Elderly Co-Watching 360-films – learnings and implications for sessions and design

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ABSTRACT
With an ageing population, there is a need for elderly to be involved in the technology changes and be involved in finding ways for it to fit them and their needs. Virtual reality is one example of new technology that can be used to engage and help elderly. This, in combination with devising an experience with co-watching and co-location, there is potential to have something where watching creates value for the user.

The aim of this thesis was to look at how co-located and co-watched 360-degree films in a head mounted device was experienced by elderly and which implications could be drawn in terms of arranging and executing 360-film sessions. The data was collected through non-participant observation and semi-structured interviews. Drawing from a thematic analysis two main themes emerged:

- Enriching the everyday life through new and reminiscing experiences
- Togetherness while co-watching depends on external social factors

From there, the results are discussed and summarized into six key implications; the role of the administrator, the group composition, value of watching, enhancing the co-watching experience, decrease weight of head mounted devices and the importance of content, to consider in future work.
SAMMANFATTNING

I en värld med en åldrande befolkning, finns det ett behov av att inkludera äldre människor i hur tekniken förändras och hitta lösningar för tekniken att passa dem och deras behov. Virtual reality är ett exempel på ny teknik som kan användas för att engagera och hjälpa äldre, och detta i kombination med utformningen av en upplevelse med samtittning och samlokalisering finns det potential för att själva tittandet skapar värde för användaren.

Syftet med denna uppsats var att se hur samtittande och samlokalisering i en head mounted device vid tittandet av 360-graders filmer upplevdes av äldre människor och vilka slutsatser som kunde dras beträffande arrangemanget och verkställandet av 360-films sessioner. All data samlades in via icke-deltagande observation och semistrukturerade intervjuer. Genom att tematiskt analysera all data kunde två huvudteman fastställas:

- Berika vardagen genom nya och andra minnesvärda upplevelser
- Gemenskapen under samtittande beror på yttre sociala faktorer

Därifrån är resultatet av studien diskuterat och summanfattat i sex viktiga slutsatser att ta hänsyn till i framtiden; rollen som sessionsledare, gruppsammansättningen, värdet i att titta, förbättra upplevelsen av samtittandet, minska vikten på head mounted devices och betydelsen av innehållet i filmerna.
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Author keywords
HCl; Virtual reality; elderly; Immersive film; co-location; co-watching; HMD

INTRODUCTION
Over the next thirteen years, the world’s population is estimated to increase with a little more than one billion people [9]. Additionally, according to the World Health Organization (WHO) [51], the rate at which the world’s population is ageing is rapidly increasing. The WHO report states, briefly summarized, that the two key explanatory factors to the rapidly ageing population is increased life expectancy and falling fertility rates. This, combined with the rapid advances in technology, poses a need to keep the elderly involved in the changing times. One way to do that while at the same time combating issues [19], such as social isolation and loneliness, is to use the virtual reality (VR) technology to engage elderly in different ways. Studies [22, 30] has shown that loneliness and isolation in particular, are common within the elderly population. Moreover, an additional goal is to help the elderly to maintain the overall well-being and health.

The use of virtual reality in different facets of health care can be described as vast and expanding. From being used as a learning tool for students in both dental [36] and medical school [34], to using it as a way to motivate patients [4, 6] in rehabilitation, and lastly as a way to activate elderly through physical exercise in nursing homes [28].

This study concerns an ongoing project that Film Stockholm is conducting with Norrtälje municipality, where they are trying to improve the quality of life of the elderly at nursing homes by having them watch short films in 360-degrees in head mounted displays (HMD’s) that are recorded in the vicinity of the homes. This study will examine how VR-technology plays out in a situation where elderly is watching 360-films simultaneously and how the usage of this technology affects them.

In this study, sessions were held where 360-films were viewed by groups of elderly. The data was generated through interviews and video recordings and was thematically analyzed focusing on practical implications and user experience. The aim of this study was to identify if there are any difficulties experiencing the 360-films in a co-watching setting. Co-watching, in this case experiencing short films in a group setting, presumes that everyone has their own headset, but are watching synchronously. Some aspects that are taken into consideration in the study is how this affects the everyday life of the elderly and how the ones administering the sessions can have an impact on the experience.

RESEARCH QUESTION
How is co-located co-watching of 360-degree films in a HMD experienced by elderly people?

- What implications can be drawn from themes, established from qualitative data, in terms of arranging and executing sessions?

BACKGROUND
The medical and healthcare field is extensive and has different branches, and human-computer interaction (HCI) is relevant in multi-faceted ways. One way is to use it in
traditional medicine and healthcare by medical professionals, who can use different types of technology to help patients, such as rehabilitation [11, 24]. Another way is by directly targeting the users/patients for self-use or information [20] through apps, and platforms such as YouTube.

**Elderly in Sweden**
In Sweden, a person has the right to work until the age of 67, but is allowed to retire earliest from the month of their 61st birthday [33]. According to the government agency Statistics Sweden’s (SCB) projection [40], the population of Sweden is set to pass eleven million people in 2028. Compared to 2017, where the population over 80 years old was around 300,000 people, that number is expected to increase with 50% in ten years.

