Social VR Activities Should Support Ongoing Conversation - Comparing Older and Young Adults Desires and Requirements

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ABSTRACT

Keeping in social contact with friends and family and engaging in social and enjoyable activities is important for our well-being – especially for older adults, who often live distant from loved ones. A new opportunity is provided by Social VR (SVR) for engaging in shared activities beyond just talk. We present findings from interviews with older and young adults on their needs and desires for social VR, especially regarding the types of activity they would like to engage in. We compare these findings to identify differences, commonalities, and opportunities for inter-generational social VR activities. Despite the favoring of cultural (older) and sport (younger adults) interactions, both users groups preferred low-intensity and game-like activities that allow for ongoing conversation and 'sharing the moment'. Furthermore, ease of use, realistic avatars and the mitigation of age-related differences were core requirements for the older demographic.

CCS CONCEPTS

• **Human-centered computing → Collaborative and social computing**.

KEYWORDS

Social Virtual Reality, Proximity over distance, Remote Intimacy, Older Adults, Seniors, Age-related Accessibility, Movement Games

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1 INTRODUCTION

In today's world, many individuals find themselves geographically separated from their loved ones (friends and family). Yet our well-being and health strongly depend on our relationships with family, friends and partners. Feelings of closeness and connectedness are crucial factors for health, well-being, and life expectancy [23, 28, 31, 53]. Especially the elderly population, who often see children and friends relocate, is affected from social isolation [77], while participating in social, creative, or enjoyable activities is crucial for enhancing and sustaining well-being as people age [17, 40, 69].

One opportunity for maintaining closeness with loved ones over a distance is Social VR (SVR). Different from video conferencing, SVR allows for more than just conversation – it supports shared activity, within a shared context or environment, through natural interactions. Besides giving people 'something to talk about', shared activities can result in memorable experiences and feelings of closeness. This provides the context of our research, which is part of a larger project. We see a particular opportunity for SVR activities that can be shared across generations within a family, as well as for SVR activities that enable friendship circles (of any age) to meet up and do things together. Thus, we need to understand how to make SVR attractive and accessible to both younger and older age groups.

However, little is known about the needs and desires of elderly users in VR and SVR, with most research focusing on accessibility issues experienced by this age group [25, 78]. In general, research and commercial developments tend to focus on young adults as a target group, despite a number of studies having shown the benefits of VR and SVR experiences for the cognitive and mental health of elderly people [5, 9, 13, 14, 32, 42, 51, 52, 58, 70].

To foster the feeling of connection in SVR, an underlying premise of our project is that activities where participants experience being 'in-sync' with each other are especially suited for creating feelings of togetherness. This is because individuals tend to unconsciously synchronize their movement over time with others they have rapport with – and in reverse, behavioral synchronization, such as in chorus-singing, football crowd activities, dancing, and marching, creates feelings of sympathy and belonging. Studies have shown that this synchronization fosters intimacy, closeness, and empathy[24, 38, 41]. Interactive technologies can enable such synchronized activities, in-presence and remotely [56]. This provides

another argument for SVR, where people can see each other moving and can engage in joint activities.

But what sorts of shared SVR activities are attractive to both young and elderly users in the first place? While synchronized joint action can create strong feelings of togetherness, such activities might not be desirable for everyone – or may exclude some, such as users with limited mobility. In particular, when considering SVR as a medium to connect extended families, it is crucial to ensure that interactive experiences provide sufficient appeal across age groups.

We here present findings from an interview study with 30 participants, comparing the desires for SVR activities (with a focus on movement-based activities) of young adults with those expressed by older adults who still live independently. We found older people to often be initially hesitant regarding the idea of using VR, which was a hurdle for recruitment. However, after experiencing VR examples, they enjoyed it. Both age groups saw a potential of SVR for spending time together in an enjoyable way. The desires expressed went beyond pure conversation, which nevertheless should be simultaneously possible. While cultural (older adults) and exercise-rich activities (younger adults) are favoured differently, low-intensity and game-like activities were desired by both age groups. Activities not possible in reality were also of interest (e.g. exploring the human heart or exploring an underwater world as a non-swimmer). Our work contributes to a deeper understanding of what kinds of SVR activities would appeal to older adults, and requirements to consider, as well as the wishes and needs of young adults, supporting identification of opportunities for inter-generational SVR design.

2 BACKGROUND

Three areas provide the context for our research – the support of feeling closeness over distances (and Social VR as an option for this), older users' interest in playful technologies and digital games (as SVR activities may include game-like interactions), and the needs and desires of older people for VR and Social VR.

A difficulty is that there is no uniform definition of 'older adults'. While the WHO considers people aged 65 and above as 'older adults', often the 'next-generation' is also included, from age 50 or 55 up [33]. In addition, age is not a predictive factor for interests or abilities, given the heterogeneity of older adults' needs and preferences (cf. [1, 33]). Definitions of 'older people' or 'seniors' as aged >65 usually consider gerontological perspectives regarding changes in health and abilities. Other fields use the term to refer to people who use technology less. In marketing, 'senior' can refer to people age 50 upward [20] or to people previously considered 'too old' for a product, who rarely uses it. For instance, currently less than 10% of people aged 55 or older utilize VR [18].

2.1 Closeness over Distance, and Social VR

Ample research has investigated how technology can support feelings of being close to each other over distance ('remote intimacy'), usually addressing couples and families. One of six strategies for remote intimacy technologies [22] is to enable joint action. People already utilize existing technology to share time in everyday life, for instance, using video conferencing tools as a media window [19]. Couples might cook and eat together, mediated through video. Some continue to chat in bed and fall asleep with the video still running [44, 54]. However, video conferencing limits the range of shared activities, and does not provide a shared environment.

