Abstract
This research looks at the use of digital voice assistants (DVAs) as devices in assisting older seniors, particularly concerning those who are 75-plus, with setting their medication reminders, along with other functions involving daily tasks and activities, i.e. looking up the weather, playing music, etc. This research draws from published journals and articles on related studies, questionnaires, interviews, and usability tests looking at a variety of DVAs, including the two we used during testing: The Amazon Echo and Google Home. After analyzing and evaluating our findings, we see DVAs as having a great potential for providing assistance to senior users in setting and maintaining medication reminders, along with help in facilitating daily activities.

Author Keywords
Voice Assistants; Seniors; Medication Reminders; Usability Testing

ACM Classification Keywords
K.4.2 Computers and Society: Social Issues

Introduction
A PEW Research Center report from May of 2017 found that 46% of Americans were using some form of digital voice assistants (DVAs); popular DVAs include Siri,
Among the PEW respondents who used DVAs, 55% named the ability to use the device without hands as a major reason [5]. Many respondents (22%) also felt that the spoken language interface of DVAs felt natural to them. In this project, we argue that DVAs can be especially helpful for people who are over 75 years old, i.e. helpful in allowing older seniors to live independently for longer periods of time, enabling autonomous aging [1].

Both the Amazon Echo, and Google Home include a medication-reminder, a feature we feel is especially useful for seniors 75-plus. Medication adherence among seniors can be a problem for a number of reasons. Causes include difficulty with containers and social isolation, but also that seniors can forget how to take a correct dose of a medication or forget to take the medication at the right time [4]. Many factors can contribute to missing medications, but the overall need is consistent. Medication adherence is a critical component to continued good health, especially for those recovering from stays at hospitals and/or rehabilitation facilities [11].

Digital voice assistive technology has proven to be an efficient way to help seniors with issues such as medication adherence by incorporating reminders and alerts [9]. Seniors are open to using the technology if it can help with life on a day to day basis and find that digital voice assistants can make a positive impact by giving them reminders for medications, as well as keeping them engaged with their medical and social appointments [7].

In this project, we conducted a usability evaluation of medication-reminder skills on the Amazon Echo and Google Home. We defined skills as the ability to complete tasks that the digital voice technologies are programmed to accomplish. We evaluated the two DVAs to determine which device and its medication-reminder is more efficient and easier to learn for seniors 75-plus. As our participants had not used DVAs before, it was important that they first read information on the box and remove the device from its packaging, learning what they could from any directions that were included. Our findings have several implications for the design of DVA medication reminders. Following are the methods that we used to come to our recommendations.

**Methods**

In the following sections, we describe our participants, data collection and data analysis methods.

**Participants**

We recruited seniors who were 75 years and older through friends and family in their local area. Age was an important consideration for our usability study, as older seniors are more likely to need medication reminders and may have the greatest trouble with an unfamiliar technology interface [8]. None of the participants had extensively used digital voice assistant technology before participating in the study.

<table>
<thead>
<tr>
<th>Pseudonym</th>
<th>Age</th>
<th>Gender</th>
<th>Technology used</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Pam</td>
<td>75+</td>
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<td>Computer, iPhone</td>
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Table 1: A breakdown of participant demographics.

**Data Collection**

Using a within-subjects design, one group of participants started testing using Google Home, followed by Amazon Echo. While another group of participants tested Amazon Echo first, and then Google Home. All participants tested both devices during their
After obtaining informed consent, we asked participants to complete a short pre-screening series of questions which determined if they were aged 75 or older. We also asked about their technology use in a questionnaire.

The participants were asked to complete four tasks:

1. (For initial setup): "Open the box and read the directions";
2. (For initial use - learnability): "Ask about the upcoming weather forecast";
3a. (To test the learnability of the medical reminder): "Ask to set a medication reminder";
3b. (To test the learnability of the medical reminder): "Ask to set another medication reminder on the same day"; and
4. (To test general learnability): "Ask to play some music."

After each task was completed, we asked the participants to rate their experience of the task on a 5-point Likert scale, ranging from "I loved it" to "I hated it". Once both products had been reviewed, participants completed a final post-test comparison survey, which asked how easy it was to complete task requests on the Amazon Echo and the Google Home. And finally, a short debriefing asked informal questions to gather any additional feedback.

