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Virtual reality as a possible aged care technology – opportunities and prejudices from older persons and their caregivers in a qualitative study

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Introduction: Virtual Reality (VR) offers new opportunities in healthcare, especially for older adults, who often suffer from reduced mobility, cognitive decline and reduced social contact. However, VR is still not widely accepted among current older generations and their caregivers as a healthcare tool.

Methods: This qualitative study explores the perceptions of older adults and their caregivers, formal and informal, on VR and its potential use in aged care. 67 interview participants explained their views after being presented with a video showing older adults using immersive VR technology. The data was analyzed using thematic analysis.

Results: The study reveals that the three stakeholder groups foresee potential of VR as an entertaining and therapeutic technology, but that they also worry about VRs' impact on loneliness, the cognitive capabilities needed to use it, as well as its safety for older adults.

Discussion: Our study identifies clear opportunities for VR technology in aged care. Comparing our results to current research on VR and older persons, our research points to important prejudices that need to be dismantled before VR will be widely adopted as a technology in aged care for current older persons.

KEYWORDS

aged care, caregiving, older persons, travel, therapy, cognitive decline

1 Introduction

Virtual Reality (VR) is a technology that can be defined as “a three-dimensional computer-generated simulated environment, which attempts to replicate real world or imaginary environments and interactions, thereby supporting work, education, recreation and health” (Abbas et al., 2023, p. 7). This relatively broad definition emerged in a healthcare focused systematic review (Abbas et al., 2023), which is the domain of this research article, yet other definitions have been used throughout the literature (see for example, Burdea and Coiffet, 2003; Furht, 2008; Heim, 1993; Steuer, 2000). VR can be non-immersive or immersive (Hamad and Jia, 2022; Wohlgenannt et al., 2020), the former in the form of screens surrounding the user (Rahouti et al., 2021) and the latter through the use of head-mounted displays (HMDs), which allows

the virtual information to be presented to the user in a fully three-dimensional manner and always from his standpoint (Hamad and Jia, 2022; Slater and Sanchez-Vives, 2014). This multitude of sensory inputs from VR (through visual, sound, and haptic feedback through controllers or gloves (Wohlgenannt et al., 2020)), plus the user's ability to interact with the environment, create a feeling of immersion, presence and embodiment in the virtual environment, which can trigger behavioral responses similar to the ones in real life (Seinfeld et al., 2022; Slater and Sanchez-Vives, 2014). Medicine and healthcare have recognized the benefits of VR, incorporating the technology in medical and surgical education and training (Chheang et al., 2024; Haque and Srinivasan, 2006; Jiang et al., 2022; Shaun et al., 1999), in diagnostics (G. Burdea et al., 1999; Ma et al., 2022; Randell et al., 2013; Shaun et al., 1999) and in therapy (Chheang et al., 2023; Freeman et al., 2017; Liu et al., 2019; Lohse et al., 2014; Shaun et al., 1999). In a meta-analysis of current literature on therapy opportunities of VR, Riva and colleagues summarize the potential of VR as a technology that "offer [s] an important source of personal efficacy" (Riva et al., 2016, p.8). This is why scholars consider VR as a (moral) education tool that is potentially able to reduce racial bias and improve empathy (Francis et al., 2017; Kiafar et al., 2024; Maister et al., 2015).

Gerontological research indicates that older adults can greatly benefit from the use of VR technology. Older adults often suffer from gait, balance or mobility disorders, which can increase their risk of falls (Campbell and Buchner, 1997; Verghese et al., 2006). A systematic review comparing (both immersive and non-immersive) VR-interventions with conventional balance training and physical exercise programs, concluded that older adults receiving VR-therapy had better outcomes regarding muscle strength, static and dynamic balance, and postural control (Rodríguez-Almagro et al., 2024). An explanation for this may be the precision and continuity with which VR can measure movement and offer corrections (Clark et al., 2012; Rodríguez-Almagro et al., 2024; van Diest et al., 2014). Another issue that older adults are likely to experience is cognitive decline (Jaul and Barron, 2017). In a study with a fully immersive VR-application, involving both cognitively fit older adults and older adults with mild cognitive impairment, both groups showed improvement in cognitive abilities, such as new information retention and frontal lobe activity (Maeng et al., 2021). VR-based cognitive exercises, such as simulation of shopping at a virtual supermarket or a virtual closet where pairs of shoes had to be organized, improved execution of daily activities, verbal memory and global cognitive function in older adults who suffer from cognitive impairment (Liao et al., 2020; Oliveira et al., 2021; Son and Park, 2022). Veterans suffering from cognitive decline and post-traumatic stress disorder exhibited less psychological symptoms of dementia and needed less medication after an intervention with VR (Appel et al., 2022). Older adults are more prone to experience social isolation, an issue that was highly present during the COVID-19 pandemic (B. Wu, 2020). VR's ability to gather users in a virtual space, thus overcoming physical distances, can foster social engagement in older adults. A study connecting older adults in a VR environment in pairs