HCI research in relation to the elderly population is diverse. For example, there are studies focusing on different methods of digital game design for elderly [21], and studies focusing on using multimodal interfaces to allow users to communicate with their social network [10]. In healthcare, HCI for elderly is used as an intervention for, e.g. cognitive training to slow down deterioration of cognitive function [52] or to encourage physical movement and counteract loneliness through social games, such as using Nintendo Wii, as games are popular tools for health prevention [5].

**Virtual reality**
VR-technology can be described as an umbrella term for an environment that is three-dimensional and computer generated in which a user is immersed in [22]. There are two types of environments that the technology can be applied to, where the difference is characterized by how immersed the user is, low-immersive virtual environment (LIVE) and high-immersive virtual environment (HIVE). In addition to this, the term VR includes non-immersive applications, which amounts to an unclear divide between what fully immersive and non-immersive is [14]. There are some key characteristics that need to be present, e.g. non-visual technologies (audio) and three-dimensional viewing, for an application to be considered immersive.

As with any technology there are technical limitations to VR-technology [12], one of them being limited horizontal space. In newer HMD’s, the field-of-view (FOV) is usually limited to around 110 degrees [48]. Another limitation is network delays, such as transmission of data which could cause delays in an experience, especially when users are in different geographical locations [12].

In medicine and in general, VR is mainly used to expose all the human senses to virtual objects or complete scenes [42] in a natural way. In this strand of work, VR is an effective tool to treat anxiety disorders [50], such as agoraphobia, social phobia or PTSD through exposure. It has also been used for educational purposes in dental [36] and medical [34] school where using simulators allows student to practice different procedures, without need for human subjects and with less demand of supervision. In addition, immersive videos and 360-degree videos are considered a form of VR [1].

**Co-watching 360-films in HMDs**
The act of watching film together, e.g. on TV or YouTube, can be described with different, yet not always synonymous terms. In the present study, the term co-watching will be used to describe the act of a group watching something synchronized.

The research done on co-watching has mainly focused on watching TV (long formats) [2, 29] and watching online videos (shorter formats) [44]. In terms of online videos, there are systems with the purpose to enable co-watching, such as Zync [39], by allowing people to watch videos synchronized. Hence, a research gap exists within the VR realm in which 360-film have not yet been sufficiently studied.

Some aspects of co-watching have been researched and is relevant to the present study. First, one study explored the co-watching process and suggested that co-watching was a way for people to manage “other’s impressions of themselves” [41]. The results also indicated that co-watching has the ability to alter the engagement and intentionality depending on, for instance, where the users are located (e.g. public space). Another study [26] aimed to answer whether co-watching with a HMD at-a-distance could exceed the experience compared to co-watching TV at-a-distance, found that the participants preferred the HMD-condition over the TV-condition. Moreover, it was established that for an at-a-distance experience an embodied VR telepresence in combination with the level of immersion contributes to it being “a more engaging, enjoyable and emotionally synchronous” experience.

Another study [16] recognized the struggle to communicate while wearing a HMD and how it can create a social barrier. In that study, which was tested on 54 people, a web-based framework for three users is suggested which allows the users watching with HMD’s to see each other in a 360-degree virtual space and be represented with 2D video streams. The aim of this was to enable people communicate within a VR-environment. This was done by using Kinect to capture them and then alpha-blend (combining an image with a background in order to show transparency) that image so that everyone saw the exact same thing. They were in a VR-environment where they were sitting at a table with the other users in front of you and a video was then projected onto the table. The study found that the framework helped provide high immersion and presence, but it acknowledged that there is still a great deal left to work on, as the HMD was still visible on the other users which might have made it feel less immersive.

Furthermore, an additional perspective was given in a study [7] that addresses the co-watching experience where all but one of the users are not in the virtual world/not wearing a HMD. This, which effectively excludes the HMD-wearer from the rest, led to the creation of a HMD that combines an eye-tracker with a front-facing screen that enables eye-
contact. This is thought to increase the communication between the HMD-user and the outsiders.

**Co-location and co-presence**

Co-location means “to locate (two or more things) together or be located together” [8], according to the Merriam-Webster dictionary. It could also be described as the subjective “sense of being there” [27] and has the ability to induce presence in the virtual environment, at which point users respond to, as it was reality, “virtually generated streams of sensory information” [37]. Co-presence and co-location can be classified [17] to understand the VR-mediated social behaviors. Co-presence refers to which extent the users are all co-present in the VR-world and ranges from full co-presence (wears HMD + enters virtual world) to partial co-presence (no HMD, or only a few wear HMD, while following a virtual word on a separate screen). Co-location ranges from connected to physically co-located and refers to the degree users are physically co-located when using a VR-application together. Full co-presence and physically co-located status is achieved when two people physically are in the same room and both are in VR together.

With regards to physical co-location, there has been done studies on tools for visual feedback. One study [38] compared different visual feedback mechanisms for preventing physical collisions when using HMD’s. The feedback that was compared, included a 3D-avatar that was co-located with other users, a grid that shows when the user is close to the boundary of the play area and a live video feed that was overlaid on the virtual environment. The study indicated that, while the second mechanism resulted in least collisions, it would be more beneficial with some type of hybrid mechanism.

