An Exploration of Virtual Reality Use and Application Among Older Adult Populations

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Abstract

Despite increased research on virtual reality (VR) platforms in recent years, there are very few studies that specifically examine its application within a gerontological context. This study examines the usability, preferences, and application considerations of a mobile VR platform by individually interviewing community-dwelling older adults both before and after trying the Samsung Gear VR. Participants were asked to self-select and view short VR videos (30 s-3 min) that were filmed within the local community (e.g., walking path and art museum). Semi-structured interview questions explored participant perceptions of using the device and was followed with two focus group sessions. Thematic analysis was employed when reviewing observational notes and transcribed audio recordings. Ten adults (aged 63-89) participated and themes identified include (a) usability, (b) video subject matter preferences, and (c) application. These themes highlighted both the challenges and opportunities of VR use among a wide range of older populations and provided greater insight with its exploration and application in future studies. This included potential use among those older adults who have notable functional limitations, such as those who are immobile, or reside within a care facility.

Introduction

In 2015 Samsung released Gear VR, a mobile virtual reality (VR) platform that incorporated use of a Samsung smartphone and headgear to view a virtual environment. Potential uses of VR platforms have caught the attention of researchers from various fields, including those who focus on older populations. However, one must consider usability issues, needs, preferences, and ethical considerations before designing applications and implementing VR programs.

Nonetheless, as new digital products become available on the market, opportunities arise when considering how they may be useful in terms of physical, emotional, and social health for older consumers. This includes exploring how modern modes of mobile technology may be beneficial to those who are comfortable with and may readily use such technology. Advancements within digital technology indicate great promise and may be of tremendous use (beyond entertainment) to select segments of our population. For example, VR applications have been utilized within educational contexts for students in medical programs (e.g., Ekstrand et al., 2018).

This study poses that there is potential benefit for VR among older populations. Yet first, we must critically assess aspects such as usability and content considerations that may influence motivation, its contribution toward well-being, and realistic adoption of the platform.

To explore these issues, the research team (composed of the author and three student research assistants) individually interviewed community-dwelling older adults who viewed short videos via the Samsung Gear VR and followed-up a short time later with focus group discussions. This was done to answer the following research questions:

Research Question 1: What aspects influence the usability of VR among older adult consumers?

Research Question 2: What are the video viewing preferences of older adults when using VR?

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Research Question 3: How might VR be applied to age-related contexts and what considerations should be taken into account?

Literature Review

Before the release of mobile- and game-based platforms of VR by companies such as Sony, Valve, and Samsung, scholars referenced to using different modes of VR technology in research studies. However, it can be argued that the user interfaces assessed in such studies were not true immersive representations of VR, at least not by modern standards. When compared with viewing a traditional screen (e.g., a television or smartphone screen), VR technologies allow the user to be fully visually immersed and interact within a three-dimensional (3D) world (Bardi, 2019), typically with the use of a headset. This is not to be confused with augmented reality (AR), which is a form of technology that allows the user to view virtual information or images within the real world—"both virtual and real worlds harmoniously coexist" ("The Ultimate Guide," n.d.).

Nonetheless, numerous studies focusing on similar technology provided a foundation for understanding the benefits and challenges of digital interfaces among older users. The most common commercially available digital-based intervention used in health-related studies for older populations was the Nintendo Wii for therapeutic interventions (e.g., Agmon, Perry, Phelan, Demiris, & Nguyen, 2011; Rendon et al., 2012; Young, Ferguson, Brault, & Craig, 2011; see Molina, Ricci, de Moraes, & Perracini, 2014 for sample overview of studies.)

At the time of this writing, only two published studies have been identified that focus on the use of VR by older adult users. Roberts, De Schutter, Franks, and Radina (2019) explored its use among older retirement community residents by allowing participants to view two commercially available VR simulations. Qualitative findings indicated a range of positive to negative feedback and, overall, the VR experience was enjoyed by participants. The other study focused on VR use among members of assisted living communities (Lin, Lee, Lally, & Coughlin, 2018). This comparison study consisted of a control group viewing video via a television and an experimental group viewing the same content via a VR platform. There were more positive reactions with the VR viewing and feedback suggested that it was not as socially isolating as a TV and promoted a better sense of well-being.