and assigning them problem-solving tasks increased their social engagement (Kalantari et al., 2023). Another study investigating VR as a group activity in a nursing home found that older adults with low engagement with others before the intervention became more proactive and socially engaged with others after (Li et al., 2024). VR has had promising results regarding the mental health of older adults. A scoping review found that function-oriented VR interventions tended to improve the mental health of older adults, more so than merely entertainment-oriented VR interventions (Li and Muschalla, 2024). Immersive VR experiences enhanced the quality of life of older adults and decreased signs of apathy (Appel et al., 2020; Kang et al., 2021; Lin et al., 2018; Roberts et al., 2019). Lastly, palliative patients can cope better with their symptoms through the immersive nature of VR that invites relaxation and focused attention (Woo et al., 2024).

Even before the appearance of VR, interactive computer games relayed promising results for older adults, indicating that digital environments are beneficial for them. For example, digital games improved performance in everyday life for closely related tasks for older adults (Simons et al., 2016) or incentivized exercise due to requiring physical movement (Bleakley et al., 2015). Lastly, gaming simply proved beneficial for older adults because they perceived it as a pleasurable activity or because it improved their social connectedness (De Schutter and Brown, 2016; Osmanovic and Pecchioni, 2016; Pearce, 2008; Schell et al., 2016).

VR can trace its beginnings back to the 1960s, with technologies such as the Sensorama developed by Morton Heilig (Bown et al., 2017) and the Ultimate Display by Ivan Sutherland (Sutherland, 1965). The commercial success of VR started approximately a decade ago, when the social media company Meta acquired the VR-company Oculus (Hamad and Jia, 2022). VR currently remains a technology mostly used by younger persons (Di Natale et al., 2020; Korn et al., 2024). Given that the older population worldwide is growing (United Nations Department of Economic and Social Affairs, 2022), which means an increasing user base, some companies are recognizing the market potential and trying to create VR-products specifically for older adults (Kalantari et al., 2023; Rendeveer Inc, 2023; Sonida Senior Living, 2023). The fact that users can tap into experiences without physically leaving their homes means that VR can offer activities to older persons that are not accessible to them in the real world anymore (Kalantari et al., 2023). Nevertheless, acceptance among older persons regarding VR and new technologies in general is currently relatively low (Fowe and Boot, 2022; Shah et al., 2022b; Xu et al., 2022). The main reasons for VR include the unfamiliarity with the technology (Han and Oh, 2021; Wang and Wu, 2021), skepticism regarding its usefulness or even fear of potential downsides such as accidents and the lack of social connectedness (Shah et al., 2022a; Shah et al., 2022b). Conversely, a factor enhancing acceptance for older adults is social relatedness, meaning that, if technology can enhance the feeling of belonging to a group, it is more easily accepted (K. Chen, 2020). Interestingly, these factors of hindering or fostering the uptake of VR for older adults seem similar to factors researched for digital interactive technologies in general, where older adults reported either a lack of familiarity, a perceived difficulty in actually playing the video games, or a lack of interest or value in the activity (Brown, 2017). Likewise, many healthcare providers lack familiarity with VR as a professional technology and therefore are not equipped to include it in their practice (Ong et al., 2024; Seifert and Schlomann, 2021).

2 Purpose

In short, while research on VR and older adults indicates a beneficial impact for their health and wellbeing and should therefore receive a chance as a caregiving technology, adoption of VR among older adults and their caregivers is still scarce. Successful incentives to integrate VR into caregiving for older adults will however depend on the actual needs and wishes of the involved stakeholders to tailor them accordingly, as well as understanding their fears and concerns regarding VR, to avoid realizing them (Wei et al., 2023; Xu et al., 2022). As current research is sparse (Sadowski and Khoury, 2022), we conducted a qualitative study to explore the opinions of older adults, as well as their caregivers (formal and informal) on VR, to fill in the gaps of how VR technology adoption could be improved. Our research question can be summarized as follows: What purposes do older adults and their caregivers foresee for VR technology in caregiving and what concerns do they have regarding VR in such a context?

Our findings contribute to understanding the potentials and the risks older persons and their caregivers perceive when using VR in a caregiving context. The results thus expose conditions that facilitate or hinder acceptance by these groups. Knowing what older persons and their caregivers want and expect from VR can pave ways for a successful introduction of the technology into the care process and an easier adoption among these populations of future involvements of VR.

3 Methods

This paper is part of a mixed-method study (Creswell and Clark, 2010), called “RESOURCE” where the goal was to explore the existing knowledge, attitudes and barriers to acceptance and emerging ethical issues regarding the use of different technologies in aged care in Switzerland. The qualitative part of the study followed exploratory theoretical framework that used thematic analysis (Konstantinos, 2024). The data for this paper stem from interviews carried out in the German-speaking part of the country involving 3 stakeholder groups and investigated other technologies next to VR (Felber et al., 2024; Wangmo et al., 2024). Below we report our method and analysis using the COREQ-32 checklist (Tong et al., 2007).