**RELATED WORK**

Examining the use of VR in a group setting, one study [25] investigated how the use of VR, by elderly in assisted living communities, over a two-week period of time might contribute to the participants social and emotional well-being. This study consisted of two groups, one being a control group that watched the same content on a regular TV (content being whatever clips was available on the internet), where the participants sat in a group and simultaneously watched (co-watched) the same clips with HMD’s. The outcome of the study was users reporting being less socially isolated, being less likely to show signs of depression, experiencing positive effect more frequently and feeling better about their overall well-being.

In a case study [30] done with residents of inpatient long-term care facilities in Austria, the residents were asked to report on their first experiences with VR-glasses. The aim of this study was to understand how a first encounter with virtual reality works and the feelings that follow such encounter, however the author also wanted to know what types of virtual scenarios the participants wanted to see. For the first-time experience a simple nature scene was viewed and then a semi-structured interview followed. The participants in this study viewed the films individually. The study showed that the first encounter with VR-glasses and technology elicited positive feedback and an overall positive experience. Furthermore, the residents reported being interested in the technology. Among the types of films that the participants wanted to see was different types of nature scenes in Austria.

Another study [43] that was made in collaboration with Film Stockholm aimed to examine how the well-being of elderly could be improved with virtual reality technology. This study measured subjective well-being (SWB) and did so by conducting a survey prior to having the participants watch two films individually and then finished with an interview. The study found that the experience did stimulate positive emotions, triggering memories and led to discussions, however it only partially affected the participants’ SWB.

Wallace, Wright et al. [47] did a study with experience-centered design in which they identified characteristics of anchoring, capturing and supporting sense of self and connecting relationships to work as guides within design for personhood, particularly in people with dementia. Personhood in dementia is distinguished by focusing on the immediate social circle becoming active in maintaining their sense of self. What they were able to conclude with this study is that while reminiscence is seen as a potential value of digital technologies, there is a risk that looking back can be seen as a sense of loss of self and what has been lost. They emphasize on the importance to focus on the present and imagined futures as well as remembering the past in order to see if this can bring new potential for digital interventions. In an associated study; Wallace, Thieme et al. [46] found that in dementia, possessions including places, groups and local culture, are essential in preserving parts of a person’s sense of self and this can be supported by the ones in proximity (e.g. staff at nursing home) finding “ways in” to the person with dementia. This means that design needs to encourage conversations in which the people with dementia can share their knowledge and expertise.

Hodge et al. [18] conducted a study where they designed and created VR-experiences for people with dementia and their caretakers, using this to outline implications for designing and use in future experiences. To find the implications they used iterative design workshops, semi-structured interviews and analyzing it with thematic analysis. They found that the weight and the fit of the HMD is of concern for the participants and that they wanted to share the experience with their caretakers. The latter part the authors suggest can helped by having the caretakers demo the system or following the experience on an additional screen displaying the same view. Another finding was that it is important to personalize the experience to the preference of the user. Lastly, they note that it is important to be aware of the fact that a VR-system cannot replace social interaction and that VR-experiences created for people with dementia needs to have the person in the center of the experience and enrich their lives.

An additional study [13] used a device, designed for elderly people at a care home, called the Photostroller. It showed continuous slideshow of pictures from predefined categories
and the aim was to use this design to argue that design can support older people’s experiences with pleasure, engagement and sociability, while taking their diversities into consideration and using that in design so it has a clear identity but is still flexible enough to be used in many different ways. What they found in this study was that the elderly seemed happy with drifting along with the slideshow and that was reflected in the memories that came up and the conversations that also changed with the imagery. Also, the open way the device was designed, presenting the pictures without a larger narrative, enabled its users to be open to reminisce and socialize about their own memories.

There are also challenges to make sure that the technology can interact with the elderly users in a comfortable way. From a technical perspective, important things such as the weight of the head-mounted device and avoiding the use of high frequency tones on feedback, are important to have in mind when designing to enhance the virtual reality presence for the elderly users [27]. Considering all of these aspects, this present research study has established a need to further examine not only how the elderly users experience the technology but also the experience overall.

**METHOD**

In order to further understand the experiences, challenges and practicalities around elderly that co-watch 360-films for increased wellbeing, a study at three elderly centers was devised. The study consisted of five sessions with 19 elderly in which they co-watched one to three 360-films using HMDs. Data was collected using non-participant observations [49], video, and semi-structured interviews [15]. The data was then analyzed using a thematic approach [3]. Prior to the sessions, consent was given from the participants, part of this consent was to record video and audio during the sessions.

**Sessions**

The data was collected during what will be referred to as sessions and consisted of a preliminary survey, screenings of the films and an interview. Five sessions were arranged on three separate occasions and locations during a one-month period with different elderly and people who administered the sessions. The size of the groups varied across the sessions (2-8 participants/session).

**Survey**

Prior to the VR-session, the participants filled out a short preliminary survey with background questions such as age, gender and information about their technological habits.

**Non-participant observation**

Non-participant observation [49] is essentially defined as a method where the object is to gather key data without the observer participating in the activities being observed. This can be conducted with the observer either being present in the natural setting of the activity or not.