Research Design and Methods

Participants and Recruitment

Recruitment for this study began after receiving institutional review board (IRB) approval (Project #: 18-X-67). To qualify as a candidate for this study, participants had to be at least of age 60 years or older, be a community-dwelling adult, and self-report to have at least a fair health status. Persons who reported having any history of or concerns with motion sickness were disqualified. Participants were recruited within a county in Ohio via snowball sampling and ads were placed within local senior newsletters and social media. Once a candidate was deemed eligible, a mutually agreed upon time and location was identified for an interview. In addition, participants were informed that they also had the option of participating in a focus group at the conclusion of the individual interviews.

Equipment and Videos

Samsung's Gear VR equipment was used for this study, which consisted of a headset, a Samsung smartphone that was secured within the headset for viewing, and a handheld controller. The controller was connected to the smartphone via Bluetooth and was calibrated to ensure accuracy between movement of the controller and cursor within the viewing field of the VR headset.

Instead of asking participants to view videos within the commercial app that was downloaded to the smartphone, the research team created a series of six videos ranging from 30 s to 3 min in length. Each video was filmed within the town where the participants live via a Gear 360 camera. The purpose of doing this was to provide an assortment of scenes that were likely to be familiar to each participant and to provide a foundation for a following study. The videos consisted of walks (or walk-throughs) and drives around town. This included venues or environments such as a local art museum, a hike on a well-known trail on the edge of town, and an empty church sanctuary. It also included scenes that were filmed while riding as a passenger in a car. (The camera was held outside and above the car by the passenger.) These videos included slowly driving through an old and well-known local neighborhood, the main street through town, and a scenic drive around the grounds of a historic landmark.

Individual Interviews

Upon providing written consent, the participants were individually interviewed in a lab setting with the use of a digital recorder for transcription and analysis purposes. A semi-structured interview guide was used for each participant. This included background questions regarding their general use of communication technologies and any experience or exposure they may have had with VR technology.

Next, the participant was shown the VR equipment in appropriate detail: the headset (including the attached smartphone) and hand controller. They were encouraged to ask questions to ensure their understanding of how the device worked before trying it. Each participant sat in a cushioned, swivel chair that afforded the ability to fully rotate around in the event they wanted to better explore their VR environment. The chair had arms to

promote a sense of stability, and a member of the research team was always next to the participant to ensure safety. Once they felt comfortable doing so, the headset was placed upon their head and the elastic straps were adjusted for comfort and fit. Finally, the controller was placed in their dominant hand.

The VR software was already cued to the primary screen that showed the menu of the study's video options. This was done so that the participant would not have to navigate through the various prerequisite menus. (This consideration surfaced in a pilot study conducted by the principal investigator [PI] the prior year, as many of older adults encountered challenges with navigating multiple menu options.)

Once the participant decided they were done viewing their selected videos, they were asked a series of follow-up questions. This included asking questions that probed, for example, their perceptions on: the use of the VR system and its components, the video that were viewed, content preferences and dislikes, and potential VR applications.

Focus Groups

When all individual interviews were completed, two focus group sessions were made available to the participants. This took place in a conference room on a university campus and was audio recorded with consent from each attendee. The purpose of the focus groups was to allow participants to discuss their experience with peers and provide insight that might have occurred to them after the individual interviews. Similar to the individual sessions, a semi-structured interview guide was used that posed questions regarding their perceptions of the VR system and to explore how VR may serve to benefit (or not) the well-being of older persons, especially those who have notable health issues or restrictions.

Assessment

Research team members examined transcripts and the notes that were taken during the individual and focus group sessions. This included identifying and discussing themes that emerged from the coded transcripts and observations made during the individual interviews and focus groups. Thematic analysis was employed, which consists of identifying, analyzing, organizing, describing, and reporting themes within a set of findings (Braun & Clarke, 2006; Nowell, Norris, White, & Moules, 2017).

Results

A total of 10 community-dwelling older adults participated in the individual interviews and ranged in age from 63 to 89 years (eight females/two males). Focus Group 1 consisted of four females, and Focus Group 2 consisted of two females and two males. Three candidates who wanted to participant in the study were disqualified due to reporting a history of motion sickness.

All of the participants reported owning at least one mode of communication technology (e.g., smartphone) and reported feeling at least relatively comfortable and confident with using it. All of the participants expressed that they had heard of VR before the study, which was mostly via TV advertisements or their grandchildren. In addition, three of them shared that they have tried some form of VR (or at least their understanding of VR at that moment) via an educational demonstration (e.g., viewing the solar system at a science museum) but had not used VR beyond those singular experiences.

Multiple themes surfaced from both the interviews and focus groups but the three that address the research questions are as follows: (a) VR usability, (b) VR viewing preferences, and (c) VR applications and implications with use.