Compared to video conferencing, SVR expands the scope of possible shared experiences, by providing a shared environment and virtual user representations. While previous work has explored the use of VR for shared museum visits [60], the vision of sharing everyday activities in the real world through immersive technology still faces many challenges [55]. Although shared activities in SVR thus usually are purely virtual experiences, they can create new shared memories and strengthen relationship bonds [80]. Considerable research has explored how best to facilitate specific aspects such as group navigation [4, 75, 76], communication [21, 29, 74] and collaboration [11, 66] in SVR. But there is limited research on how people might want to use SVR to spend time and share activities with relevant others as a means to foster existing relationships [73, 80].

2.2 Older Users, Technology and Digital Games

There is increasing evidence that older users are open to new technologies and do engage with digital games, if they see benefits thereof regarding their own cognitive and mental health, and for socialisation and social connectedness, besides entertainment [27, 71]. An issue is that digital game design has tended to target younger generations, with only few products aimed at older generations (cf. [45]). Given older users' tendency for limited prior experience with digital technology and changes in physical and cognitive abilities, digital games need to take account of their needs and preferences [15, 33]. (Note that the age group referred to as 'older users' varies in the literature, some including people as young as 47 [45] or from 50 onward [71].)

One of the design opportunities highlighted in the literature is using digital games as 'means for socialising', which includes intergenerational games that can support family bonds and enhance understanding of the other generation [33, 45, 68]. This is especially pertinent since the elderly are most at risk of social isolation and loneliness [77], while it is well known that an active 'social life' is a key factor for successful aging (life satisfaction, cognitive, emotional and physical health) [40, 69].

2.3 VR and Elderly Users

Several studies explored VR's potential for older adults, primarily in retirement homes where supervised VR activities can provide distraction or new stimuli and improve general well-being. These found that once older people experience VR applications first-hand, they enjoy these [32, 52]. VR and SVR have been shown to improve physical and cognitive health [5, 13, 14, 42] and to promote social wellbeing [51, 58, 70]. VR (and SVR) enable experiences otherwise inaccessible for those unable to travel [9, 37, 72], Interestingly, while age has been found to negatively correlate with VR enjoyment, this relation was weaker than for other technologies [52] – VR thus appears to be a better fit for the elderly than e.g. cell phones.

Despite this, elderly users are still largely neglected in current VR research [63, 79] and rarely involved in designing VR applications [16, 62, 73]. This results in a lack of understanding of their needs and preferences. To ensure elderly users derive enjoyment and benefits from VR, experiences must be tailored to their needs

and capabilities, for instance, requiring less intense physical activity or accommodating reduced range of motion [81]. Accessibility is a key concern [8, 12, 26, 39, 62, 73]. Elderly users are more likely to encounter accessibility issues [26] and need to invest more cognitive and physical effort to learn new technologies compared to younger individuals [50, 61]. Thus, a comprehensive approach that addresses accessibility, desirability, usefulness and acceptance in the development process of technologies is needed [12]. Moreover, it is crucial to enable users to work on self-chosen challenges, rather than conforming to preset goals, and to acknowledge that for some, constant improvement is impossible, and fitness and ability levels will fluctuate [67]. But, as Abeele et al. [1] highlight, making VR accessible should not be equated with simplification, as older adults do desire challenges and enjoy rich visuals and soundscapes.

To appeal to older adults, technical solutions must demonstrate clear advantages over offline alternatives [6] and integrate into daily activities [57]. Age-related disabilities, such as visual and hearing impairments and susceptibility to cyber-sickness, need to be taken account of [34]. Safety considerations (e.g. collisions with furniture) and intuitive, easy-to-learn operations are essential [73]. Easy onboarding and provision of comprehensive support are key for senior users to navigate VR environments comfortably. Familiarity with hardware and software interfaces further enhances user experience, emphasizing the importance of familiar interaction paradigms [26]. It also is helpful if interaction partners can assist less tech-savvy users with set-up and operation over a voice channel [73].

Other work highlights factors concerning the design of VR content [1, 8, 39, 47, 59, 65, 73]. A serene, familiar virtual environment can boost engagement, conversations and memory retention [1, 73], but it must be carefully designed to avoid triggering anxiety or unpleasant memories (which might be highly individual) [1]. Familiarity is essential for users with dementia, and can also prevent a harsh entry into VR experiences. Smooth transitions between VR and the real world prevent spatial disorientation and balance issues [47, 65]. Designers should balance visual richness with simplicity in user interactions, prioritizing safety and physical engagement [1, 73]. Tailoring experiences according to individual preferences ensures inclusiveness and satisfaction [8, 39, 59]. This includes avatars that can be customized to the users' needs and, for example, "reflect current physical appearances" [73, 79].

Beyond these basic design requirements, empirical research on what specific types of VR experiences would appeal to the elderly demographic remains sparse. In general older individuals particularly favor social VR applications, [2, 3, 35, 58, 64, 73], for example, cooking and eating together, or simply chatting [73]. They value the ability to connect (despite physical distance) through meeting up, sharing experiences [2, 79], and reminiscing together [73]. Moreover, they enjoy the ability for virtual travel to otherwise inaccessible locations, and envision healthcare and sports VR applications [2, 73].

While various applications and projects use VR to enable housebound (or hospitalized) people to travel [9, 37, 72], these experiences are often single-user only. Far fewer projects investigate the potential of SVR for enjoyable social experiences for older adults, despite SVR having been established as a viable option [17, 73]. Moreover, there is little research on inter-generational SVR. Wei et al. [73] began to address this by interviewing grandparents and their grandchildren together. Our study extends their findings, focusing on generational comparisons and differences.