In this case, the task to administrate the sessions fell on the person arranging the occasion. This included fitting the headset onto the participants, getting the settings right, starting the films and engaging the participants throughout the sessions. The participants were seated during the sessions. Each group session was recorded with video and audio. The number of 360-films and what films that were showed simultaneously to the participants varied in the different sessions, with regard to films and time available.

**Figure 1. Example of a group during a session**

This was done partly in order to ensure that the experience included something for everyone, but was also caused by a factor of availability since the different occasions used different sets of the equipment. The administrators present where familiar with the films they were showing and had seen all of them before the sessions, in addition to being able to follow the sessions, and what the elderly was seeing, on a separate screen.

All 360- films had a connection to the local area and were filmed by Film Stockholm, or Film Stockholm in collaboration with summer working teenagers. The films that were shown in the present study was for instance a boat trip to Ängsö; which is located in the archipelago of Norrtälje (F1), lemurs at Skansen (F2), a guided tour at Storåsfortet (F3), an art exhibition/walk (F4) and a canoe ride (F5).

**Oculus Go**

The head mounted device (HMD) that was used in this study was the Oculus Go, which is owned by Facebook. It is delivered with a controller and is designed to even be worn with glasses [31]. The HMD’s focus cannot be adjusted. Rather, the HMD itself can be moved by the user to find a position where the lenses are adjusted so that the user has the best experience; it varies among people. To be able to watch your own videos synchronized, which will be done in this study, a third-party application and software is needed. In this study Showtime VR was used and it was controlled through either a tablet or smartphone.
Figure 2. A picture of the HMD. In the present study multiple devices were used and they were connected through an application, which was controlled with a tablet or smartphone.

** Interviews **

After the film viewing, semi-structured interviews [15] was held to capture the elderlies experiences and thoughts around co-watching 360-films. The questions were based on four aspects: feelings, group connection, technology and user experience.

** Participants **

The participants were recruited through the different care homes and their caregivers. In total, 19 participants took part in this study, thirteen women and 6 men. The participants’ ages ranged from 55 to 93 years of age, with the average age of 80.8 years.

In total, 12 of the 19 participants (63.2%) said that they owned or previously owned a computer. Meanwhile 13 out of the 19 participants (68.4%) had never owned a smartphone. When asked to rate their level of experience with technology on a scale 1 through 10, where 1 was “very inexperienced” and 10 was “very experienced”, the average for the participants landed on 5.3. The participants were then asked to rate themselves on being an “avoider” of new technology or being an early adopter of the technology. Here on a scale 1 through 10, 1 was “avoid as long as possible” and 10 “try as soon as possible” and the average for all of the participants was 4.4.

Additionally, the sessions initially included 21 participants, but the study only includes 19 of them as two participants decided to discontinue their participation.

The following table will show the breakdown of the participants into groups and which specific films the groups watched.

<table>
<thead>
<tr>
<th>Group</th>
<th>Participants (gender, age)</th>
<th>Films</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>P1 (M, 84), P2 (F, 77), P3 (M, 88)</td>
<td>F1, F2</td>
</tr>
<tr>
<td>G2</td>
<td>P4 (M, 93), P6 (F, 85), P8 (F, 90)</td>
<td>F1, F2</td>
</tr>
<tr>
<td>G3</td>
<td>P9 (F, 64), P10 (F, 82), P11 (F, 75), P12 (F, 87), P13 (F, 89), P14 (F, 89), P15 (F, 78), P16 (F, 84)</td>
<td>F3, F4, F5</td>
</tr>
<tr>
<td>G4</td>
<td>P17 (F, 55), P18 (F, 79), P19 (M, 81)</td>
<td>F3, F4, F5</td>
</tr>
<tr>
<td>G5</td>
<td>P20 (M, 78), P21 (M, 78)</td>
<td>F1, F2</td>
</tr>
</tbody>
</table>

** Thematic analysis **

The method of thematic analysis is used for “identifying, analyzing and reporting patterns (themes) within data” [3]; where the goal is to, in its natural element, get a direct understanding of an event [49]. It is a systematic approach when analyzing qualitative data and reducing data in a flexible way [45].

In this study, thematic analysis was used in the context of analyzing the recorded data. A cursory analysis was conducted by listening to the interviews and transcribing them. This was then used to try to identify which themes were more prominent and recurrent. With these themes identified, a deeper analysis was made on the video data and interviews. The aim with the analysis was to analyze with an as open mind as possible and not attaching too much significance on focusing of the direction of the initial research question. The themes that were identified as most pertinent to the study was:

- Enriching the everyday life through new and reminiscing experiences
- Togetherness while co-watching depends on external social factors

As described in the method, the themes were identified by initially only looking at the interview data and then analyzing the video data.

** RESULTS **

Here, the general experiences and observations are presented and continues with the themes that were identified.

** General experiences and observations **

Overall, all of the 19 participants that made it to the end were very positive to the whole experience, as P2 stated: “It was
only positive!", while the overall feeling of awe was a
commonality between the participants. All of the participants
expressed that this experience was something that they
wanted as a recurring event.

