **"AI monitoring elderly in South Korea for signs of 'loneliness or insecurity'"** [23]. This article discussed the use of VUIs for surveillance purposes and also of the potential of VUIs to help address loneliness in older adults. This article addressed the first theme of "Perceptions of Adoption of VUIs by Older Adults" and the fourth theme of "Impact of Trends Towards VUIs".

3.2.2 Part 1: Session 1 Interview. In the first part, participants met with the researchers for a semi-structured interview over a video call that lasted between 1-1.5 hours. In preparation for the meeting, each participant was asked to read five news articles mentioned in 3.2.1. During the session, participants were asked for demographic information, their previous experiences with smart speakers, their relationship with the mass media and news, their expectations of smart speakers, their impressions of smart speakers based on the news articles they read, and their perceptions of smart speakers in relation to the four themes from the paper [29].

3.2.3 Part 2: Deployment and Check-in Session. We sent participants via an Amazon Echo Dot (3rd generation), as this and similar devices were the most mentioned voice-only device in the media [29] – our study purposely focused on voice-only instead of devices that also incorporate touchscreens in order to avoid any confounds from prior familiarity with tablets or smartphones. The Echo Dot packaging includes the Echo Dot device, a power cable,

one instructions booklet on setup, one booklet on warranty information, and one card containing a list of sample commands.

Participants were asked to set up the Echo Dot (i.e., connecting it to power and connected it to Wi-Fi). They were permitted to ask for assistance from family members and/or from the researchers during the check-in session (session format described in the following subsection) to help set up the device if needed. The only participants who did not successfully set up their devices on their own or with family members were: P7 and P11, both of whom completed setup during their check-in session with the assistance of the research team; and P10, of whom completed setup during their check-in session with the assistance of their son and the research team.

3.2.3.1 Check-in Sessions. Check-in sessions lasted about 30 minutes (with the exception of P7, where the session went for 1.5 hours due to setup processes). Participants were first inquired about their experiences and preliminary thoughts about the smart speaker so far. Then, they were asked to complete five tasks with the smart speaker: set a timer for 5 minutes, ask for the side effects of Tylenol, find out the weather for the day, tell Alexa that their cat is vomiting, and to try to find a nearby theatre (of any kind). After the completion of each task, participants were asked to comment on the experience, on if it matched expectations, and (where applicable) how accurate they perceived the provided information to be.

3.2.3.2 Deployment Period. At the end of the check-in sessions, Session 2 was scheduled for at least two weeks later. Participants were then allowed and encouraged to use the device however they wish. The research team did not provide any prompts or direction to participants on how to use the devices, in order to simulate natural use of the device.

At halfway through the deployment session, participants were sent an email to check-in with them on any technical issues and to request from the participants examples of how they used the device. No participants reported technical issues. Responses provided in check-in emails were noted down by the researchers and followed up upon during the second interview session.

3.2.4 Part 3: Session 2 Interview. In the third part, participants met with the researchers over video call for a final interview that lasted for 1-1.5 hours. Participants were asked the same questions as in the Session 1 interview, but this time in terms of their hands-on experience as well.

3.2.5 Data Analysis. All first sessions, check-in sessions, and second (final) sessions were audio recorded, transcribed, and systematically coded using inductive thematic analysis [6]. Specifically, the Consensual Thematic Analysis approach was used [12]. This technique has been used in similar qualitative HCI research [8,9]. Initial coding and clustering of the codes were conducted by two of the researchers that attended the respective interview session. Each of the researchers worked independently. Once all of the data was coded and initial clusters created, a data session between the two researchers and additional researchers took place. In this session, the researchers closely reviewed the coding and initial themes for each session were generated. These themes were further refined by the initial data coders in order to identify overarching, high-level themes among all of the codes across all of the sessions. All researchers had a background in HCI and had experience in conducting qualitative data analyses. In the following section, we report on the differences between expectations and experiences with VUIs discussed by the participants based on the four themes that emerged.

4 Findings

Our findings suggest a number of VUI aspects to consider to help close the gap between expectations and experiences when it comes to older adults' use of VUIs. In this section, we cover these considerations in depth in terms of the results of the inductive thematic analysis. Table 3 summarizes the themes and subthemes.