3 STUDY APPROACH AND PROCESS

Within the context of the GROOVE project, the core user groups are friends (of any age), romantic couples, and extended families (e.g. grandparents and grandchildren). In the current study, we aimed to investigate what kinds of movement-based SVR activities (that can create synchronicity) would be promising and appealing for peer groups and for inter-generational groups. We focused on young and older adults, as these are distinct user groups with diverging user profiles. Ethical approval for this study was provided by the review board of our project partners at the Technical University of Ilmenau (Bauhaus-Universität Weimar has no ethics board).

As international students fit into several categories (currently having friends, family, often romantic partners at a distance), we focused on recruiting international members of our university for the first set of interviews. They were recruited via posters, university mailing lists and postings on university bulletin boards.

The second set of interviews focused on older adults. As mentioned, there is no universal definition from what age one is considered to be a senior citizen or 'older user'. Given less than 10% of people aged 55 or older use VR in their spare time [18], we opted to define 'older' more broadly. Retirement age in Germany, where the research was conducted, may begin with 60, and from this age onward, 'seniors' pay reduced entry for many cultural offers. Our recruitment strategy thus prioritized senior citizens (60+), but also included some participants aged 50+, given these could be 'young' grandparents in the context of intergenerational Social VR. The older adults were recruited via targeted mailings to seniors' groups and clubs, sport and church groups, seniors' choirs, or multi-generational centres.

For both target groups, it was emphasized that we were looking for people with close friends, family or partners who live further away. While it was easy to recruit young adults, recruiting older participants turned out to be difficult (cf. 4.1). We succeeded by focusing on general senior citizen meetings and so-called multigenerational houses.

3.1 Participants

Overall, we conducted semi-structured interviews with 30 participants (14 men, 16 women, age 20-90) from October 2023 to April 2024. All had at least one close relative, friend or partner that lived far away. These relevant others did not take part in the study.

For young adults (P1-P14), we had 14 participants (9 men, 5 women), 20-29 years old, all students in computing, engineering or media related fields. All but 2 were international students, e.g., from Syria or India. Six had no VR experience (or only a short one), while eight had tried it multiple times and some even developed VR applications. On average, they rated themselves an 8.1 on a 10-scale (M = 8.1, SD = 1.7) regarding tech-savviness. None reported restrictions in movement or disabilities, apart from corrected eyesight.

For older and senior citizens (P15-P30), we had 16 participants (5 men, 11 women). 13 were 60 - 90 years old and retired, and three between 50 and 60 and still working. They either had no VR

experience or had tried it once (3 participants). On average, they rated their tech-savviness as 4.8 from 10 (M = 4.8, SD = 1.9). Some reported movement restrictions: two mentioned being easily dizzy (later we saw that more people preferred to play while seated), and two had difficulties lifting the arms up high due to shoulder pain.

3.2 Procedure: Interviews with VR Demo

To gain insight into participants' perspectives, we chose semi-structured interviews as general approach. Semi-structured interviews provide flexibility and openness to emerging topics, allowing to enquire further into ambiguous responses, while ensuring focus through an interview guide. Further, the fluid, conversational style of semi-structured interviews is beneficial especially for working with elderly people [7]. To ease recruitment, in particular that of older participants, and make participants feel more comfortable, some were conducted as group interviews. The process further included a technology demo, and thus could be labelled as 'focus group' session. For group interviews, facilitation paid attention to balanced speaking time by addressing participants directly in round-robin style. Furthermore, the duration of the session was extended a bit taking the number of participants into account.

The interviews with young adults were all conducted at the university. For the other participants, interviews were conducted at a multi-generational house, a senior citizens' meeting, or at participants' homes to reduce barriers to participation. All sessions with young adults were in English, except one with two German native speakers, while sessions with older adults were all in German (native language). Young adults were interviewed individually or in pairs (2 cases), when friends were brought along.

For the older adults, besides individual interviews, we conducted group interviews with two to six participants as this eased recruitment (6 individual interviews, 1 pair, 1 group of 6, 1 group of 4 with 2 older adults – for this latter group, the remaining 2 people, aged in their mid 40s, were neglected for analysis as they did not fit into either age group)(cf. 4.1). Senior citizens had often responded very hesitantly to invitations for an interview on Social VR. During group interviews (all within groups that knew each other well), they appeared less reluctant to try the new technology and to speak freely about concerns or wishes. We believe the group interview format did not create bias regarding their responses. Participants seemed comfortable and open, likely due to the presence of familiar peers from their senior club or a multi-generation home.

The first two authors took the role of interviewers and were both present for all sessions. As participants were asked to attend the VR demos with a partner if possible, interviews with pairs were conducted in parallel in different rooms. For group interviews, only one of the researchers acted as interviewer/facilitator, to not overwhelm participants if questions were asked by two people and to increase the comfort. For the group demo sessions, two additional people supported the conduct of the VR demo, given more VR glasses were provided and needed setup support. The sessions had 3 phases: (1) Pre-demo interview, (2) VR demo, (3) Post-demo (deeper) interview, and took around 90 minutes. For larger groups this was extended to up to 150 minutes.

3.2.1 Choice of VR Demos. A pilot study had indicated that participants without previous VR experience found it difficult to imagine interactions in VR. Therefore, a VR demo was included where participants could choose two out of five pre-selected VR applications (including games) to try out in pairs or a group.

Already available applications were selected, to cater for the varying fields of interest of our two target groups, and to ensure the VR examples experienced would be fully functional. In close collaboration with VR experts, the available applications were selected based on the following criteria: (1) The interactions should be suitable for both age groups (fields of interest, playability regardless of age-related restrictions) and (2) be movement-based (walking or arm movements were sufficient), and (3) availability of a multiplayer mode.