Since the HMD was an integral part of the experience, one
question asked to the participants after the session was how
it felt to wear it and if they experienced any difficulties with
it. The majority (14 out of 19) of the participants did not
express any issues in comfort or felt that it lessened their
experience. However, five participants experienced some
noteworthy problems. First, three participants (P9, P16, P18)
expressed that the they encountered visual problems during
the session and stated that it looked blurry. All three were
wearing glasses. P18 elaborated: “I got used to it (...). It was
blurry, maybe it has something to do with my eyes or my
glasses (...) but it always had that little tremble”. However,
other participants wearing glasses did not explicitly state to
have any problems with this or being uncomfortable to wear
the HMD with their glasses.

P3 also expressed having severe problems seeing, saying:
“You could not see anything!”. However, looking at the
recorded video it was evident that the participant had trouble
holding his head up which could indicate that the HMD was
too heavy. Although P3 did not report any discomfort using
the HMD. However, P10 did state that the HMD was too
heavy.

Enriching the everyday life through new and
reminiscing experiences
Before the experience no participant expressed having any
prior expectations. The general interest was to explore
something new. After the sessions were finished, many
expressed positive experiences such as it being fantastic (P2,
P6, P17), wonderful (P15) and exciting (P18). P10 related
the experience to a previous one, stating: “This reminded me
of that cinema with IMAX (...) like Cosmonova (...) but in a
smaller size”.

When asked about what feelings the session invoked no one
had adverse comments. P1 was clear: “I feel happy”,
Another participant (P15) said: “Just hearing her narrate
[the guided tour, F3], you get into it. I thought that was really
cool”. Additionally, P17 stated: “It feels a lot more intense
than sitting in front of the TV and watching a movie”.

Furthermore, some participants directly correlated the
experience and films to old memories and associating the
feelings to those. One (P17) could recall the smell from a
memory only by watching the film (F3), stating: “(...) when
she walks into that mine you could actually smell it (...) I
could smell it. I haven’t been to that mine, but what I could
smell was like a salt mine (...) which I have been in many
times. That smell is what I feel [when I saw this mine]”.
Another participant (P4) was familiar with the area in the
film (F1) and commented on that, saying: “This looks like it
did 20 years ago! I have had 3 different boats, [so I recognize
the area I just saw], generally speaking”.

Another question that also triggered old memories was about
if they could choose what types of films they would like to
watch. One participant, P1 stated: “I would like to see the
Swedish mountains [Fjällen]. My wife was from there”.
Another participant, P19, stated that they wanted to see
things that they never had seen before. A lot of the other
suggestions circled around nature with some of the
participants detailing their suggestions, P13 saying: “I would
like to watch more nature, maybe some birds chirping.” and
P20 stating: “Imagine all the blueberries and lingonberries
or red colors [in the forest]”.

When asked about if, and how, this experience had enriched
their everyday life, P8 related it to experiencing the new
technology saying: “Sure, yes, it’s that we’ve been following
[technology] during our lifetime and a lot has happened. So,
to get to experience something I’ve only heard about; that
was fun!”.

Continuing, P4 also answered this question but by
implying that this type of experience should be an everyday
element, saying: “You, of course, get happier, that’s certain.
A little while every morning [should one get to do this]”.

Figure 4. Another example of how a session could look. This
was also the biggest group in the study.

Togetherness while co-watching depends on
external social factors
Almost all the participants expressed that they did not pay
attention to the other people that were in the sessions with
them. As one participant stated: “I was just looking at what
was in front of me, not thinking too much about what was
happening around me” (P9).

When asked about if they thought it was better to watch
together in a group or if it made any difference to the
experience, the consensus was that it did not make much
difference (all except P20 and P21). P6 answered: “It doesn’t
really matter.”, while P4 and P17 respectively said: “I didn’t
think about it [it being watching together], I was out in the
archipelago” and “No, I just felt like it was just me there”.
P18 elaborated on what P17 said and continued: “You were
in your own little world”.

Looking at the sessions on a group level, what could be
deduced from the recorded video was that there was a
difference in groups where the participants knew each other
beforehand in comparison to groups where they were
strangers to each other. In groups where the participants
knew each other (G1 and G5), they were more likely to
comment on and talk about what they were seeing with each
other.
In comparison to the groups that had participants that were familiar with each other beforehand, the remaining groups (G2, G3 and G4) were quite uncommunicative and the sessions were at times silent aside from the sounds coming from the HMD’s.

However, individual communication also appears to be influenced by the actions of the person/persons administering the sessions and how active/involved they were. In G1 the interactions between the participants occurred in the beginning through talking. However, there was almost no talking when administrators were not there to interact with them by prompting some of the participants to look around or ask questions about what they were watching.

In G2, the participants interacted with each other as long as the administrators were engaging them, otherwise everyone seemed to be very much in their own heads. In both G1 and G2, due to other circumstances, the participants were left to watch by themselves the majority of time. In general, this led to participants interacting a lot less. The participants in G3 and G4 spent almost the whole session being quiet and just watching the films, with the exception of the beginning where they just commented on how “cool” it was. The difference between these two groups and G1 and G2 was that the administrators of the sessions were completely distant and did not engage the participants at all throughout the sessions. It was evident that it affected the interaction between the participants as it was quiet during the sessions.