The research project was approved by the Ethics Commission of Northwest and Central Switzerland (EKNZ) under ID: AO_2020-00027. A document containing all relevant information regarding the purpose of the study, the content of the interviews, the measures taken to ensure data privacy and a contact person in case of doubts were distributed before the interview to each participant. Participants provided written consent before the start of their interview and were told that they could retract their participation anytime up until the transcription of their interview started. No participant chose that option.

3.1 Participant recruitment

For participant recruitment we used purposive and snowball sampling. That is, participants were approached through a

variety of techniques, including contacting relevant institutions, such as nursing homes, home care organizations and additional services (such as Meals on Wheels), distributing flyers in points of interest, such as organizations centered around age or caregiving, online advertising, for example, in online journals centered around aging, as well as social media, and word of mouth. Inclusion criteria were the following: 1) being 65 years or older OR being a caregiver to a person 65 years or older and 2) living in Switzerland at the time of conducting the interview.

3.2 Data collection

An interview guide was developed to aid in the interview process. It was semi-structured and consisted of open-ended questions, with a specific section dedicated to VR. Participants were shown a publicly available YouTube-video (in German) showing 4 older women testing VR, immersing themselves into an underwater world. The video was chosen for several reasons: it belongs to a channel that encourages older adults to play videogames (Senioren Zocken, 2015), it shows the older adults experiencing the underwater world independently and starts within the experience, thus avoiding experience-unrelated information, such as the installation of the HMD and the VR-application. Furthermore, the women in the video seem engaged, but not overwhelmed. They comment on the beauty and calm of the underwater world. Overall, we perceived the video to be a good introduction to VR in case the participants had no prior experience, given that it was calming in nature (Appel et al., 2022) but gave a good impression of what a full immersion would look like to the participant (Restout et al., 2023). The questions about VR for the participants included their general impression of the technology, its potential benefits and risks, as well as its impact on caregiving and relationships with caregivers (or older persons, when caregivers were interviewed). For example, participants were asked directly if they would use the technology, either themselves (for older adults) or for their care recipient and what motivated their answer. The interview guide was drafted in English, then translated into German by the first author and back translated by two independent researchers to ensure consistency and coherence. The interview guide was then slightly adapted for each stakeholder group.

Two native female German-speaking interviewers, who were trained in qualitative methods and interviewing skills, carried out data collection. The participants did not personally know the interviewers and there was no prior personal relationship with the participants.

The interviews took place in the place of choice of the study participant. For older persons and family caregivers, this was most often the home, and for professional caregivers, the workplace or a neutral place, such as a café. One interview was conducted over Zoom. The interviews were on average 96 min long (range: 46–189 min) and were audio recorded, upon the consent of the participant. The interviews were usually conducted in one session, except for cases where the participant was either pressed on time (formal caregivers) or unable to continue the interview without a

break (older persons). Interviews were conducted in Swiss German (dialect) to facilitate communication and strengthen the relationship of trust with the interviewer. Field notes were made during the interviews to capture the situation of the interview as well as to remember which questions to probe on. No repeat interviews were done and transcripts were not returned to the participants for comments or correction as it was not requested. During all the interviews, there was no one else present besides the participants and the researchers.

In total, 67 participants were recruited, of which 27 were older persons (of which 15 were women, either living at home, in assisted living facilities or nursing homes), 23 professional caregivers (of which 19 were women, working for home care services, nursing homes or assisted living facilities); and 17 family caregivers (of which 13 were women) caring for an older person with dementia or other care needs. All participants approached agreed to participate in the study. The average age of participants was 87.4 (older persons), 45.2 (professional caregivers) and 57.1 years (informal caregivers) respectively.

3.3 Data analysis

The interviewers transcribed all interviews verbatim into German. The finished transcripts were then analyzed with the support of the entire RESOURCE team (NAF and TW are authors in this manuscript, VD and YJT are acknowledged for their contributions), using applied thematic analysis (Guest et al., 2012; Konstantinos, 2024). The analysis was first conducted in the research group, using MaxQDA. These group sessions served to familiarize the whole team with the data, as well as to ensure agreement regarding the emerging codes. The coding process followed an inductive approach. The authors considered data saturation to be reached due to the sample size of each participant group on the one hand (which was minimum 17) and the fact that no new themes found, on the other hand (Guest et al., 2006; Saunders et al., 2018). At least 3 transcripts for each stakeholder group were analyzed fully in this group setting, then NAF analyzed the remaining transcripts for the professional and informal caregivers, while another team member (YJT acknowledged in the paper) analyzed the interviews of older persons. For this publication, NAF retrieved and re-coded all the VR coded segments to again check and inductively develop the themes and sub-themes (i.e., the coding tree) around the aim of this paper. The themes and sub-themes were discussed with the co-authors.