Theme	Subthemes
VUIs Are Too Primitive for Serious Use	• VUIs meet expectations for simple tasks, with only a few caveats • VUIs do not meet complex or essential tasks • VUIs' communication abilities are too primitive
Media's Interpretations	• VUIs have more shortcomings than envisioned
Missing Prerequisites for Full Use of VUIs	• Subscription requirements is a barrier to full use of VUIs • Setup is more difficult than imagined • There is less guidance on how to use VUIs than expected • VUI need to be more pervasive than expected to be useful
Trust in VUI Content	• The sources behind VUIs affects trust in VUIs

Table 2: A table summarizing all of the themes and subthemes of the findings.

4.1 VUIs Are Too Primitive for Serious Use

The first theme pertains to older adults' impressions of VUIs for serious tasks such as interacting with essential services. Older adults reported discrepancies between expectations and experiences in terms around completing simple tasks with VUIs (Section 4.1.1), more complex or essential tasks (Section 4.1.2), and the device's communication abilities (Section 4.1.3).

4.1.1 VUIs meet expectations for simple tasks, with only a few caveats. Participants could see VUIs being useful for simple tasks, with only a few caveats. Tasks that participants tried out on the Alexa included looking up the weather (P2, P5, P6, P9, P10), lottery numbers (P6), trivia (e.g. about history, celebrities, or small facts) (P5, P6, P9), setting up timers (P2, P4, P5, P8, P10, P11), reminders (P1, P2, P4, P5), and shopping lists (P5), looking up addresses (P2, P5), finding definitions (P2, P10), playing music (P1, P2, P3, P5, P9), playing games (P3, P7, P9), listening to the radio (P2), and tracking package delivery statuses (P3, P9). Some participants were creative with their uses of Alexa, such as P4 who created YouTube videos to demonstrate their process in trying to teach it non-mainstream points of view and positive emotions such as love and gratitude. Participants found VUIs to be quick and easy to use (P2, P3, P4, P5, P6, P7), even if they were not fully comfortable using a computer on their own (e.g., to the point of setting up a Zoom call by themselves) (P5, P6). Some participants liked that Alexa did not provide detailed or lengthy responses (P9). Alexa was noted by some participants as having better sound quality than other devices they owned, and thus was a reason to switch (P1, P3). However, some participants found the music selection on Alexa to be limited (P2, P7).

4.1.2 VUIs do not meet expectations for more complex or essential tasks. Participants were also interested in using VUIs for serious tasks such as inquiring about government services or health information (P4, P6, P7, P8). However, while participants were not particular about the source of the information when it comes to simple pieces of information of low risk and could be easily verified (e.g., the weather) (P3), participants became more critical about using VUIs for serious topics. When trying out the Alexa, VUIs were found to rely on disreputable sources of information (P2). In particular, when P2 asked about the most common cancer, Alexa gave P2 an answer from a women's magazine, rather than from an expected trusted health source. This is especially the case when a VUI continues to use a disreputable source even when a specific, official information source is requested (P2). Furthermore, when the VUI does not provide the source of its information, trust in the device decreases (P2).

Furthermore, it was unclear to participants how Alexa went about choosing its information sources for health information (P11). As P11 noted, "I have a medical background so I'm much more skeptical of information of a medical nature. Because so much of it in social media, for instance, is inaccurate, so I'm not just sure, in terms of a device like this, how much of that information is accurate and who looks at it decides what's worthwhile to broadcast." Participants indicated that they would only use a VUI for health and government services if it was approved by the government (P11).

In the end, participants did not perceive VUIs as being able to meet their needs for serious tasks. Some of it was due to the superficiality of the information Alexa delivered (P2, P4, P6, P7, P8, P11). Participants reported a range of topics they tried to discuss with Alexa. P4 wanted to engage in discussions with the Alexa about non-mainstream viewpoints, only to be disappointed to find out that it would present mainstream content. P4 had concluded that Alexa was too influenced by the internet, which in turn is controlled largely by mainstream media. P8 tried to discuss politics with the Alexa only to find that its capabilities limited it to sharing facts about voting information. In the end, deep research was seen to be reserved for the computer (P9).

Another factor that contributed to views of VUIs' unreliability was the degree of miscommunication that would occur when Alexa does not provide an accurate answer or is not clear on what was asked of it. Participants encountered cases where Alexa would respond with the answer to a different question from the one posed (P7, P10) or mishear the question due to accents (P4). As P10 mentioned, "[It] would drive me crazy if she start playing music, that I don't really want her to play, and then I can't tell her to stop." Participants expected Alexa would follow-up and ask for clarification, but this did not happen in older adults' experiences (P4, P8). Miscommunication in such a manner for even simple tasks alone made older adults doubtful of Alexa's ability to handle more serious requests and manage financial transactions (P4, P9, P11).