Based on the above criteria, five applications were selected, four from the meta app store, and one self-developed VR-application from our VR lab. These cover a variety of types of interactions and fields of interests. The choice fell on 'Beat Saber', 'Eleven Table Tennis', 'Mash Me Up' and an application for visiting a local museum virtually. In one case, the multi-player criterion was ignored, so as to present as wide a range of applications as possible that demonstrate the possibilities of VR. This enabled us to demo natural interactions with detailed hand tracking and provided an example of non-competitive, calm activities.

In 'Beat Saber', boxes have to be destroyed to the music beat. In 'Eleven Table Tennis', two players compete. 'Mash Me Up' includes various mini-games, such as air hockey, snowball fight, or beer pong. In 'Hand Physics Lab' child-friendly puzzles are solved, such as marble mazes or coloring of eggs; while it does not have a multiplayer mode, it features hand-tracking control and thus demonstrates further possibilities in VR. In addition, the 'Social VR Museums-Demonstrator' allowed joint exploration of the local Goethehaus museum while standing or sitting. We hoped that the local museum would be of particular interest to them and that the noncompetitive activity would lend them confidence with the new technology.

3.2.2 Process. All sessions (regardless of whether they were individual, pair or group interviews, had the same structure.

Pre-demo interview. Participants provided informed consent, demographic data was gathered, and they rated their experience with VR and overall technical affinity. They were instructed to relate all following questions to one person (friend, family member, partner) who lives far away. Questions concerned the current relationship, e.g. how often they meet in-person or digitally, and how the relationship has changed due to living at a distance. We then enquired into typical activities they like doing when meeting in person or remotely. After general open-ended questions, we moved to the topic of movement games and activities that make them feel connected with others. Participants were asked their opinion on VR, and whether they can imagine using VR-games with the selected person or with other people. We asked for reasons for their willingness or reluctance to do so. Next, there was an investigation into any concerns, worries, or barriers they might foresee, but also what benefits VR might have compared to other media. We explored situations or activities where they might prefer VR meetings over (video) calls, and where they would prefer traditional media. The used interview guide can be found in the appendix.

Figure 1: VR demo with elderly participant. (photos with permission of participants)

VR-demo. All VR applications were briefly explained to participants. In the next step, they could choose two from the five applications. Once they had decided which to start with, its purpose and handling were explained in detail. Participants were provided with VR glasses, with the game already started. Thus, set-up and start of the application were facilitated by the research team and participants were able to interact immediately together (see figure 1). If the demo was part of a group interview, all interested participants experienced the chosen application with up to four VR users at a time (4 VR glasses were available), and they themselves decided who would start. While two interacted in VR, the remaining participants could follow their experiences by means of a projector and a screen. To increase comfort and alleviate any age-related physical limitations, participants could choose to try out the VR application either standing or seated. Within 15 to 20 minutes everybody who wanted to could experience the application. Once they were all done, the application was stopped and the same procedure was followed for the second application. Finally, the other non-selected applications were shown as a video-demo. The rationale for showing these as video was to ensure ensure sessions kept within a reasonable length while providing good and varied insight into VR.

Post-demo interview. Now, some of the earlier questions were revisited. Participants were asked whether, in their view, potential application scenarios had changed or broadened due to the demos, for instance, with whom, when or where they could imagine playing VR games. We asked how this might influence their relationship to the other person and what factors would contribute to stronger feelings of connection. We further asked about advantages and disadvantages of VR over other media, and whether participants' prior concerns or hesitations had been eased. Lastly, we investigated their desires and suggestions for potential VR interaction scenarios (types of activities and games) and requirements for attractiveness and accessibility.

3.3 Data Analysis

Interviews were recorded with consent and during the demos, observational notes were taken. Analysis aimed to gain a deeper understanding of how participants currently keep in touch with their beloved ones, and of their perceptions, desires and concerns regarding SVR. A qualitative content analysis according to Mayring (Inductive Category Formation) [46] was conducted by the first two authors.

Starting inductively, both researchers first independently read all the transcribed interviews for familiarization. They looked for patterns, recurring codes, and outliers (e.g for requirements on SVR). Five main themes were identified, which were then discussed together and subsequently individually reflected. After a week's pause, the themes were discussed again and the codes were assigned to the five themes by each researcher individually. Afterwards, the assignment of codes were discussed and reflected together by both researchers. The identified themes then were reviewed for consistency, and the names/labels refined to represent the codes more accurately. During this process, sub-themes were created, applying the same coding process to identify and label. In total, five themes and 13 sub-themes were created.

The findings from both user groups (young and older adults) were evaluated separately, and later compared systematically for similarities and differences.

4 FINDINGS

In the following, structured according to the 5 identified themes, we summarize our findings regarding participants' general attitudes towards VR. These attitudes changed considerably within the older adults group. We then move from how participants currently interact with loved ones living afar to the kinds of shared activities they could imagine doing in SVR. We close with their suggestions for VR design, and concerns and problems anticipated.

When asked about loved ones living far away, young adults most often mentioned parents or grandparents, but also (less often) partners and friends, or siblings, while elderly participants predominantly talked about grandchildren. All but one young adult expressed a desire for more contact. They expressed wanting to take part in the other's everyday life, and better quality of contact. One person mentioned: "I feel like I am loosing a friend because we can't do activities together". (Note that in the following, all quotes from German interviews are translated into English)

4.1 General Attitudes Towards VR

Recruiting young adults had been easy and their attitude to VR was positive from the start: "I love the entire idea, it's like magic" (P1). Initially, they could primarily imagine using SVR activities with friends and partners. Parents and grandparents were only considered after having experienced the demos due to participant's previous assumptions of different interests and age-related physical impairments. VR experiences were seen as an option to increase the feeling of being part of each other's lives: "the games strengthen the feelings/ emotions which you normally just have while doing

stuff in person" (P8). But the interviewees also pointed out that such interactions would need to be scheduled in advance, and that phone calls would be more suited for fast contact.