VR Usability

Headset. Each participant was asked to strap on the VR headset and a team member helped with this process if needed. Two of the participants expressed that the headset felt heavy in weight and, therefore, mildly uncomfortable. One of those participants shared that the headset kept sliding down her face despite multiple adjustments to the elastic bands. It was noted that these two participants had loose, curly hair which may have contributed to how well the straps stayed in place. Also, one of the participants appeared to have a smaller-sized head so the headset seemed to be rather large in proportion to her face.

Another aspect related to the headset is the use of glasses. Upon seeing the headset, some of the participants expressed concern that they may not be able to participate because they did not consider how or if it could be worn on top of their glasses. There was also concern of whether or not the headset would scratch the lenses of their glasses. Fortunately, this was not a problem for any of them, as the headset was large enough to accommodate the glasses without putting them at risk for bending or scratching.

Handheld controller. Each headset was paired with a Bluetooth-enabled handheld controller. Overall, the participants liked the idea of using a controller as compared with selecting features via the headset. They did not report having many problems and even enjoyed this aspect, as it added a sense of control.

One controller issue reported by some participants was that the virtual controller represented within the virtual environment did not align with the physical direction in which they were holding the controller in the real world. For example, a participant pointed their handheld controller directly in front of them, but the virtual controller that

they were seeing in the virtual environment was positioned to the right or left. Thus, it took them time to adjust to or correct this discrepancy.

Another issue noted by some participants is that they would lose sight of the virtual controller. When this occurred, they were asked to look around their virtual environment while holding up the physical controller. In most instances, this addressed the confusion but would sometimes require a recalibration.

Engagement with the virtual environment. Most of the participants expressed sentiments of curiosity or delight when they viewed their first virtual environment. This exploration was afforded by the swivel chair that was used by each participant. Except for one, the participants were not directed to "swivel," as the team wanted to observe the extent to which each explored the environment by looking around and do so at a pace that was comfortable to them.

None of the participants expressed that they felt physically unsteady while seated. Nonetheless, each was assured that a team member was immediately next to them to ensure their safety. Their sense of steadiness was of concern when participants selected to view videos that involved walking or riding in a car. Although feelings of imbalance were not expressed, a few shared that they felt "turned around" or "up too high." For example, when the video of walking on a trail began, it was viewed as if they were walking backward, so they had to swivel their chair to face the forward direction of the video. Also, the video was recorded at a relatively high height. (The Gear 360 camera was mounted to an adjustable "selfie stick" and held slightly above the head of the relatively tall team member who recorded the video.) Thus, what the participants were viewing was not at the natural height (viewpoint) that they were used to. This was of particular note among the feedback of shorter female participants.

In addition, some participants stated that there was too much movement in select videos, so they indicated preference for those that had minimal or no movement (e.g., the video recorded on a mounted tri-pod inside a church). The "movement" described by the participants was attributed to the natural movement of walking or driving while recording, thus affecting the steadiness of the camera. This produced some mild shaking within the footage that resulted in some visual discomfort for a few of the viewers.

Participants self-selected as many or as few of the videos as they wanted and most viewed all of them. At the conclusion of viewing, two participants reported feelings of mild imbalance upon taking off the headset. Thus, they were asked to remain seated until the participant expressed with assurance that they were feeling balanced again. To further ensure continued safety, the participants were escorted upon leaving the lab and were contacted the following day to ask how they were feeling.

Overall, participants did not indicate difficultly with navigating the menu to select the videos they wanted to view. The level of support varied for each participant in terms of selecting and stopping a video and then returning to the main menu. Those participants who reported having higher levels of experience with digital platforms indicated a lower level of need for guidance. Also, it must be noted that observed proficiency with navigating the platform was not associated with participant age but seemed reflective of reported levels of experience with digital technologies.

Viewing Preferences

An additional theme that surfaced within the findings pertains to subject matter preferences among the participants. The participants viewed short videos that were filmed in familiar environments and typically commented on how they knew the environment while watching. In addition, some shared stories linked to the environment. For example, while viewing the video of walking along a trail, one female told the team about her and her spouse walking the same trail years ago and how he would conduct fieldwork (plant research) on a nearby hill that could be seen in the video. Another female participant who viewed the still-shot video of the church recalled going to a friend's wedding at that very church. Yet, she, as well as others, commented that the video would have been more enjoyable if it were recorded during an actual service and included music. (The inclusion of music was also echoed in the focus groups.) Similar stories and preferences suggest a reminiscent component of viewing these particular videos.