The last group, G5, is a counterexample of the previous groups and was different in the sense that not only did the participants know each other (close friends) beforehand, they were likewise familiar with the administrator, and the administrator was also engaging the participants throughout the whole session with questions about what they were watching and seeing, having them describe where they were in the film, and their connection to it. The participants in this group were also the only ones who did find the experience to be better and more enjoyable when sitting in a group, with P20 saying: “Well, you can actually talk about [what’s happening] and that does add something”. P21 continued: “Yeah, I think that it’s good, it gets better by not sitting by yourself”.

Co-location
In terms of being co-located some participants (7/19) noted that they felt as if they were in the film being viewed and as if they were there and felt immersed in the virtual environment. After watching the guided tour, P10 said: “I wanted to ask the guide [a question], but then I realized that there was not a guide here!”. On the contrary, P1 was aware of being in two different spaces and said: “It was a bit weird, you could not blow your nose”. This was also confirmed by the recorded video, showing the participant trying to blow his nose but not managing to do so since he could not see the outside world during the film.

On a group level, in the second group, G2, it could be seen that during that session there was a lot of sounds and commotion around the participants, apart from the session, but the participants did not seem to have any problems with being distracted or knowing where they were in context to what they were watching and reality. This could also be said for the other groups, where it was quieter around them, but the participants were still very much focused during the session and immersed in the virtual environment.

Not knowing what the other participants were looking at created a case in G1 where P2 was trying to get P3 to look at a specific thing in the film. Calling out “look over there” while pointing, created some confusion as P3 had no idea where to look. While there was only one instance of this, there were indications that this could have happened in other groups.

DISCUSSION
Concerning the first part of the research question; “How is co-located co-watching of 360-degree films in a HMD experienced by elderly people?”, the results overall indicate that this was a pleasant and enjoyable experience for the elderly that they would gladly repeat, and while they did not have any prior expectations, the majority was there to try something new. In terms of co-location, it was found that on an individual level the majority of the elderly did not have any troubles with feeling like they were in two spaces. On a group level this was apparent in an elderly trying to use pointing as a marker to make note of something to another participant. Regarding how the experience enriched the elderly’s life, they felt like it was an enriching experience that also made them reminisce and think of old memories that made them happy. All except two elderly stated that the experience was not better because of co-watching and that it would not have mattered had they been watching alone. No one, however, expressed that the co-watching experience was negative or harmful. Nonetheless, it could be seen from a group perspective that knowing the other elderly beforehand and having sessions that were carried out with an active administrator that initiated conversations, had a positive impact on the social climate while co-watching.

Concerning the elderly that experienced difficulties with the HMD, some of the problems could be attributed to being unfamiliar with the device. The problems stated by the elderly was visual and weight problems. The problem with the weight of the device is highly individual and a potential solution is to support the device with the hands. However, HMDs for elderly should clearly have less weight to be accessible technology and this is supported by Hodge et al. [18] as well. In regards to eyewear, according to the manufacturer [31], it should be possible to use glasses with this specific HMD and most participants with glasses did not have any problems. It is possible that the blurry experiences recorded might be due to individual differences and eye conditions. However, repeated use could potentially also make using and adjusting the HMD correctly easier, at least in regard to the visual problems.

Below, the second part of the research question is answered and key findings from the themes are discussed followed by implications that are important for a co-located, co-watched VR-experience for elderly users.
The role of the administrators and the importance of group composition for engaging 360-film experiences

An important part of the experience is the person leading the session. The results imply that the level of engagement of the administrators is of importance for the whole experience and how the participants interact with each other, which make their significance difficult to disregard. Looking across the groups, the engagement of the administrators varied throughout the sessions and that noticeably affected the social interactions. The differences in the interaction of the groups can therefore, in part, be directly correlated to how the administrators engaged. G5, the last group, was the only group where both the administrator and the participants all knew one another beforehand. It could be suggested that this group is somewhat of a special case since the participants where so familiar with each other. However, it also suggests that co-watching have more experiential impact in a familiar social setting.

The interaction of the administrator is not only vital to make the experience pleasant for the individual but also for the group as a whole. Having groups, such as G3, where no one knew each other beforehand, the administrator could have helped bridge the gap between them and initiated interactions and conversations. This is important since it could lead the elderly to feeling more comfortable with one another, but also helping with making this a truly shared experience by pointing out things while the elderly is watching. This is because the elderly otherwise has no way of knowing what the other persons are looking at, keeping them in their own “HMD bubble”. In this, the administrator can help by e.g. asking questions to one participant that lets the others know what that one person is looking at and also opens for others to respond to their thoughts and experiences through conversation. Thus, it could be argued that depending on how the person leading the session is interacting with the participants, it will change the outcome of the experience and what the participants will take away from it.

Who this experience is shared with also seemingly affects the interaction level of the participants. The results indicate, overall, that in the groups where the participants were familiar with one another there was more interaction, not only during the session but also after. Being familiar with each other surely makes it easier to engage in conversations. Here it is important to highlight that conversations are essential for deeper values emerging from sessions, such as interesting discussion, sharing old memories and experiences, or otherwise reminiscing parts of the past. Group composition, therefore, becomes an important part of the co-watching experience.