In contrast, the older participants were more hesitant to anticipate VR use. However, this might reflect accessibility issues [26, 50, 61] and their lack of familiarity with VR. When using the VR applications, some were initially hesitant, fearing they might make mistakes. However, the overall attitude became predominantly positive during the demos, with many not wanting to stop: "I'd prefer this over making phone calls" (P16), "It felt like I was actually there" (P26). There seemed to be a strong immersion effect, with two older adults attempting to place their controllers on the virtual table during table tennis. After the demos, the majority of older adults had a positive attitude, and initial doubts were dispelled. Nevertheless, there were some critical voices (3x) who could not imagine playing such games with their grandchildren.

At the end of the interviews, both age groups considered SVR beneficial for maintaining contact and closeness over distance, and thought that VR-applications could help to feel more connected.

In general, recruitment of older study participants had been difficult. Two senior citizens' clubs we had approached reported they had not found anyone interested, despite personally inviting people and advertising via posters. Most older adults that we directly approached could not imagine using VR. When trying to snowball via personal contacts, we often received feedback along the lines of 'my friends all thought this is not relevant for them'. The very fact of how difficult it was to recruit older participants testifies for this hesitant attitude. Partially, the effort required to recruit older-age research participants might even be a contributing factor for the lack of research on this potential user group of VR.

4.2 Current Interactions

For keeping in touch, older adults mainly use phone and video calls (16 of 16 participants), less often text messages, sometimes letters. All young adults use video calls and text messages. Both groups use these media mainly to talk and exchange news. A few young adults (4 of 14) pursued other activities during (video) calls, such as household chores. In contrast, two elderly participants explicitly stressed the importance of not engaging in other activities during a call. While calls were frequently mentioned, participants lamented limited opportunities for interaction and feeling distanced: "the connection don't really satisfy you" (P1, young adult), "the personal is missing" (P4, young adult), and one person was frustrated he "cannot properly express himself just over the phone" (P5, young adult). Nevertheless, many found phone conversations to be satisfactory.

For in-presence interactions with close friends and loved ones, both young and older participants prioritized social activities with a relaxed and calm atmosphere that allows holding a conversation. Both age groups often mentioned 'going for a walk' and hiking. When young adults talked about things they would do with parents/grandparents, they emphasized activities that foster "enjoying the moment" and experience of togetherness. For interacting with their peers, more sportive activities, such as table tennis, hiking or dancing were mentioned. While all older adults mentioned board or card games, these were mentioned only by four young adults.

Across both age groups, activities with low physical exertion or reduced range of movement were preferred, except for table-tennis (mentioned by both age groups). As other shared activities, 2/3d of both age groups mentioned 'talking' or 'hanging out'. Especially among older adults, shared experiences and activities appear popular that allow spending time together and creating shared memories. They favored quieter activities and cultural activities (visiting museums, concerts, theatres, cities). Such cultural activities were mentioned far less by the younger generation (only by 3), which, instead, often spent shared time with cooking and eating.

Overall, while both age groups enjoy activities that enable holding conversations simultaneously, there are slight differences in preferences, especially concerning the popularity of board and card games, and cultural activities.

4.3 Desired SVR Activities

Participants' ideas for SVR activities that involve movement were assigned to different categories, such as *cultural activities*, *games*, *sports*, and *low-action activities* which allow for conversation in a shared virtual space. Interest in sharing *everyday activities* in VR was low in both groups, and thus is not reported here. We found that most desired VR activities build on real-life interactions, but include things not possible in real life. What activities are desired differed between the age groups.

In both groups, the ideas regarding desired SVR activities were similar to those activities engaged with in real life. With the older participants, *cultural activities* were the most frequently mentioned category (12 of 16 participants), with visits to museums and sightseeing (historic castles etc.) as favourites, and a few mentions of theater or art galleries. This supports Baker's observation of senior citizens' interest in VR travel [2]. Our younger participants were far less interested in cultural activities (mentioned least frequent, 3 of 14 participants) and preferred *games* (mentioned by all young adult participants). While games were also popular among the older adults (11 of 16 participants), these listed a more constrained range of traditional board and card games. Young adults also mentioned puzzle games (e.g. escape rooms), group adventure games, treasure hunts and shooter games. Here, it appears that young adults anticipated interactions with peers (some older adults explicitly expressed dislike of action and shooter games (cf. [33]). In contrast, some of the game types desired by older adults aimed at interaction with grandchildren, including educational and construction games (Lego), riddles and the Memory Game. This was sometimes explained with the wish to support the grandchildren's development (e.g. supporting grandchildren through school or learning games (P17, senior)), similar to Freeman et al.'s findings [10].

Sports and *low-action* activities were equally interesting to both age groups (10 and 12 from 16 older adult participants vs. 11 and 9 from 14 young adult participants) . While the younger participants suggested various intensive or fast-paced *sports* activities (dancing, basket ball, climbing), the older adults preferred calmer and slower activities (Yoga, mini golf). This could reflect age-related physical limitations. Nevertheless, after having seen or experienced table tennis in the demo phase, there was high enthusiasm for this sport in both age groups. Despite being requested to think about physical activities, both groups also mentioned various *low-action*

activities. These primarily involve enjoying each other's company, socializing, and slower physical activities, such as sightseeing, walking, hiking, or going to a beach. This reflects real-life interactions, where emphasis is on enjoying the moment. Some participants described the shared virtual space as an underwater world, garden, or zoo. These findings regarding low-action activities support insights from previous work on older adults' preferences for social VR [2, 3, 35, 58, 64].