4.1.3 VUIs' communication abilities are too primitive. Some of the limits to participants' impressions to take VUIs seriously was through its limited communication abilities. The human-like qualities of communication were initially aspects that some older adults sought and indicated that they would have been delighted by (P3, P4, P5). While some aspects of Alexa not spoken about by the media, such as whispering to the Alexa and hearing it whisper back and hearing Alexa sing happy birthday, brought joy (P5), many other aspects of Alexa's communication ability disappointed participants. To start, participants often found that they had to word and reword their questions in a way that Alexa would understand them (P1, P2, P3, P4, P5, P7). Some expressed willingness to adjust their natural speech to accommodate the Alexa (P2, P3, P5), while others were frustrated with having to do so (P2, P4, P9), to the degree of being willing to abandon use of the device because of it (P1, P7). Some wished Alexa had a better sense of humour and would deliver and understand jokes better (P9). P4 expressed disappointment in the lack of conversational ability and stated, "I try to just suck in, nice conversation but, it was not possible to go too far." P4 compared communicating with VUIs to providing military commands, as communication had to be very short and concise. Because of their poor experiences communicating with the Alexa, some participants raised doubts as to VUIs' effectiveness for addressing topics like social isolation and loneliness given their difficulties in understanding humans. As P2 put it, "some people have difficulty – like stroke victims, for example. If their speech is impaired, I don't know how something like [the Alexa] would be any benefit in terms of isolation." Some participants likened VUIs to pets (P3, P9). P3 mentioned, "every time I say her word she lights up and, it's like a dog. Ear's going up 'are you talkin' to me? You got treats?"" Even so, P3 adds that "if Alexa was a pet, [it would be] more like a goldfish than a puppy to me," hinting that Alexa still had plenty of room to improve in terms of its intelligence, capabilities, and usefulness.

Overall, older adults found VUIs' communication abilities to have room to improve, and that inadequate communication ability on the part of the VUI was a reason for them to abandon a VUI device.

4.2 Media's Interpretations

The second theme pertained to older adults' relationship with media messaging. The primary mismatch was between the messaging participants received and what they found out they wished they knew about VUIs after having personal experience with the devices (Section 4.2.1).

4.2.1 VUIs have more shortcomings than envisioned. Participants generally considered the news articles to be useful in pointing out the features and benefits that VUIs could bring to older adults (P5, P6, P8, P11) and privacy concerns with the devices (P11). However, participants also expressed a shared sentiment that the media articles were surface level and did not cover the topics of VUIs in depth (P7, P8, P10). Participants indicated that they wanted more directions on how to use and get started with the VUIs (P8), including more information about VUIs' support for languages and accents (P4, P6), comparisons between different VUI devices (P3), the adjustments one needed to make in their speech clear enough for the device to understand them (P4), and negative aspects of VUIs (P4, P9). P2 pointed out additional shortcomings of VUIs based on their experience with Alexa that were not mentioned by the media when P2 stated, "they're not going to tell you that it doesn't give you the right answers, that it doesn't have good sources. It's not going to tell you that if you want this you gotta pay extra, or if you want to do something you got to go back to the app and do it on the app; you can't do it through there." In other words, it was not expected that Alexa would not give the correct information based on reputable sources, that many key services would require extra payment, and that using Alexa still relied heavily on having access to the smartphone app.

4.3 Missing Prerequisites for Full Use of VUIs

The third theme related to the mismatch in expectations compared to actual prerequisites older adults need to make full use of VUIs. This was in terms of subscription requirements (Section 4.3.1), setup (Section 4.3.2), needed guidance (Section 4.3.3), and required ubiquity for usefulness of VUIs (Section 4.3.4) make full use of VUIs.

4.3.1 Subscription requirements is a barrier to full use of VUIs. VUIs can be connected to external services such as music streaming services. From the start, there was less interest in subscription services, even from participants who were interested in connecting smart devices (P4). That said, listening to music was one of the more common services for which participants indicated interest connecting their Alexa (P3, P4, P5, P6, P7). However, only one participant connected their Alexa to Spotify or had an account on Spotify to start with (P3). Other participants tried asking Alexa to play music but were disappointed or uninterested in Alexa's suggestions for them to subscribe to Amazon Music services in order to listen to their desired music (P1, P4, P5, P6, P7). P2 participant tried connecting the eBook service (Libby) from their local library with no success.