4 Results

4.1 VR's envisioned utility

4.1.1 A substitute for travel

Older adults except for one participant had no experience with VR prior to the study, and the participant that had, had used it as a substitute for travel. Some caregivers also mentioned having experience with VR, either through museum visits or their own children and many were open to using the technology

in old age. They foresaw it as a more immersive and engaging replacement for watching TV or as a substitute for travel. Travelling was often mentioned as a specific purpose to use VR by participants from all groups, especially to revisit places where the user has pleasant memories. Caregivers foresaw an even therapeutic aspect of such virtual revisits to familiar places. For example, in the case of nursing home residents that had grown up outside of Switzerland, the possibility to revisit their country of origin seemed appealing to the caregivers as they imagined this to be a comforting experience for the care recipient and in the case of (mild) cognitive impairment, an exercise for remembering. Caregivers were aware of the difficulties associated with travelling for older persons, and VR therefore was appreciated as the closest substitute for real travel. However, the idea of travelling to a place that the care recipient never had the chance to visit in real life was seen as less entertaining and to potentially induce sadness or regret, because of the comparison between virtual and real (see later theme regarding realism), where the virtual experience would always fall short of the real experience.

PCH5 (Professional Caregiver Home 5): Virtual reality, I think that's something. ... Of the trips I've taken, to have that played out again for me, that would be awesome. Yes.

NAF: So reliving your journeys?

PCH5: Exactly, and then also the positive feelings associated with that, I think that would be really ... yes, an entertainment.

ICR8 (Informal Caregiver regular 8): Yes that would be absolutely. ... Because the other day she [mother] said, oh, I must not have been to [village in the mountains] in 5 years, but that's not true at all, she was still there last year. But that shows that she would love to go again. She would love to go again, but the 4.5 h' drive, that's just. ... You would have to think about that. But that would be great, something like that. Such things, if they experience a familiar environment again, that would be great.

4.1.2 Therapeutic purposes

Next to travel, participants from all groups seemingly appreciated the idea of a new, enriching experience that can be lived without leaving the house. Some older persons described the shown video as "entertaining" or "enriching" and caregivers described how the world of older persons becomes "smaller" and more limited, precisely because they cannot leave their dwelling anymore. They therefore felt VR as an animating, beneficial experience that could compensate for the older person's physical limitations. Even further, two professional caregivers revealed how VR games motivated nursing home residents to move and be physically active, suggesting a therapeutic purpose. They especially applauded the gamification aspect, which made the older persons competitive and engaged with the exercise. On the other hand, caregivers from formal and informal groups also foresaw VR scenarios as potentially calming and relaxing, and envisioned to use them for agitated older persons or for pain management.

PCN6 (Professional Caregiver Nursing Home 6)¹: Yes, at first they did not want it (VR) as activation at all. (...) And then that also started here - one resident said: "I do not just want an activation, I want to win! So producing such a will, that something artificial can produce such a will to compete, to win - I find these very important feelings.

ICR4: Or I think, everything in nature that you can somehow slow down or also speed up, like for example, an ice flower, that is also something amazing. ... that has a calming effect on people like that. (...)

ICR3: Yes, or in the Great Barrier Reef with clown fishes and colors (...). I would definitely like to try that. That would be interesting to put something like that on your mother. With an explanation. Look, you can go to another world now. Let's see. And there are people who'll say, oh, that's amazing, that's great.

4.1.3 A means to ease loneliness

A means to ease loneliness. Loneliness was recognized as a pressing issue among study participants, and at least one person from each stakeholder group suggested that VR could ameliorate feelings of loneliness. However, this was under the condition that the person is already very lonely, indicating a preference of use for people that already experience a high degree of loneliness. Professional caregivers saw VR more as an instrument to foster communication between older adults and their surroundings, rather than a tool that can relieve loneliness in and of itself. They thought that providing older adults with VR experiences would expand the older persons' horizons in a way that would enrich conversation with others and strengthen relationships.

OPH13 (Older Person Home 13): If now the person is alone. So really nobody he has around, then I can imagine that.

ICR6: That's actually nice, because it's really so against the loneliness or monotony in everyday life. From that point of view, it's actually something very nice.

PCA5 (Professional Caregiver Assisted Living facility 5): an experience like that, if you have an experience like that, you can talk about it. Sure, so okay, it's not mandatory, but I notice that with my mom, for example, with the audio books. It's crazy. So since my mother has audio books, she always talks about it and we have other topics. And I imagine that's the same here (VR).

Some participants however considered the use of VR as more isolating and increasing loneliness for older adults. They had not convinced that VR could provide any sort of social experience, expressing clear and strong preference for real encounters. Also, they imagined that VR would substitute real human contact, which they did not appreciate. There was fear that the older person would prefer virtual reality over real interactions or because caregivers may

"offload" older persons into the virtual world, occupying themselves less with their care recipients in real life.