Despite the frequent wish to replicate real-world interactions, participants from both demographics expressed interest in activities that diverge from reality (4 of 16 older adults; 3 of 14 younger adults). For older adults, this included overcoming physical limitations (a non-swimmer suggested exploring an underwater world), while younger participants mentioned impossible or dangerous activities (climbing Mount Everest, skydiving, exploring the human heart). The inclination of older adults towards 'impossible' interactions aligns with findings from prior work [2].

4.4 Requirements for VR Design

Asked about the VR design, the older adults most frequently found a *realistic avatar* important (13 of 16 participants), closely followed by *user-friendliness* (12 of 16). Two-thirds mentioned requirements relate to the *game concept* and to *desired functions*, such as a constant audio connection. Young adults all emphasized *accessibility and consideration of age-related differences*, anticipating their elderly relatives' needs. They also frequently mentioned *desired functionalities, game concept requirements* and a *realistic avatar.*

4.4.1 Avatar Design. While a realistic avatar representation was important for younger participants, for the older adults it was key to recognize one's counterpart. In addition to customization features, they wanted realism, such as inserting an image of their own face, even a full-body live video as avatar representation (8 of 16 older adult participants). Moreover, after the VR demos, they criticised that "the other person is not real, it's just a figure" (P27), that they "do not want a funny cat jumping around" (P28) and instead would like to "see how the grandchildren have grown." (P26). For interacting with loved ones, the younger participants also wanted a photo of the other person for the avatar (6 of 14 participants). Both age groups would like to see facial expressions and gestures. This desire for realistic avatars supports findings from previous works. Avatar appearance can influence how people behave in VR [36], and a familiar appearance facilitates interactions between grandparents and grandchildren [73].

4.4.2 Accessibility Issues and Ease of Use. Contrary to our expectations, issues concerning accessibility and age-appropriate design were more often mentioned by the younger participants (all younger adults vs. 12 of 16 older adults) who thought about making VR activities suitable for their elderly relatives. Prior research on accessibility issues influenced our choice of VR demos (to avoid predictable issues), which means that our older participants had a largely positive VR experience. Moreover, these possibly did not want to think about their own physical limitations during the sessions. Nevertheless, the most frequently cited requirements for age-appropriate design align across age groups.

Both participant groups emphasized the necessity for individual adjustments of intensity and movement range for physical activities (7x in both age groups), confirming findings from previous work [68, 81] that recommend adjusting gameplay so that each participant can take part according to their individual abilities. The older adults further stressed the ability to play while seated (7 of 16 older adults). However, they should then have the same viewing height in VR as their interaction partner. Dizziness should be prevented, for example by limiting the need for fast movement and supporting close-up views and zooming. In contrast, younger participants talked more about age-related visual or auditory limitations, which were less frequently mentioned by the older participants. All mentioned aspects align with prior design recommendations for VR applications or full-body motion games targeting older populations [15, 34].

Accessibility issues also became evident in the demo phase. Some older participants had difficulties remembering button functions and using the controller joysticks. However, interactions that mirror real-world actions, such as shaking hands, moving a table tennis bat, and grabbing objects were well understood. Navigating menus was challenging, e.g. for changing settings. It was noticeable that older participants were less agile, and preferred to play while seated.

Ease of use was particularly important for older users (12 of 16 participants); this shows from the frequency of requests and their detailed nature. They mentioned having difficulties with complex inputs, such as using a joystick and pressing buttons simultaneously, wanted as few buttons as possible, and preferred intuitive movement-based interactions. They further demanded reliable, trouble-free systems, and voice input. Here, accessibility issues [26, 50, 61] and lack of familiarity with VR might have an influence. These findings support recommendations from prior work for simple, familiar VR interactions for older users [26, 34].

Both groups further emphasized a need for good and simple instructions or tutorial videos for onboarding, aligning with Ijaz' design considerations [26]. A few young adults suggested a direct voice or video connection from the very start, so they would be able to help their less tech-savvy interaction partner with the set-up.

4.4.3 Preferences for VR Activity Design. The younger participants (being more experienced with VR) mentioned specific VR functionality to ease use and enhance safety, such as precise hand tracking, automatic collision-detection for real objects inside the game area, and haptic feedback on leaving the game area (11 of 14). The older adults, on the other hand, rarely raised any suggestions for technical functions. Only a constant voice connection was deemed important by both age groups (mentioned by ca. half of each group): "When you're living far apart, it's important that you communicate. That shouldn't be neglected while you're playing." (P26, senior). Younger adults emphasized the utility of a constant voice connection for helping with setup and explaining how to use a VR app.

Regarding the overall concept and interaction design, older adults most often mentioned educational games (to play with grandchildren). Some also suggested activities that promote physical and mental well-being. Young adults instead far more often stated that games should offer feelings of success by reaching a goal. The older adults stressed there should be no depiction of violence, whereas some of the younger participants suggested shooter games. These

findings are in line with prior work finding that older adults prefer cooperative games over competitive games [33]. Additionally, several participants from both age groups mentioned that VR activities should be easy to play without prior knowledge, and should have more the character of a shared experience than a game.

4.5 Concerns and Potential Problems

The type of concerns mentioned were similar across age groups, but were prioritised differently. Young adults mentioned aspects related to technical setup and context of use, such as limited physical space at home, poor internet connections, and that the VR setup process takes time and thus reduces spontaneity. In contrast, a few older participants feared getting dizzy. Interestingly, both age groups had concerns about addiction potential, and are not sure whether the other age group would want to engage with them in VR. Some young adults assumed their (grand)parents would not be interested in using VR, while four of the older adults believed their grandchildren would rather play with friends: "My grandchildren are 17 and 18 years old, I don't think they would want to play with their grandmother" (P26). In addition, the older adults disliked the idea of not being able to physically or cognitively compete with their (younger) interaction partners: "You don't always want to lose." (P26), "The differences are too big" (P28). A main concern raised by both age groups, though, were difficulties with operation and set-up (8 participants of each participant group). Here, younger people anticipated difficulties for their older interaction partners. In addition, the acquisition costs for VR equipment were considered critically by both participant groups.

