School's Back: Scaffolding Reminiscence in Social Virtual Reality with Older Adults

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Social virtual reality (social VR) is an emerging technology that has the potential to support unique social experiences for groups of older adults. In this paper we explore the use of social VR to support group reminiscence, an activity that has been shown to have a positive impact on the lives of older adults. We developed *School Days*, a bespoke social VR application that enables groups of geographically dispersed older adults to meet in a virtual environment to reminisce about their school experiences. We conducted a user study over the course of 5 months with 16 participants aged 70-81 to evaluate how School Days supported reminiscence. In this paper, we focus on how the use of reminiscence scaffolding features in School Days impacted on the older adults' ability to participate more fully in the reminiscence activities. Our results illustrate the value of social VR for connecting older adults over distance, and contribute new knowledge of how virtual environments can be designed to scaffold reminiscence; how techniques such as 3D conversation starters and individual artefacts can be used to scaffold reminiscence; and how pre-recorded holographic stories (Avacasts) can be used to introduce new perspectives and prompt self-reflection. We contribute five design reflections aimed at guiding the design of future reminiscence tools in social VR.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**; *Virtual Reality*; User studies.

Additional Key Words and Phrases: Older adults; Reminiscence; Social virtual reality

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1 INTRODUCTION

Social virtual reality (hereafter, *social VR*), is an emerging technology that has the potential to support rich social experiences by allowing people to 'meet' in a shared virtual environment and interact via digital avatars. Unlike tools where the user has to reveal their identity, avatars can provide control over anonymity and self-presentation [10]. In addition, social VR enables the sharing of 3D representations of physical objects, which people can interact with in a virtual space using natural gestures. Such interactions with digital objects are either not possible, or are prohibitively complex, using other media [30]. Although social VR is an emerging technology, and is not yet in wide use among consumers, these unique features make it a promising and compelling platform for exploring new opportunities to enhance connectedness among older adults [2, 4].

In the field of human-computer interaction, research into the design and use of new technologies to support social connectedness for older adults has led to a number of bespoke applications being developed and trialled that support specific interactions [33, 38, 59]. Such research aims to provide older people (typically, those aged 65 and over) with opportunities to strengthen existing connections, or to interact with new people. There is growing interest in this area because isolation and loneliness are known to be major risk factors that can impact the physical and mental health of older adults [14, 15]. Social VR offers exciting new opportunities to advance this work. For instance, recent research has shown that co-designed VR experiences can enrich connections between people with dementia and caregivers [20], while participatory design work has identified that older adults themselves are enthusiastic about the potential of social VR as an exciting new communication medium [2, 4].

Aligning with the broader goal of designing technologies to address isolation in later life, this paper explores the potential for social VR to support *reminiscence* among older adults. Reminiscence involves the "vocal or silent recall of events in a person's life" [64] and has been shown to be a positive social activity for older adults [12, 52]. Prior work has explored how technology can facilitate reminiscence and address feelings of isolation and loneliness [28, 51]. Social VR has the potential to extend existing technological support for social reminiscence by connecting older adults over distance and giving them the ability to interact around digital objects that are relevant to the life experiences being discussed. However, it is currently unclear as to how social VR applications might be designed to support group reminiscence for older adults.

To address this research gap, we created *School Days*, a social VR application designed to leverage the affordances of social VR to scaffold reminiscence between older adults. The term 'scaffold' has been previously used to refer to elements of a virtual environment that help to stimulate social interactions and activities [35]. Here, we use the term to refer to features of School Days that were designed to support and encourage older adults to reflect, reminisce, and share their life experiences with others. These features included *conversation starters*, which were open-ended questions that acted as prompts for conversation; *personal artefacts*, which were digital versions of physical objects from the older adults' own lives; and *Avacast holograms*, which were pre-recorded 3D representations of older adults recounting their early-life stories.

We conducted a user study to evaluate School Days, trialling the system with 16 older adults aged between 70 and 81 over the course of five months. The participants used School Days in groups of 2–3 to visit a virtual classroom where they could reminisce about their school experiences. Our study

was part of a larger program of research that has sought to understand older adults' views on social VR as a communication medium. Key aspects of the design of School Days were informed by this earlier work with the same participants. We use a participatory action research (PAR) methodology [44], which involves: long engagements with a participant group, inclusion of the participants in all aspects of the project as co-creators, and an approach to rigor that emphasises trustworthiness over generalisability [18, 44]. Drawing on questionnaires, semi-structured interviews and video recordings of participants' interactions within the prototype, we sought to answer the question: how can social VR technologies be designed to scaffold group reminiscence experiences?

Based on a thematic analysis of the user study data, we contribute new understanding about how older adults view social VR as a communication medium. Our analysis of the specific scaffolding features in School Days shows how the virtual environment itself impacts on group reminiscence, and reveals that the individual scaffolding features combined to prompt different types of social reminiscence. This helped to establish closer social bonds between participants during the social VR sessions and enabled poignant self-reflection after they concluded. In addition, the School Days application is the first group reminiscence application that has been co-produced and co-evaluated with older adults themselves. As such, it facilitates new insights into how social VR might be of value to older users and, in doing so, inspires future research to consider how the emerging medium of social VR might be tailored to older adults into the future. We end the paper with five design reflections that can be used to inform future social VR applications designed to support group reminiscence.