ICR5: I felt like an inner rejection, because I thought, oh, it's nicer for the seniors to meet in real life, does not it make more sense to spend money and effort on driving one to the other. But this is something completely different. But it still does not change their loneliness.

ICR6: I do not think so. So at best also rather supportive, because it would be some kind of change or so a bit of an encouragement that everything is a bit more relaxed. Yes, it's still difficult now, or whether they then have the feeling that you want to ... sedate them. No, not to keep them quiet, but that you do not want to come by yourself anymore. That could perhaps still be something. But otherwise actually no.

4.2 Perceived limitations to VR's utility

4.2.1 VR as a bittersweet experience

Older adults often mentioned that they would prefer a real experience over a virtual one, and some caregivers from both groups agreed with them, although their preference for reality was less pronounced. A few caregivers thought that VR would have difficulty to live up to a real experience, as it would lack certain qualities (such as touch, taste or smell). Therefore, the VR experience may just be good enough to remind the users what they are actually missing. This for some translated to VR use being depressing, or at least boring after a few uses. Similar to the possibility of discarding an older person with VR mentioned above, some caregivers felt that the technology would be deceiving for the older adults who are using it, which seemed to infringe on their dignity.

ICR7: Or that you can be deceived somewhere by maybe ... by features that these technologies offer, that you then have a completely different picture of the world than it actually is, so that you could somehow drift away and get a bit away from this world, or maybe dive somewhere into a world where you then also have trouble finding your way back again and then become like dependent on technologies through overuse or incorrect use.

ICR5: You cannot breathe in the scent of the flowers or sit in a café and try a local specialty (with VR)... So it's a travel experience light. And that's probably also very individual, whether that's enough for someone or whether it then rather feels like. ... ah, I've missed my chance now to actually do it, and then it also makes you a bit ... yes, sad.

4.2.2 Cognitive fitness as a must

Participants from all groups considered that users of VR would need certain cognitive capabilities in order to properly use it. They especially expressed doubts for people with dementia, thinking that they would get too confused when being immersed in a virtual environment. Furthermore, some participants considered the VR experience overwhelming even for cognitively fit older adults. The sheer newness and the

¹ Abbreviations of stakeholder groups are written out in full if mentioned for the first time

immersive character were deemed be too much for an older person. However, some participants in both caregiver groups did not outright reject the use of VR even for persons suffering from cognitive decline, but proposed that the technology be very customizable, in order to tailor the experience exactly to the capabilities and wishes of the care recipient. Doing so, would in their opinion, minimize negative impact and to provide a positive experience. Furthermore, one older participant guessed that VR could be used for cognitive training, to maintain cognitive fitness.

OPN10: My sister had Alzheimer's, and she was happiest when she was sitting in her chair watching TV. She talked to the people there, if they said something, then she gave an answer. She was really happy with the television. But if she had had to put on glasses like that, I think she would have gone crazy. So I cannot imagine that at all. They have freedom, but as soon as they have glasses on, they are no longer free. Do you understand what I mean?

PCH1: if the program had matured in such a way that it's not a coincidence what people see, but that you can guide people like what they see, then I would find that better especially for demented people. And certainly useful. That they do not see something by chance, but that you could give them the way, if you know their history, at their pace, so that they see what they like to see.

4.2.3 Constant supervision required

Next to cognitive fitness, participants were also worried about the physical health of older persons when using VR, as the technology invites movement and therefore there are risks of accidents, such as stumbling and falling or walking into a furniture. Many caregivers thought that VR should not be used unsupervised by older adults. They also expected that installing, introducing and explaining the technology would take much time and effort. There were worries that older persons may actually not be able to ever use the technology on their own. Lastly, caregivers expected care recipients to suffer from vertigo or discomfort when using the VR goggles and therefore asked for design solutions that would diminish these consequences.

ICD6 (Informal Caregiver Dementia 6): That does not help me, that (VR) would be an action for him (husband), but that does not help me, I would have to build that, I would have to explain it, that's double work for me.

PCN9 (Professional Caregiver Nursing Home 9): And to stay seated like that, I think for most people that's a little difficult. I find, I do not know. Afterwards they did not show any nausea or headaches? I think that can also be, because I also have myself, I'm young but after VR I also had a bit of nausea.

PCN2: Eh yes, if that works for the people, for that you probably still have to see well <laughs>. And I do not know, so I've worn such glasses before, and they are insanely heavy, and are not comfortable at all, so <laughs> but yes, I think that's actually still

a cool thing. But yes, I think when we suggest that they walk around with them, you're already pretty wobbly on your feet as a normal person, so I do not really see that.