5 DISCUSSION

Our findings support and add detail to many aspects emphasized in the literature on accessibility of VR for older adults (easy-onboarding, utility of a constant voice channel so interaction partners can assist, preference for low (physical) intensity activities, adjusting ranges of motion, preventing cyber-sickness, simple interfaces and controls, use of familiar interactions). Older adults explicitly requested the option to play while seated and emphasized that in this case, the avatar placement would need adjustment.

Our findings add detail in particular regarding what types of SVR experiences older adults would appreciate, identifying what kind of low intensity activities are preferred, and we find that their interest in virtual travel extends to SVR. Different to Wei et al.'s findings [73], cooking and eating together were not desired activities, instead card and board games were frequent suggestions. Furthermore, compared to other studies [1, 73], reminiscence and familiar environments were less important, and there was a preference for interactions that have more than just conversation going on. Such interaction does not need to be fully integrated into daily life (unlike [57]), as it is more akin to a casual game night that needs to be planned. Prior work also mentioned such a kind of planning aspect [10]. Our study contributes evidence of an interest of older adults for educational VR games, construction games and simple memory games to play with their grandchildren, a category not identified in prior work (cf. [73]). On the other hand, none of our participants explicitly mentioned reminiscence scenarios [1, 2, 73], possibly because the interview process focused on joint movement-based activities.

We found some activities to have appeal largely within an age group. For instance, dancing, ball games or shooter games appeal largely to young adults, while cultural activities mostly interest the older generation. Thus, when developing such activities, focusing on the needs and interests of a specific age group will be most important. We still need to consider that sometimes older adults might want to show something to their grandchildren (e.g. a historic site), but these will be rarer events compared to 'spending time together'.

Yet, there was comparable interest within both age groups for low-action activities with low-intensity movement (e.g. walking, hiking) and game-like activities. This suggests to focus idea development for inter-generational VR-activities on such low-intensity activities and games, or to combine aspects of cultural activities with low-action activity (e.g. walking through a culturally interesting scenery, having conversation in VR in beautiful scenery). For these activities, it is important to take account of age-related accessibility needs and to use simple, intuitive controls. Besides of emulating activities already engaged in when meeting in reality, both age groups expressed an interest in activities and scenarios otherwise not possible or too dangerous (cf. [2]).

Low-intensity activities were also preferred for allowing to hold a conversation, as the focus of SVR activities would be on spending time together in an enjoyable way. For younger adults, when thinking of interacting with their peers in SVR, this was less of an issue, and they mentioned dancing and competitive sports. Regardless of the interaction, the focus should be on enabling users to 'enjoy the moment' while allowing for conversation during the activity, which should be rich in content. An audio connection was important, not just for conversation, but also to enable younger users to support their relatives in setup and explaining how to interact in VR.

Our findings further highlight that for meeting friends and family/partners, in particular for the older users, realistic avatar appearance is highly important (cf. [26, 73]). This is very different from the 'dressing up as...' avatars common in many VR applications, and far extends customizable comic-style avatars.

While initially, older participants were hesitant to imagine themselves using VR, and it was very difficult to recruit older adults for the study in the first place, after experiencing a number of carefully selected VR demos, they were quite enthusiastic. This reveals a potential for VR use.

5.1 Limitations and Future Research

A limitation of our work is that while the young adult participants had a culturally diverse background (although all well-educated and living for at least one year in Germany), the older adults almost all (two were born in the former USSR) grew up in Germany. Future research should investigate whether a more diverse sample express more varied preferences. Furthermore, while presenting preexisting applications can cater to different fields of interest, these were probably not tailored to each user group. As these were carefully chosen with both user groups in mind, we believe this to be a minor limitation. Nevertheless, selection of VR demos may have influenced responses. For instance, the mentioning of table tennis

by older aged participants (despite otherwise preferring low-action activities) is likely influenced by seeing this application demoed.

Another limitation of our work is that we interviewed younger participants individually (demo attended as pairs) while most older adults had a group interview. This was in response to the difficulty to recruit older adults for our study. Only when offering a group session, more people agreed to take part. However, facilitation made sure that speaking time was balanced and all opinions could be voiced. Furthermore, many participants expressed strong opinions, often opposing those of other participants (e.g. sceptical vs. convinced views towards VR). We did not see any indication of 'group think'. Moreover, given the age difference between researchers and participants, the group setting might have made free expression easier for older participants as it allowed them to discuss with their peers – whereas for the young adult participants discussing with the researchers was more natural as these were of similar age. For these reasons, we do not believe that the two approaches employed for the interviews had a major effect on our findings.

Finally, we have so far not included children as participants. Given there is still considerable concern whether younger children should use VR at all and given VR headsets are not tailored for their smaller heads [30, 43, 48, 49], it is not clear whether this would be an advisable research direction. Therefore, we focus on scenarios that could connect young adults and their elderly family members in VR. Lastly, it could be useful to run interviews with pairs who meet in SVR. Such interviews would likely need to take place online, since the involved people would live far apart.

6 CONCLUSION

VR and AR experiences have been shown to significantly enhance the well-being of older adults [51, 58, 70]. However, this demographic remains underrepresented in VR research, and thus, understanding of their specific needs and preferences is limited. In our work, we contribute to identifying design and interaction aspects, and requirements for the use of social VR, comparing preferences and expressed needs of older and young adults.