This study has focused on the very first 360-film sessions with the elderly. Hence, the learnings drawn from these sessions mainly applies to initial sessions at elder centers. In the case of having 360-films sessions as a reoccurring activity in this context, it might be beneficial to keep groups consistent in order for the elderly to get to know each other and promote long term joint experiences and conversations to emerge and increase quality of life through social integration. In groups where conversations begin to emerge, the administrator’s role as a facilitator for interaction probably diminish over time.

Value of watching

A big part of the result amounts to the question of what the value of co-watching 360-degree films is. Value is something that can be measured in different ways and furthermore, you have to examine where the greater values lie. It can help in future endeavors to know if the value is in the pure form of watching, or if it lies in watching as the context of something bigger and what value this type of experience brings.

The administrator engaging the participants is not only to have them interact, but they could also be a catalyst to start new discussions and relationships independent of the VR experience to create more value. Discussions have a way of invigorating people and could help in keeping them alert and thinking. Such discussions do not only have to be between participants, but also between the administrator and participant. This is likely to be especially beneficial for those in situations where the administrator is also the caregiver for the participant (e.g. in a nursing home), creating an opportunity for the relationship and bond between the caregiver and participant/patient to become better. This is also supported by the study by Wallace, Thieme et al. [46] in which they state that e.g. places that is recognized by the elderly can be used as a catalyst for a discussion with the administrator. This could also be taken one step further. In the purpose of creating value from the start, having set discussion points for every film adds another element to the experience that could lead to enrichment of the everyday life. Furthermore, you could also make films with the purpose of creating a discussion. This could serve as a way to, not only enrich the everyday life and create value for the user, but also to activate the user.

Co-watching and co-location

The results infer that watching the films creates an immersive enough feeling that it succeeds in shielding from outside disturbances. This could also be said for the groups, where it was quieter around them, but the participants were still focused on the film. However, it still might influence the co-watching experience, e.g. disturbances around might make the administrator distracted and pull away focus from the session at hand. So, to have the optimal experience a calm setting is probably more advantageous.

The overall result indicates that the majority of the participants considered co-watching to be an afterthought and not something that was the main focus. The experience can be classified as an experience with full co-presence and users physically co-located [17] and this leads to some missing properties. While the immersion is welcome and is what makes VR what it is [26], there are also some problems with co-presence. While there was only one instance of this, the situation where a participant was pointing and telling another participant to “look over there” while watching, it highlights an important property that is lacking that would make the co-watching experience better. For instance,
Knowing where other participants are looking in the film could lead to discussions that would not be possible had they not known that. As it stands, co-presence is not visible during the experience, which could be an indication of why the participants did not feel like co-watching was a factor in the experience.

Looking at ideas [7, 16] that are available to improve co-watching, finding ways to somehow make it known where the others are present, or as with this current situation where they are looking, might be difficult to achieve and at the same time keep the experience as immersive as it is. The issue in the present study is that the users are not represented in the virtual environment, and while it could be sorted with a solution such as the one Gunkel et al. [16] have, in this situation it would be too intrusive and the level of immersion would potentially be lower. The ideal solution should be unobtrusive where the aim would be to make the users aware of one another, without losing the level of immersion that is there now.

**Enriching the everyday life**

The enrichment of the everyday life is a measurement that is, in nature, highly subjective. Subjective, in the sense that what one person found made their everyday more enjoyable, might be something another did not like. All of the participants in the present study did find the experience to be positive, which could be considered to have made their everyday life better, however only for the moment. The scope of the study is not sufficient enough to conclude if their everyday life is better for long term. Moreover, loneliness and isolation are two things that are common within the elderly population [23, 32], on account of e.g. not being able to do the same things as before, and while that might make it seem like any type of new experience would be enriching, the quality and suitability of the experience should be considered [21]. In addition, there is proof [25] that a VR experience in a group can combat the aforementioned problems.

For many of the participants the value of the experience seemed to be in the actual content of the films, which for some brought back memories. VR-technology and an experience like the present, is a good way for people, who are no longer able to do things they would have been previously (e.g. traveling), to still be able to at least simulate experiencing them again, this time in a virtual environment. It is also a way to see places and anything that you might not have seen before. In this study the films used were of places in their vicinity that the majority was highly likely to have already experienced, but even if they didn’t the films are open enough to connect to another memory to then be able to reminisce. This openness is described by Gaver et al. [13] and how openness was an important factor in the design of the Photostroller. On the whole, from what could be seen in the sessions, this connection to location seemed to have the most positive effect, as it made them revisit memories and places they had not been to in a very long time. Therefore, this type of experience, where the films have a geographical connection, becomes a way to continue to have a connection to another, or past, part of one’s life. However, a risk with this is that looking back at old memories could be seen as a loss of self and a look on what has been lost, as described by Wallace, Wright et al. [47]. There also needs be a focus on the present and potential future, and this could be done be having films that show new scenarios and locations.

Besides this, results also suggests that the value of the experience is in the viewing, but in a bigger context. It is not only about viewing a film that might bring you back to old memories, but also about the discussion that occurs before, during and after the act of watching. This supports the notion that VR experiences cannot replace social interaction [18] and should be used as tool to engage the elderly and enrich their lives. Additionally, in some way, it is also about keeping the elderly in loop with technology and letting them experience it. In all, the conversations that were born from the sessions that had the participants talking on their way out, is how one could measure to see if this was successful in enriching their life.