We collected data on the task completion (success), learnability (time of task), and ease of use (errors). We encouraged participants to use think-aloud protocol as they completed the tasks.

**Data Analysis**

We compared both the average time on task, and the satisfaction level of Tasks 3a and 3b on the Google Home and Amazon Echo. Next, we looked at the failure and partial-failure (errors) across all tasks. Finally, we compared the overall satisfaction level on all tasks combined between the two digital voice assistant devices (refer to Chart 1 – Satisfaction Ratings, in sidebar on the following page).

Participant responses taken from the debriefing sessions, the facilitator notes, and the think-aloud protocol were inductively coded by each team member and added to a collaborative online whiteboard (see Figure 2 - Affinity Diagram, sidebar). We clustered entries that shared an affinity and looked for themes to emerge.

**Findings**

The five participants attempted all tasks on both the Google Home and Amazon Echo devices.

**Quantitative Data Findings**

The team compared quantitative data on all tasks and found Google Home and the Amazon Echo to be comparable in success rate, learnability, and satisfaction levels.

As our focus was on medication reminders, we compared the average time of completion (learnability), success rate, average number of interventions and average satisfaction ratings for Task 3a and 3b for the Google Home and Amazon Echo (refer to Chart 2 – Time Completion, in sidebar on following page). We found no significant differences among the metrics and the margin very narrow between the Google Home and the Amazon Echo.

**Figure 1 – DVA Testing**: Google Home and the Amazon Echo were used to conduct our usability tests, because they are currently some of the most widely used and bought devices on the market. Retrieved from https://www.pcmag.com/news/350050/watch-these-echo-google-home-speakers-get-stuck-in-infinite on November 9, 2018.

**Figure 2 – Affinity Diagram**: The affinity diagrams showcase various Digital voice assistant (DVA) themes and patterns collected during usability testing.
To set a normal medication reminder versus setting a recurring reminder, the average times of completion are not significantly different. The average times of completion for setting a single medication reminder was Google Home: 0.99 minutes vs 0.90 minutes for Amazon Echo. Whereas the average times of completion for setting a recurring medication reminder are Google Home: 0.87 minutes versus 1 minute for Amazon Echo.

A comparison of the failure or partial failure rate between all tasks on the Google Home and the Amazon Echo together, shows that Task 3b had a much higher failure/partial-failure rate. Learnability on this task was difficult in comparison to the other tasks.

Chart 1 – Satisfaction Ratings:
Displays the average satisfaction rating for post-test results of Google Home (blue bar) versus Amazon Echo (orange bar).

In addition to discovery on medication reminders, we found valuable metrics on other tasks. We assumed that having a hands-on experience with the devices would familiarize the users with the keywords and formation of commands but most of the users still had a hard time with commands and therefore, completed the tasks in multiple interventions. 3 out of 5 users struggled with asking Google Home about the weather, whereas 2 out of 5 users struggled with the Amazon Echo. This means that Amazon Echo was easier for the users to give commands to.

Qualitative Data Findings
The team assembled response entries onto the online affinity tool Stormboard. Each member of the team entered their response data onto one Stormboard where we inductively coded and formed clusters of like responses, establishing several themes.

Themes about Difficulties
Medication Pain Point: The theme of greatest interest to the study related to difficulty with medication reminders. There was frustration with requests for multiple medication reminders in one day. Users on both devices generally failed in this task, growing frustrated and confused, and sometimes even blaming themselves. One Amazon Echo user stated, “I don’t like this one (Task 3b)!” While a Google Home user said, “You should have the ability to request more than one medication in a day!”

Communication Pain Point: Further, problems with understanding how to communicate with the device were another major pain point for participants during the study. Participants often crafted very long complex sentences to complete requests. These did not sync well with the device. Participants often used “Please” and “Thank you”, adding to the complexity. Further, the initiating phrase was often forgotten. For example, one Google Home user had to be prompted by the moderator, stating “You have to say, ‘Ok Google.” While an Amazon Echo participant structured a sentence in the future tense by saying, “Alexa, what will the weather be at 3 p.m. today?”
Cost Pain Point: Cost was another factor that was of major concern to seniors during our study. Several noted that the music should be free, rather than as a premium option requiring subscription. A Google Home user said, “You shouldn’t have to sign up for ‘Premium’ something to hear music!”