Another aspect in which reminiscence emerged from the interviews and focus group sessions was when participants expressed how they would enjoy VR video footage of an environment from their childhood or at an earlier point in their life. For example, one of the female participants voiced how she would enjoy seeing her hometown from when she was a teenager. Furthermore, she suggested how it would be even more meaningful if she could share and view that VR environment simultaneously with her grandchildren, as if she was giving them a tour and would tell stories of her childhood.

Similar sentiments were expressed by other participants, especially within the focus group, and overall, they believed that it may not be sufficient to merely view meaningful environments but to share those experiences with loved ones. One participant compared it with viewing a scrapbook. She stated that it is nice to reminisce to oneself when looking at old pictures but to show those photos and the stories that go with them to a loved one is a different and more meaningful experience. This highlighted the importance of potentially using VR as a tool for storytelling and meaningful socialization.

In comparison with the familiar locations featured in the videos, six of the 10 participants expressed interest

in viewing videos of other locations. This typically consisted of locations that they would like to travel but knew they may not actually do so, such as hiking a mountain range in California or walking the streets of an exotic foreign city. The suggestions offered were typically paired with an activity. For example, one participant commented that she would like to take a virtual tour of Spain while another commented that he would like to scuba dive. That was an activity he used to enjoy but cannot any longer due to health concerns and finances. This also reflected the potential reminiscent value of viewing select VR videos, as he also commented that VR scuba diving would bring back a lot of memories of when he used to dive in real life.

Applications and Implications of Use

One of the points of discussion within the individual interviews and focus groups pertained to how VR technology may be used by older persons in various contexts. Responses ranged from creative ideas that reflected benefits for the user to concerns about ethical considerations.

One of the female participants voiced the potential for VR to be applied in a context that may aid those with cognitive limitations. To illustrate, she provided her brother-in-law's situation as an example. She shared that he was diagnosed with Alzheimer's disease and now experiences moments of confusion and pain. She speculated whether or not a VR environment that had a meditation or reminiscent component would help to calm him. She suggested a beach with peaceful sounds or a familiar environment (to him) with music he enjoyed from his younger years, as this would provide both visual and audible stimuli for him.

Another idea that surfaced among the participants is the potential to use VR as a mode of communication or engagement with family members. All of the participants reported using video communication at least once (e.g., FaceTime, Skype, etc.). However, the participants discussed if it were possible to use a 360° camera to communicate in real time rather than a traditional camera on a smartphone or laptop. They liked the idea of live VR to see the full environment of the person with whom they were conversing. In particular, they believed that this would be meaningful for those who are unable to travel or are immobile.

A related example that was proposed by a participant during a focus group session included the older person viewing a live VR event. Rather than communicate one-on-one with a loved one, it was discussed that it may be enjoyable to virtually attend a family event in real time. Participants suggested events such as weddings, birthdays, and sports events in which a grandchild may be playing. Although they liked the idea of being able to verbally communicate with persons in that environment, they were unsure if such technology was readily available.

Despite the potential positive benefits that the participants proposed, ethical challenges were raised. Participants expressed concern about VR being used in studies or implemented in real-life contexts where the older person may be emotionally or mentally vulnerable. For example, several participants believed that sharing VR videos of real-world environments with persons who feel isolated may be welcomed by some, as it may be regarded as an opportunity to virtually explore beyond the confines of their physical environment. However, they also proposed that others in the same situation may see it as a reminder of their limited ability to navigate beyond their physical environments or engage meaningfully with loved ones; therefore, emphasizing their feeling of isolation.

Another dual-sided example discussed by participants in one of the focus groups involved the potential use of VR among residents at a care facility, especially among those who are immobile. They projected how it may be beneficial among some to virtually view familiar environments, such as the videos they saw during their individual interviews. It may contribute a sense of reminiscence for the older person, especially if the video was filmed at their former home or community. They proposed that such a video could aid with transitioning to their new environment. However, they also expressed ethical issues that may arise from this, as viewing such immersive videos of their former home may cause anxiety or depression because they can no longer interact within that environment in the real world.

Discussion

This study targeted older adult participants who live independently as a means of establishing an initial baseline for basic usability considerations, content preferences, and application considerations with a mobile VR platform. By doing so, it provided insight into potential benefits as well as problematic issues that may arise when exploring VR use among older populations, especially those who may be emotionally, cognitively, and/or physically vulnerable. For example, this may include persons who self-report as lonely or depressed, immobile, geographically or socially isolated, or live within a skilled care facility (that is not regarded as "home"). Details pertaining to the themes merit consideration for how future VR studies should be approached.