While prior research focused on accessibility requirements for VR applications for older populations, there has been far less research on what sorts of in-VR activities these would desire. Research on the latter question tended to focus on individual VR use. Prior research found that older adults would prioritize social VR (SVR) applications. Our work focuses on SVR, and in particular, movement-based activities (where interaction partners move in a more or less coordinated way). It contributes to a deeper understanding of what kinds of such activities would appeal to older adults, and what other considerations regarding activity design, avatar design, and ease of use are important to them. A main preference of older adults was for cultural activities, whereas younger adults preferred sports activities. Despite these differences, both groups can imagine low-intensity, game-like activities, that facilitate ongoing conversation and shared experiences with their beloved-ones. Additionally, ease of use, realistic avatars, and minimizing age-related differences were essential requirements for older adults. By comparing interview responses from young and older adults, their specific interests and needs are highlighted. Our findings can help in determining what specific activities as well as VR designs appeal to older and to younger adults, and can assist identifying opportunities for inter-generational SVR designs.

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A INTERVIEW GUIDE

General Information

Which gender do you identify with? How old are you?
- Ranges:

- younger than 20
- 20-29
- 30-39
- 40-49
- 50-59
- 60 or older

Are you employed/are you studying? If yes, what is your profession/what are you studying?
On a scale of 1 (not at all) to 10 (highly), how tech-savvy (how much interested in technology/how well can you work with it) would you describe yourself?
Do you have any prior experience in the field of virtual reality?
What types of movements can you perform well?

- Are there any movement restrictions?

Information Distance Relation

Are there people close to you (friends, family, partners, etc.) who live further away?
If so, who, and in which relation do you stand to this person?
How far apart do you live from each other?
General info about this person - How old are they?
- Ranges:

- younger than 20
- 20-29
- 30-39
- 40-49
- 50-59
- 60 or older

Do they have any prior experience in the field of virtual reality?
What types of movements can they perform well?

- Are there any movement restrictions?

How frequently do you stay in contact with this person?

- How often can you meet in person?
- How often do you interact virtually/medially?

Would you like to have more contact?
Have you always lived further away from each other?

- Has this relationship changed because of the distance?
- How?
- Why?

Current Interaction

What are typical activities / favorite activities when meeting in person?

- What activities made you feel especially connected to the other person?
- Are there any "movement games" you like to do at meetings in person?
- Are there any "movement games" that you would still like to do (but haven't yet)?

What media do you use to keep in touch at a distance? (phone/video chat/etc.)

- How do you use the medium?
  - Typical activities? (conversation/playing games)
- Is the respective medium sufficient for you?
  - Why? / Why not? / What is missing?

When was the last time you felt connected despite the distance?

- During which activity?
- Would you count such activities among "movement games"?
  - If so, which ones?
  - Are there any others?

When did you not feel a sense of proximity while using a medium at a distance?

- Why?

Project

What is your general opinion about virtual reality?
Describe the project:
Often, groups of friends live all over Germany, couples are in long-distance relationships, or grandparents live far away from their grandchildren. While it is possible to spend time together in video conferences, this is perceived as a shared experience only to a limited extent. Social virtual reality offers more extensive possibilities for this. In the context of this project, we want to address the question of how interaction, which provides social proximity, can become even better in virtual space. With respect to the latter, social virtual reality allows to experience interpersonal interaction together even over distances. However, current VR applications do not support precise temporal synchronization. Therefore, activities such as singing, dancing, or motion games are not experienced simultaneously and the interacting parties literally get out of sync. Accordingly, the aim of this project is to enable synchronously perceived social interaction in virtual reality.

Assessment / Advantages and Disadvantages

What do you think about such an approach?

- Do you think you would use such a solution?
  - Why? / Why not?

With whom would you use something like this?

- Are there other people with whom you would use something like this? (Besides the one mentioned above?)

What problems might arise? (Worries / concerns? / obstacles?)
Which advantages would such a solution have compared to other media?
Are there situations / activities where you would prefer such an application compared to common media?

- What about the other way around? Are there situations where you would still prefer common media?

Are there things that would be difficult for you in VR interaction? (too exhausting, painful, or not possible at all)

Show Demo

How has your assessment changed as a result of what you have now seen?

Can you see yourself using such a solution now?
Some questions repeat from before:

- Regarding the demo, has the application scenario changed / expanded for you?
  - Usage with other groups of people?
  - Prioritization in other situations/activities?
- Which advantages would such a solution have compared to other media?
- Could your concerns/worries/inhibitions/problems be allayed by the demo?
- Would usual meetings / media contact be enriched by such a solution approach?
- Do you think that such a solution can strengthen the feeling of connection between people who live far away from each other?
  - What aspects do you think are responsible for this?
  - Would its use strengthen your relationship with the above-mentioned people?
- When do you think you would consider such a solution approach?
  - When used?
  - Used how often?

Ideas for Interactions / Motion Games

In this context, which possible interactions can you envision in virtual reality?
Which of the above activities (that you do in person at meetings) could be considered as "motion games"?

- Are there any others?
- Could you envision these in VR?
  - Why / Why not?

Think about other people as well: What interactions would you like to have with them in VR (if they lived further away)?

- E.g. grandchildren, nephews, nieces, friends, partners, siblings, etc.

Can you think of activities that fit broadly within 'motion games' that you could be additionally considered?

- With whom?
- Why exactly would you introduce them?

What activities would be less attractive to you?

- Why?

Which activities / movement games in VR could be interesting for other people?

Further Requirements

Recalling the shown VR applications, what things would you be able to customize? Related to

- Audio/sound,
- Visuals,
- Movements of interaction,
- Speed and other general factors

How could a VR application take into account that there are age-related differences in physical mobility (as well as vision, hearing), etc?

What could be further requirements for such an application?
What should be taken into account? / What should be particularly considered?

- Especially with regard to different groups of people/constellations?

Which further functions would you desire for such an application?
Where / when / how would users use such an application? → Do further requirements arise from this?
What problems could arise? How could these be countered?