Themes about Positive Experiences
Delight with Ease and Convenience: Participants generally noted that the music requests were easy and delightful. One participant said, “I love it! The Google Home found Indian Classical Music. It’s smart!” There was also a general curiosity and openness to a digital voice assistant technology working in their home. For example, one user said, “I can turn the lights off if I want to!” While another stated, “It looks easy to lock the front door. That would be great!”

Companionship: Lastly, the device was seen as an additional companion in the home. One participant said, “I can see now why my friend thinks she has a friend in the house now!” While another said, “Would she sing to you?”

Discussion
Looking at the overview from the findings, we asked ourselves “What does this mean for examination of the 2 DVAs and their medication reminders for seniors?” Both DVAs were not programmed for a multiple medication reminder. There should be a priority voice tree task development for both devices. A simple, friendly user-script, or preferred way to tell the device about how to set multiple reminders should be told to seniors early on in their use of the device. This would go a long way in improving interaction with the device and also medication compliance.

Further, in opening materials, state clearly how a user (senior) should ‘talk’ to the device. This would accomplish simple Error Prevention, making the senior user feel more competent and confident in using the DVA. Lastly, adding a way to access a favorite radio station, rather than a paid music subscription could further benefit senior interaction. The DVA can tell the user this option and how to implement when a music request is made.

Recommendations for Design
Using comparison of Voice Interaction Technology between Amazon Echo and Google Home, we have formulated design recommendations tailored towards users who are 75-plus. We recommend the following to improve assistance and on-boarding of seniors to this newer technology:

1. For setting medication reminders, we recommend using a script of simple target words, or shorter to-the-point requests in phrases. This will reduce the amount of errors and time to complete setting of medication reminders.

2. For multiple medication reminders, we recommend using a more conversational style of requests. If one medication is set successfully, the DVA should ask at that time if another medication is needed for the same day. If medication is set on a certain time, the next reminders should reference the previous one(s). This would help the seniors remember how many reminders they can expect and would give them a chance to review their medications. In senior homes, this feature could be very useful for caregivers who could use this as a backup to other ways to maintain a list of the medications for the many residents they serve.
3. Add more daily use words like “twice”, “two times”, etc. in the basic commands lists to improve multiple or recurring reminders for medications. These improvements would help make the product more fun to use, i.e. like it was found in the case of playing music and learning about the weather.

4. To improve learnability of the device, use cards with the available target words to help users make clear requests.

5. Add more example target words when the devices are asked, “What can you do?”, this will give a clearer understanding of what can be done.

6. To help ease of use on the installation materials, we recommend a more illustrative approach to the instructions, or setup manuals. We suggest using something different than the pull-up tag for Google Home because they prove difficult to notice and use for senior users.

7. We found both devices needed direct, simple, and to the point request/commands, i.e. not long sentences. Some requests made with long sentences on Google Home prompted the device to give correct but non-related information. Seniors like to describe their intent of requests and that makes them feel comfortable when having conversations with DVAs. We recommend improvement regarding scanning for verbs in a Natural Language Processing context, in order to better accommodate such long requests. The participating seniors looked forward to conversing with the DVAs, and by improving NLP could ease their acceptance to newer technological trends.

8. Add a feature to receive texted medication alerts without the need for enabling the skills in Amazon Echo or adding extensions in Google Home.

Limitations of the Study
The study was limited due to the small number of participants used for the within-groups test. A between-groups test design would add accuracy and alleviate the learning and transfer across devices which was a factor. This would also shorten session times, reducing fatigue for the participants. Our test set-up task did not include interaction with the smartphone app which is a requirement for seniors who are independently using these devices.

Next Steps
Next studies would include the testing of a script where medication reminders would be set to a certain time, and the next medication reminder(s) could reference the previous one(s). We believe this could help caregivers in senior facilities have a backup to maintain a list of the medications for the many residents they serve. We would also explore a set-up interaction for smartphones, as currently the app is an important part of independently using a DVA. This interface could be tested using low to high fidelity prototypes.

References