5 Discussion

The goal of our qualitative study was to investigate the perceived benefits and risks of VR by older adults and their caregivers to determine VR's utility in the context of aged care and to understand why the technology has difficulty to be adopted these populations. VR's utility was envisioned in a variety of ways: firstly, in traveling to places that an older person cannot access anymore due to physical limitations, secondly, in a therapeutic manner, where VR experiences were described as enriching and beneficial to cognition. And thirdly, as a means to reduce loneliness, albeit for already very lonely people. However, the hesitancy to adopt VR as a caregiving technology was expressed as worries that VR may cause negative feelings, such as regret or sadness, or that VR could be too difficult or even dangerous for older adults to use alone, therefore requiring constant supervision of care recipients by caregivers.

As mentioned in the introduction, a general hesitancy to use VR could at least partially be explained as a generational difference, as younger persons adopt technologies more quickly and the current older generations had less exposure to technology during their lifetime, making late adoption more difficult (Di Natale et al., 2020; Han and Oh, 2021; Korn et al., 2024; Wu et al., 2015). Nevertheless, the replies of the study participants shed light on two important issues. Firstly, our research clarifies the applications of VR as a caregiving technology, providing a direction for researchers and developers of VR to ensure that they offer to older adults and their caregivers what they envision. And secondly, the study uncovers fears and worries of older adults and caregivers regarding VR. Comparing them to current research highlights which fears are warranted and which seem harmful stereotypes, therefore offering strategies to stakeholders in healthcare and industry to improve adoption of VR as a caregiving technology, to promote the health and wellbeing of older adults.

5.1 Nostalgia meets cutting-edge innovation

Virtual reality can be a space where older persons can relive cherished memories and revisit familiar places, as suggested by our study participants. VR was used for travelling in a focus group study among older adults living in a retirement community (Roberts et al., 2019) and nursing home residents in an intervention study (Appel et al., 2020). In both studies, older adults were able to test VR, unlike in this study, and enjoyed the virtual experience of a new, unfamiliar environment. While the participants in the focus group suggested travel as a possible use of VR themselves (Roberts et al., 2019), the latter participants in the nursing homes filled out a questionnaire regarding their experience, and many reported feeling happier, more adventurous and energetic (Appel et al., 2020). These studies therefore seemed not to invoke feelings of sadness due to the lack of realness. Our study participants questioned the authenticity of the virtual experience, doubting that it would be

rich enough to be satisfactory. Interestingly, research is already experimenting with features of VR that could render the experience more immersive and thus more realistic, such as the perception of a breeze, for example, (Sai Surya Vamsy Malladi et al., 2023). Personalization of games and gaming experiences for older adults is gaining the interest of researchers (Hodge et al., 2018; Ijaz et al., 2016; Yang, 2019) and our results suggest a concrete direction for said personalization. Being able to offer very customizable and realistic experiences to older adults could increase the appeal of VR as a caregiving technology that improves the mental wellbeing of older adults. Furthermore, while VR currently remains a fairly expensive technology (Navea, 2024), it may still cost less money, as well as time and effort for older adults and their caregivers than real travel.

5.2 Therapeutic purposes

The use of VR for therapeutic purposes, such as cognitive training (in cognitively healthy older adults) was often suggested and viewed as a benefit. Indeed, quite a few interventional studies used VR successfully to improve older adults' cognition who suffer from decreasing cognitive capabilities (Hill et al., 2017; Man et al., 2012; Oliveira et al., 2021; Zhu et al., 2021). Furthermore, VR had a positive impact on pain management (Simons et al., 2022), depression (Cieřlik et al., 2020; Yen and Chiu, 2021) and engagement (Ijaz et al., 2016; Ventura et al., 2022). Furthermore, some VR programs designers for cognitive training are incorporating social components to increase stimulation and are well-received for it (Shah et al., 2022b).

Interestingly, virtual healthcare services like doctor's visits were not mentioned in our study at all, even though VR could be used to provide healthcare remotely (Cho et al., 2023). In oncology, for example, researchers envision utilizing VR for "virtual in-person consultations" (McWilliam and Scarfe, 2023, p.12) where patients could consult their doctors from home and where tumors could be presented in a holistic way to the patient, regarding for example, size, location and even density through haptic feedback with controllers, thus providing more realistic and comprehensible information to the patient. In physical rehabilitation, VR-assisted treadmill therapy has shown improved walking speed and balance, compared to regular treadmill therapy for stroke patients (Rodrigues-Baroni et al., 2014; Yang et al., 2011). Additionally, handheld devices are already developed to track certain joint flexion and extension remotely, thus enabling physiotherapists and their patients to meet and work together virtually (Hoffman et al., 2020; Shefer Eini et al., 2017). Further developing these therapeutic services offered in the virtual world and presenting them to older adults and caregivers could further foster adoption of VR as a caregiving technology.