In all, subscription requirements are a barrier to VUI features that older adults would expect to use the most, and older adults would benefit from VUIs being connected with the subscription-like services that they do use (e.g., library services).

4.3.2 Setup is more difficult than imagined. Regardless of how easy interacting with VUI was believed to be, getting the VUI set up proved to be a barrier for some older adults to using the Alexa. Older adults were not opposed to turning to family members for help setting up their device (P2). They also anticipated that Alexa would not include instructions for set up that were adequate to their needs (P2, P11). This was not a well-received process, and as P2 states, "one thing I find it annoying about new technological gadgets they don't give you any information they expect you to go on the Internet and look it up." Participants (P2, P11) added that too many assumptions are made on users' levels of tech literacy. P11 mentioned that setup instructions should begin with the basics and as reference quoted the process of learning about iPads: "I think they were using a software that allowed seniors to connect with their friends, on an iPad, that's all they gave us and we were supposed to teach another senior how to use this, so when I looked at the directions it didn't even say at the beginning, 'what is an iPad?'". Ready access to help (such as from younger people who were seen as more immersed in newer technology and had "clearer minds" (P6)) for setup was seen as reassuring for older adults using a VUI (P2, P6, P9, P11).

Some participants who did not have trouble setting up the Alexa still predicted the setup process to be more difficult (in comparison to using the device) and that it would be a stumbling point for some older adults (P1, P2). Of those requiring assistance for setup, some of the participants reported on relying on help from family members (P6, P8), and while others turned to the research team during the check-in sessions (P7, P10, P11). Not having ready access to a smartphone for set up was predicted (P1, P7) as a barrier for older adults to getting started, and this proved to be the case for P10 of whom required rescheduling the check-in session until a family member could arrive on-site to assist with

setup with their own device. For these participants, setup was seen as a large barrier for use. As mentioned by P10, "[That process] would be hopeless for me. Too technical."

Several of the participants who did not report requiring assistance with set up nor extra instructions were also more digitally literate (P3, P9). These participants reported the getting started video that came with the app (P3) and browsing the app to investigate Alexa's features (P9). Still, the setup process was seen to benefit from streamlining and some trouble with set up was reported even by those who successfully set up the Alexa on their own. For example as noted by P3, "I had to backtrack a little bit and uh, go to the help button and all, help and feedback thing to find out some; I was getting messages saying uh, the Wi-Fi is, or, go to settings the Wi-Fi isn't set up yet." The phrase that "Wi-Fi is not set up" is the default message that the Echo provides when it is plugged in and not yet set up, and was a point of confusion for some participants (P7).

4.3.3 There is less guidance on how to use VUIs than expected. To emulate a natural, exploratory style of usage of the Alexa, the research team did not provide specific guidance on how to use the device. Participants found that there was less guidance provided to them by Alexa than they were comfortable with. For example as noted by P1, "I think that's what's missing, uhm, for someone like me who's never used it is. Uh, and you I hadn't mentioned this, I think, in the first time but, give me a set of instructions, give me a set of to-do's, so I can learn to feel comfortable with it. So just with exploring on my own didn't cut it for me." As further stated by P1, "I'm very much one of those that, tell me how to do it, give me specific instructions." Even after having the device set up, participants indicated desires for more instructions on how to interact with it (P1, P3, P4, P6, P7). These included instructions on how to make commands (P1), guidance from the device on how to communicate with it (P1, P3), and ideas for what one can ask the Alexa (P4). Only some went online to search up suggestions on what they could do with the device (P4, P7).

Participants were receptive to instructions provided by the app and the instruction pamphlet that came with the Alexa (P3, P8, P11), but it was noted that the need for the separate app (P3) and the visual acuity required were access barriers to these sources of assistance (P8). The instruction pamphlet's small font had P8 remarking, "The directions, I felt, within the box were quite good. My one, my one, beef always about these things is, do people not know that when people get older their vision is not very good? […] I have reading glasses, but even the reading glasses I couldn't read, it was so small, I actually had to [use a magnifying glass]." There were also concerns about potential struggles with setup for those who were less tech savvy (P3). As P3 pointed out, "I think everything you own also means it's a thing you have to take care of. You have to repair."