**Implications for future endeavors**

These six key implications should be considered when arranging and executing sessions for a co-located, co-watching of 360-degree film experience:

- **The role of the administrator.** The administrator has a vital role in the co-watching experience, both for the sake of interaction and for the comfort of the users, by helping when needed. Also, they can improve the experience in terms of co-watching and co-presence. The administrator needs to be proactive in engaging the participants, as individuals and as a group.

- **The group composition.** The familiarity of the participants does affect the level of which they are engaging and interacting on their own. While this can be prevented with an engaging administrator, being familiar with the other participants allows for a better experience.

- **Value of watching.** The motivations of the participants for watching might differ but it is key to have in mind that there can be differing perceived values in the same experience. Thus, creating value can be made at different stages of the experience.

- **Enhancing the co-watching experience.** Co-watching in the form it is in, in this experience, while functional, lacks the co-presence component that makes the users aware of each other and what they are doing. This could be helped with additional tools.

- **Decrease weight of HMDs.** While most people can handle the weight of the HMD, many elders do not have the strength to use HMDs. This calls for efforts on reducing the weight to make HMDs accessible for new user groups.

- **Content is king.** It is important to provide sufficient film material to allow sessions to be tailored to participants personal interests, background and memories.
**Challenges**

Some challenges were dealt with in the progress of this study. As this study did not have independent access to gear needed (i.e. the HMD’s), there were some difficulties in setting up the sessions, with time being one of the factors. While it ended up working, some adaptations had to be made to the methodology, veering from the intended plan.

**Methodology criticism & reflection**

According to [17], the method for this type of study was appropriate since they are well established and commonly used [30]. However, there could be made improvements on the execution of some parts of the method. The interviews could have, in general, been more in-depth and longer, in order to get more variety in the data. This could have been achieved with more questions and with some of the questions being of a more directed nature. In hindsight, the sizes of the groups did have more of an impact on the outcome of the interviews than it was thought to initially have had. The discrepancies in the sizes of the groups were due to time constraints and not enough participants. The differences in group sizes might also have had an impact on the interview-part of study. In the one big group (G3), the size of the group also made it harder to push questions as a lot of the participants tended to just agree with the first answers out and did not elaborate themselves. On the opposite, only having two participants in one group had the potential to make the interview-part too stagnant. In the future, the ideal group size should be between three to five participants.

In retrospect, the preparations for the sessions could have been better by established a clearer direction from the beginning and sharpened the questions. For instance, a dedicated pilot session would have been good to tune the study. However, due to the uncertainty of getting enough participant I felt forced to stick with the format. Also, being open-minded at this stage did make it so that the data could be judged and analyzed without any preconceived notions.

Furthermore, for future studies, instead of only having one session per group, it could be groups that meet continuously for a longer period of time, with the administrator and the participants being the same people every time. This type of study could measure the long-term effect of a co-watching VR-experience to see what the outcome would be in terms of the themes that were studied in this present thesis.

**Limitations**

One problem was that the sessions did not allow the participants to freely choose films, as they were chosen on grounds of availability and appropriateness for the situation. The administrator and I were the ones that chose the films, as others some were not suited for a synchronized session. This could have had an impact on the outcome of the study, since different films might have resonated differently for each of the elderly in the sessions and therefore affected their response and experience.

Due to the time constraint, there was some initial difficulties in finding enough of participants; which, for instance, caused a gender imbalance (the majority identified as female) due to the limited selection possibilities. It is however, imperative to emphasize that this study did not take these parameters into any deeper considerations.

**Future research**

Overall, I see two things that are missing in the current research. First, on a general level, we need more research in the areas of 360-films, in particular for the emergent area of co-located co-watching of 360-films. Secondly, we need more research on tools for co-watching in VR and how to promote co-presence in HMDs. Finding unobtrusive ways, while still keeping the immersive feeling, to make it possible for users to know where others are and what they are looking is at core for co-watching experiences.

**CONCLUSION**

The aim of this thesis was to gain insight into how elderly experience co-watching 360-degree films in HMD’s by having them watch films in groups. Five sessions were filmed and analyzed with 19 elderly looking for common themes and implications. The themes from which the implications were drawn was: enriching the everyday life through new and reminiscing experiences and togetherness while co-watching depends on external social factors.

This study found that a co-located, co-watching experience of 360-degree films is generally received positively by elderly people. However, the intended social benefits from co-watching was not obvious to the participants and the social interactions observed was limited, except for elderly who knew each other beforehand. Furthermore, I conclude that the “HMD bubbles” that each elderly was put in hampered the co-watching experience, which is something that could be enhanced by adding more visible co-presence components. Overall, this indicates both that the social setting is crucial for co-watching and that the inherent quality of HMD’s might have shortages for rich and natural social co-watching such as around TVs.

It was also established that the role of the administrator is important for initial sessions, in particular when co-watchers are strangers to each other, as they could take on a role to facilitate and initiate discourse and conversations in order to spur the social experience. In terms of the value of watching 360-films, I conclude that the content itself creates valuable and enjoyable experiences that may prompt old memories and discussions among the elderly.

Finally, I have extracted six implications that can be used as a guide for arranging future sessions and design intriguing social co-watching experiences for elderly.

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