5.3 From loneliness to social connection

While participants from all groups acknowledged that VR could ease loneliness, two caveats came with this result: Only very lonely older adults would feel this way, and a few caregivers

considered VR as even more isolating. Given that loneliness is a very important issue amongst older populations and many adults fear becoming lonely (Cohen-Mansfield et al., 2016), a technology that is perceived as fostering loneliness will face difficulty in its adoption by end users. Indeed, other studies investigating VR in connection to loneliness have found the same issue between fostering and remedying loneliness (Finnegan and Campbell, 2023; Healy et al., 2022; Restout et al., 2023). Finnegan and Campbell (2023) suggest designing and using VR in a more nuanced way based on emotion rather than a label, thus not framing it as a technology for lonely persons, but persons who feel lonely. In addition to this reframing, raising awareness of the current state of research that indicates a negative correlation between the use of communication technologies (Schlomann et al., 2020) or computer gaming (Ballard and Spencer, 2023; Chao et al., 2015) with loneliness may also improve the impression of caregivers that VR may foster isolation, rather than combatting it.

If caregivers would have a more positive view on VR, older adults could be encouraged to take activities that they used to enjoy to a virtual level in order to socialize and combat feelings of loneliness. Taking social activities online is precisely one of the strengths of VR (Liang et al., 2023), especially because it allows community building beyond geographically close individuals (Ventura et al., 2022). Furthermore, the immersive and social component of VR is even accessible to bedbound persons, offering powerful experiences with others, such as such as experiencing a concert by a beloved artist together with others, for example, (Situmorang, 2023).

5.4 Improving communication and empathy in caregiving

Professional caregivers saw VR as an opportunity to spark communication and engagement among themselves and others. Similar results were observed in studies using videogames, where older adults increased communication and social connection thanks to the novel interactions with the virtual games (Agmon et al., 2011; Ballard and Spencer, 2023; Chao et al., 2015; Cutler et al., 2015; Nebel and Ninaus, 2022). Indeed, a factor enhancing acceptance for older adults is social relativeness (Chen, 2020), while the lack of social connectedness leads to rejection of technology (Shah et al., 2022a). Now, given that VR is currently more easily adopted by younger people, an increase in older users would ideally foster an intergenerational exchange between users. As mentioned before, a fully immersive space then could act as a platform for increased communication between age groups. Further research is needed to compare if a virtual space increases the likelihood of intergenerational interaction compared to physical space. Between the stakeholder groups involved in this study, there is already evidence that VR technology can expand caregivers' understanding of how it is to walk in someone else's shoes. VR applications designed to aid participants to experience dementia improved the understanding of patients' condition and prompted empathic concern in both informal caregivers (Kiafar et al., 2024; Wijma et al., 2018) and medical students (Bard et al., 2023). It would be a training opportunity for caregivers to experience simulated

scenarios in virtual reality where they face morally complicated situations (Francis et al., 2017; Zhiu et al., 2023). Promoting VR as a tool that fosters empathy, provides enriching experiences and fosters connectedness could further improve its uptake as a caregiving technology.

5.5 The prejudice around cognitive decline

In our studied population, there was reluctance to use VR on persons experiencing cognitive decline, and its use was seen only for calming purposes, due to fear of overwhelming the user or of causing the user to hurt themselves. This prejudice of perceiving older adults with dementia as incompetent or dangerous (to others and themselves) is widespread, both among caregivers (professional and informal) and older adults (Nguyen and Li, 2020). Another study that used the Nintendo Wii as an intervention found that interactive computer gaming is feasible for older adults with cognitive decline and improves their cognitive and physical functioning (Hughes et al., 2014). Furthermore, people with cognitive decline seem to be able to learn how to play computer games, contrary to the stereotype (Khalili-Mahani et al., 2020; Tziraki et al., 2017). However, one study showed that, despite the fact that participants learned how to play the game, they considered it difficult and did not get much enjoyment out of the experience (Khalili-Mahani et al., 2020). One reason uncovered in a previous study reported that older persons are easily frustrated with the technology, which may foster disinterest (Cook and Winkler, 2016). However, one study regarding VR technology for rehabilitation for older adults found no significant correlation between effort expectancy, meaning the difficulty to use the technology, and intention to use it (Chan et al., 2023). This is contrary to other interventions where older adults often reported high satisfaction after, indicating that older adults enjoyed the experience and were not overwhelmed (Hughes et al., 2014; Man et al., 2012). A reason for adopting VR among older persons seems enjoyment perceived (Lee et al., 2019; Syed-Abdul et al., 2019). These positive outcomes in research contradict the intuitive and seemingly widespread rejection to use VR on patients with cognitive decline. Educating people about dementia and cognitive decline can reduce stigma about the condition and potentially increase the willingness of caregivers to use VR for older adults (Kim et al., 2021).