4.3.4 VUI need to be more pervasive than expected to be useful. Participants' remarks suggested that they did not expect that in order to use a VUI to its full potential, it must be portable and accessible everywhere in the house. Participants mentioned that VUIs were maximally helpful only if the entire house could be voice-activated (P2). This meant having a VUI in every room, which was costly (P2). As P2 mentioned, "if I fell down downstairs it's not very useful, because [the Alexa] is upstairs. I'd have several different devices, which is a cost thing." However, VUIs did not seem useful enough yet for participants to consider purchasing multiple of them (P11). P1 notes that a VUI device is of no benefit if its notifications occur while the user is in another room. As P1 states, "if the device tells me something, and it's in the dining room, and I happen to be upstairs, it doesn't serve my purposes."

An alternate solution was to carry the VUI with oneself when transitioning rooms (P5, P7, P9, P10). As mentioned by P9, "I think that's the only real hassle. I keep it in, in the office with me, which is my, bedroom office and I'd have to unplug it if I take it in the kitchen with me and plug it back in." In the end, some participants kept the VUI in the rooms in which they could see themselves spending the most time (P8, P11). Overall, being able to access the VUI from anywhere was found to be necessary in order to full use of the VUI. Those who are limited to one VUI device (whose location must be fixed) must choose one optimal location to place the VUI, which may be difficult if the older adult lives a highly active and mobile life.

4.4 Trust, Data Privacy, and Surveillance

The fourth theme pertained to older adults' impressions of trust when it came to VUIs. We found that there was discrepancy between what older adults expected of the reputation of the sources from which VUIs draw their information versus where VUIs actually drew their information (Section 4.4.1).

4.4.1 The sources behind VUIs affects trust in VUIs. Participants' trust in VUIs seemed to be connected to the marketing practices of the companies behind the VUIs and participants' trust in the sources from which VUIs draw their information. Participants indicated that they did not expect so many advertisements and paywalls for services and mentioned throughout the sessions that advertisements from the device would discourage their continued or full use of the device (P2, P7, P9, P10). As P10 mentioned, "Well she was trying to sell me something on Amazon, and I don't want ads coming on, trying to sell me things. Because I hang up the phone, when somebody tries to sell me something on the phone. I do not like, being approached by advertisers." As a result, after trying out Alexa, some participants began to perceive the Alexa as a tool to sell users on other Amazon products and services (P2, P7). P7 describes the Alexa as "pushy because it wants me to sign up for something and I haven't even had an experience of listening" when referring to the Amazon Music subscription service. None of the participants reported subscribing to any services advertised by their Alexa devices.

5 Discussion

This study aimed to find out what were older adults' expectations of VUIs before and after having hands-on experience using VUIs. It was found that VUI experiences did not deliver on expectations. Specifically, VUIs were found to be more primitive than expected, there were more limitations to VUIs than expected, more prerequisites were required to fully make use of VUIs, and the sources that VUIs drew from fell short in earning trust. Based on our findings, we offer reflections that designers, practitioners, or those marketing VUIs to older adults may wish to consider. These aspects are issues to consider when framing the narrative around VUIs that are designed or deployed for use by older adults:

1. **VUIs currently deliver on simple tasks, but can deliver better on entertainment purposes (Section 4.1.1).** The Alexa was found to be helpful for a variety of basic tasks but could use more variety in its music selection (e.g., by not having music behind a paywall). More investigation can be conducted on how VUIs can better meet older adults' entertainment needs.
2. **VUIs do not meet expectations for complex or essential tasks (Section 4.1.2).** These older adult perceptions of VUIs have also been suggested in existing academic literature [32]. For information requests on serious topics, VUIs need to show they are providing information from credible sources. Content provided by VUIs should go beyond that of the mainstream. VUIs may benefit from following up for clarification to prevent miscommunication and deterioration of trust in the VUI system.
3. **VUIs' communication abilities to have room to improve, and inadequate communication ability on the part of the VUI was a reason for them to abandon a VUI device (Section 4.1.3).** Task- and command-based conversation styles have their place in older adults communication with VUIs [36]. However, conversational VUIs may better match older adults' needs and expectations, as has suggested in existing literature [19].
4. **There are shortcomings to VUIs relevant to older adults that remain under-addressed and may be barriers for further use (Section 4.2.1).** These include not using reputable sources of information, key services requiring extra payment, and reliance on smartphone apps to complete key VUI tasks (e.g., setup). It may be beneficial for VUIs designed for older adults to emphasize credible sources of information, consideration on if and how paywalls are used, and to minimize the role of extra devices (e.g., smartphones) to complete key tasks.
5. **Older adults are interested in using VUIs for services they currently use, and are disappointed when they are not available or are behind a paywall (Section 4.3.1).** Examples include music streaming and accessing library eBooks. VUI design may benefit from care and consideration about the sociotechnical needs of older adults.
6. **While VUIs may seem natural and easy to use, the setup process may pose as an unexpected stumbling block for older adults' full adoption of VUIs (Section 4.3.2).** Consideration should be made about instruction pamphlets and the language used in them, not needing a separate device (e.g., smartphone) for setup, and streamlining setup wizards for maximum understandability.