First, concerns were raised with respect to the actual VR hardware. Caution should be taken with those persons who have movement or pain sensitivity within their head and neck area. Although the headset was not too heavy for the participants within this study, it may be regarded as such for others. Plus, moving one's head around to see the virtual environment may prove difficult, or even painful, for those with limited mobility in their neck or are confined to a chair/bed. This may be even more challenging if a video does not begin with the

adult facing the "front" direction intended by the person who recorded the video.

Although participants did not report problems related to visual acuity, this is more likely to be an issue for those who experience common age- and health-related visual impairments, such as macular degeneration or diabetic retinopathy. Thus, it may prove advantageous to inquire about an adult's vision if implementing a VR-based program or study.

Participants in this study indicated relative ease of use of the controller and especially so when compared with the alternative of holding their arm up to tap on the control pad of the headset. Nonetheless, the concerns that surfaced with the use of the controller may inhibit those who are not familiar with the function of similar devices or do not know how to troubleshoot issues such as recalibration or connecting via Bluetooth. The team members explained the controller to participants as a device that works similar to a remote control yet no one seemed to understand how we calibrated the device if a problem occurred.

Safety is a central concern when researching or working with any population. The participants within this study reported feeling safe at all times and were asked at various points if they felt comfortable with continuing. Nonetheless, there was concern for those who took an extra moment upon completion to adjust their focus and orientation. Participants did not report any notable, residual effects yet this may not be the case for those who have balance issues. For example, some VR apps involve the user to stand but this may not be appropriate if proper safeguards are not in place. This is the primary reason why this study implemented the use of a sturdy swivel chair with arm rests. The adult could still view around them but not risk falling, especially with an observer immediately next to them to monitor their safety. Usability issues like these must be critically considered if aiming to implement a program for adults with functional limitations. This also merits consideration of how future iterations of VR may take special populations into account during development.

The participants reported enjoying familiar points-of-interest in the videos and could imagine how this may be particularly enjoyable for those who could no longer, or easily, navigate their hometown. This may be beneficial for those who are confined within their home or care facility. In addition, this may promote aspects of socialization if VR use incorporated family or friends— whether they are within the video or are able to share the VR experience with the older adults.

However, these potential uses also pose ethical considerations. As expressed by participants, viewing an immersive, familiar environment may be emotionally taxing for those who are hindered from doing so in real life (e.g., those who are confined to a bed or health care facility). This has the potential to exasperate feelings of disconnect to the outer world and promote feelings of loneliness and isolation. In addition, there may be the risk of causing feelings of anxiety or depression among such persons. Thus, caution is advised when considering VR use among persons who are physically confined or have limited meaningful social interactions. Thus, it would be advantageous to discuss these concerns with the adults beforehand.

Conclusion

This qualitative study explored VR use among a small sample of community-dwelling older adults. Overall, the participants shared that they enjoyed the experience and would consider using VR again if offered the opportunity. It was learned that VR is a viable option for enjoyment for some older persons, as it could be a tool for reminiscence, entertainment, exploration, education, and socialization. In addition, there were multiple other themes identified, such as aspects that may promote aging in place. Nonetheless, the themes presented here highlight concerns with respect to mobile VR usability, preferences, application, and ethical implications, especially when considering potential use of VR with older persons with health-related limitations.

Due to the exploratory nature of this study, the research team encountered numerous challenges. This included identifying filming locations that were likely to be familiar with most participants and troubleshooting hardware issues. It was also challenging to recruit a diverse sample set, as this was strongly influenced by the demographic characteristics of the town where all of the participants lived. All but one identified as white and all indicated advanced levels of education and financial stability. It was also challenging to identify participants who were not sensitive to motion sickness, as this was encountered with greater frequency than anticipated.

As this line of research moves forward, the PI aims to implement the lessons learned from this study in future studies and hopes that such considerations are taken into account by others who endeavor to research VR use or application. Specifically, the PI of this study will incorporate a similar framework by interviewing older adults who reside in facilities or are immobile. Yet, one of the challenges with designing technology-related research is keeping up with technological advancements.

Mobile VR is a growing area of study that does not yet have solid footing within a gerontological context. Thus, it is hoped that future studies are conducted with a critical eye for not only VR use, benefits, challenges, and opportunities but also for how it may positively influence the quality of life and well-being for older persons.

Declaration of Conflicting Interests

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