The reluctance to use VR for older adults as a caregiving technology also manifested in caregivers expressing that the care recipient would need constant supervision when using the technology. They expressed doubts whether the care recipient would be able to use VR autonomously. Caregivers foresaw that they would need to provide support to use the device and that VR could cause discomfort, dizziness or even accidents among older users. Unfamiliarity with the technology (Han and Oh, 2021), skepticism regarding its usefulness or even fear of potential downsides such as accidents (Shah et al., 2022a) have been reported in other studies as a barrier to the uptake of VR. Indeed, a study investigating the inclusivity of VR, concluded that better design is needed to respond to the needs of persons

with cognitive and physical disabilities (Radanliev et al., 2023). This may include bigger font sizes, easier interfaces, and simple controllers (Ijaz et al., 2016). Furthermore, so called “cybersickness” is a term used in VR research to describe the dizziness that can arise when being immersed in virtual reality, especially for older adults (Rmadi et al., 2023). However, other studies have not found their subjects to experience cybersickness to a minimal extent or not at all (Campo-Prieto et al., 2022; Riaz et al., 2021).

6 Implications for future research

Our study has highlighted a few conditions which may facilitate the acceptance of VR as a caregiving technology, both by older adults and caregivers. As discussed in section 5.1, personalization and improving “realness” of VR experiences could be a first priority, not only because these features seem to increase the benefit of VR interventions (Restout et al., 2023), but also because generating personalized experiences may become easier due to the increased digitalization of people’s lives, including pictures and videos (Oeldorf-Hirsch and Sundar, 2016). Next to personalization, it will be valuable to adapt interactive VR experiences that are aimed towards persons suffering from cognitive decline to their cognitive level, as this improves the experience of the participants on the one hand and fosters acceptability of the technology by caregivers on the other hand (Tziraki et al., 2017). Lastly, given that both older adults and their caregivers expressed reluctance to use VR as a caregiving technology, mentioning the fear of increasing loneliness as a potential factor, efforts should be undertaken to develop VR-intervention that foster intergenerational engagement in families (Wei et al., 2023) and greater engagement with social networks. Not only could this enhance social engagement for older adults who are prone to loneliness, it may more easily dismantle the fears of the involved stakeholders around VR.

7 Limitations

Despite our relatively large sample size of over 60 participants, our findings are not generalizable due to its qualitative nature. Furthermore, study participants were unable to test VR themselves and only watched a video of other older adults using VR for entertaining purposes, which means our participants only had first-hand experience of the technology if they had the opportunity to test it before the interview, which was the case for some participants. This may have biased the results, as many VR-studies where participants were able to experience the technology for themselves, reported no hesitancy of participants pre-intervention and enjoyment or satisfaction with the technology post-intervention (Hughes et al., 2014; Man et al., 2012; Roberts et al., 2019). Furthermore, the video presented to the participants was not personalized, nor did we investigate prior to the study if the shown underwater world was of special interest to the participants. A more personalized VR-application or at least the possibility to choose between different scenarios may have influenced the results. Specifically, familiar environments may trigger reminiscence strongly and increase older adults’

motivation so share memories (Appel et al., 2022; Restout et al., 2023). It would therefore be useful to do a future study where participants have the opportunity to test VR themselves first, ideally with a personalized application and are then asked similar questions to those that we asked older persons and their caregivers. Lastly, given that the study was conducted in Switzerland, the socioeconomic background of older adults may be higher than that of the average older person worldwide (Baeriswyl and Oris, 2023; Ghani et al., 2020) and issues such as costs of the technology or internet access were not discussed in this study, even though high costs are a common barrier to the uptake of caregiving technology (Felber et al., 2024).

8 Conclusion

Overall, our study findings suggest that older adults and caregivers see utility in VR as a caregiving technology, however they also foresee many issues with the technology that prevents them from enthusiastically embracing it. Travelling, cognitive training and a means to ease loneliness were envisioned as benefits of VR, but at the same time, fears of further isolating or discarding the older person prevailed, as well as worries about having to constantly supervise users and about overwhelming those suffering from cognitive decline. Furthermore, the virtual aspect of the experience was seldom perceived positively or enriching on its own, but rather “good enough” to provide some benefit. Comparing these results with intervention studies around VR and videogaming show which applications are already tested, what benefits they provide, and, even more importantly, which fears and worries seem unfounded by our study participants, as study results do not confirm them. The positive effect of VR on older adults’ cognitive abilities, their social connectedness and general wellbeing, as well as the lack of evidence of further social isolation, cybersickness and an inability of older adults with cognitive decline to learn how to use the technology point towards strategies that would improve the adoption of VR as a caregiving technology, namely: increasing awareness regarding the benefits of VR and increased exposure, so that both caregivers and older adults can experience the technology and its benefits for themselves, and correct their misconceptions about it. In short, the barriers we found in stakeholders need to be dismantled before VR will be accepted as caregiving technologies.

Data availability statement

The raw data supporting the conclusions are being made available on open database: swissubase.ch. The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Commission of Northwest and Central Switzerland (EKNZ). The

studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

NF: Data curation, Formal Analysis, Investigation, Methodology, Writing–original draft, Writing–review & editing. EM: Funding acquisition, Writing–review & editing. TW: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Methodology, Project administration, Supervision, Validation, Writing–review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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