7. **Older adults may expect more guidance on how to use VUI devices than is currently provided (Section 4.3.3).** This includes additional information to aid exploration of the devices' features, and ensuring these guides are accessible (e.g., that fonts on instruction pamphlets are not too small).
8. **Older adults may come to discover that networks of VUIs or portable VUIs may be more suited to their needs than a single VUI unit (Section 4.3.4).** That said, cost may become a barrier if they need to acquire more than one unit to use the VUI system. VUI design may benefit from consideration on the type and number of devices needed for older adults to use VUI features effectively, and factor as well their capacity to acquire these devices.
9. **The unexpected sensation that a VUI is trying to sell something to the older adult user can erode the user's trust in the VUI device (Section 4.4.1).** VUI design may benefit from considering the impact of VUI device-facilitated marketing on the perception and adoption of the VUI.

Differences in the expectations and experiences of VUIs for older adults may lead to barriers for continued use of VUIs. By taking heed of the above considerations, designers can be better equipped to address issues of VUI acceptance and adoption.

6 Limitations

One limitation of our approach was that this study was conducted over videocall because of global lockdown conditions. This meant that participants in the study were skilled enough with digital technologies or had enough support to access video-calling through computers or tablets or had social support to provide them with assistance. Our findings may be lacking in perspectives from those who have low digital literacy and also do not have social support to help them participate in the study.

It is also important to note that participants' responses may be influenced by design choices of smart speakers, and specifically the Amazon Alexa. Hence, some of their comments may not be reflective of all VUIs, if even all smart speakers. For example, disinterest in VUIs as caused by smart speakers upselling practices may not be characteristic of all VUIs. However, the findings presented in this paper are not specific to the Amazon Alexa or Echo Dot. Thus, they are still valuable in revealing the issues in VUI design that are important to older adults and how design choices relate to older adults' lives. For example, from the findings, we can learn that VUI upselling, and advertising may hurt older adults' interest and adoption of the VUI device.

7 Conclusion

In this paper, we report the findings of a study on older adults' perceptions of VUIs in comparison to their expectations based on media messaging. After participants read mass media articles on VUIs, they were queried for their opinions on VUIs both before and after trying out the Amazon Echo Dot. What we found were differences between older adults' expectations from news media about VUIs and what they experienced when trying out a VUI themselves. Namely, our analysis revealed that VUIs were found to be more primitive than expected, there were more limitations to VUIs than expected, more prerequisites were required to fully make use of VUIs, and the sources that VUIs drew from fell short in earning trust. These gaps between expectations and experiences may become barriers to older adults' willingness to adopt VUIs. As such, our findings suggest an issue of managing disconnects between technical capabilities of VUIs and the narrative that informs the expectations discussed in Section 4. In turn, the aspects mentioned in Section 5 inform designers, practitioners, and those marketing VUIs to older adults about narrative aspects to consider when it comes to VUIs deployed for use by older adults.

Future work could consider investigating other sources of VUI expectations and comparing our findings between academic work (including those from this paper) with the prevalent themes in the media. This would allow for a better understanding of the gaps that exist between what is pushed by the media and capabilities and perceptions of VUIs. Even if the media does not have direct influence on older adults' expectations and perceptions of VUIs, the media may still be a reflection of societal and commercial interests that drive VUI adoption by older adults. Thus, comparisons between

media messaging and academic work on VUIs can provide an increased breadth and depth of understanding of the factors of adoption of VUIs to better elucidate the barriers that exist for the adoption of VUIs and to offer a better understanding of how to improve the design of VUIs for older adults.

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