2 BACKGROUND & RELATED WORK

Our research lies at the intersection of technology-mediated reminiscence, social virtual worlds, and social VR for older adults.

2.1 Technology-mediated Reminiscence

Previous work has shown that reminiscence can occur either as a solitary pursuit or as a social activity between two or more people [51]. While reminiscence is a common occurrence for people in all stages of life [22, 60], it has been cited as beneficial for older adults due to its ability to enhance psychological wellbeing and enable healthy ageing [6, 52]. Social reminiscence in particular has been associated with older adult wellbeing by promoting conversation, social bonding, exchanges of personal experiences, and sharing of life lessons with others [61].

Prior work in HCI has studied how digital technology can play a role in mediating reminiscence. Research on solitary reminiscence has explored how technology can be designed to support the categorisation of personal artefacts [17, 54] or personal reflection over meaningful events [41, 42, 56]. In comparison, research on social reminiscence has explored how technologies such as multi-touch tabletops and photo viewers can provide families, young people and older adults with opportunities to interact around personal artefacts [1, 24, 43, 55]. Other work has explored how the creation and sharing of photographs between pairs of people can support bonding and act as a conversation starter [37]. These studies demonstrate the value of technologies that promote social interaction around digital artefacts as a way of encouraging reminiscence.

Research has begun to explore the design of technology for social reminiscence for older adults [17, 28, 47]. For example, Kuwahara et al. [26] used IP videophones and a web-based media sharing service to connect older adults and therapists in order to facilitate reminiscence therapy for people with mild dementia. Their work gives credence to the idea that networked technologies can enable groups of users to share the experience of reminiscence over distance. However, reminiscence is beneficial for older adults in general, not just those living with dementia. Indeed, reminiscence has been shown to have a significantly greater effect on community-dwelling older adults than those

living in residential aged care where rates of dementia are highest [6]. This means that the idea of using technology to support social reminiscence for community-dwelling older adults—particularly over distance—is relevant to the broader HCI agenda of designing technologies to support healthy ageing [29, 31, 57]. Our work contributes to this agenda by exploring how the emerging medium of social VR can be designed to scaffold reminiscence for groups of older adults over a distance.

2.2 Older Adults, Social Virtual Worlds and Social VR

Research examining older adults' use of social VR is scarce due to its status as an emerging technology, but prior work has examined older adults' use of social virtual worlds such as *Second Life* [40, 45]. Unlike social VR, which typically involves the use of a head mounted display (HMD) to create a sense of presence in a shared virtual environment [35], social virtual worlds are viewed through a screen [16]. However, both platforms are characterised by the use of 3D virtual environments and digital avatars to represent users within the environment [34, 39].

Research suggests that older adults view social virtual worlds as useful for inter-generational communication [45, 49], as places to collaborate with other older adults [40, 48], and as venues for the exploration of identity by customising avatars [10, 11, 45]. However, only a handful of studies have examined the use of social VR by older adults. Baker et al. [2] conducted exploratory workshops in which older adults trialled two social VR prototypes. Their participants saw value in social VR as a means of enabling social interaction between older adults, particularly for those who are socially isolated [2]. A second study involving design workshops revealed that older adults saw value in using social VR to support reminiscence [4], but these workshops did not progress past the stages of ideation and initial design. Our work extends these activities with the working School Days prototype and contributes evidence of its ability to scaffold reminiscence.

2.3 Social Virtual Worlds and Social VR as a Medium for Older Adult Reminiscence

Very few studies have considered how social virtual worlds or social VR might be used as tools for reminiscence despite the fact these mediums would appear to be ideal platforms for social reminiscence.

Siriaraya and Ang [47] report on a study that projected three prototype virtual worlds onto a screen in a residential care setting. Each virtual world was designed to elicit "past memories" and included a reminiscence room, virtual tour and garden [47, p. 3977]. Groups of 1 to 5 older adults and their carers were able to interact with elements of the virtual worlds (e.g. books, vegetables and flowers) via natural gestures captured by a Kinect sensor. The researchers reported that the older adults successfully used the system to "temporarily step outside of their closed physical environment of long-term care facilities" [47, p. 3981]. However, a limitation of the research was that the projected virtual worlds were passively consumed rather than sites of active participation and users were all co-located in the same physical environment. Our work addresses these limitations by connecting older adults over distance in a fully immersive virtual world and encouraging interaction between older users. In addition, rather than interacting with pre-configured virtual artefacts, our work integrates personal artefacts and stories from our participants to scaffold reminiscence activities by introducing personal narratives.

Our study seeks to address a number of limitations of prior work in this area. We aim to understand how the elements of a social VR system can act to scaffold reminiscence between older adults. This addresses limitations in earlier work in that: 1) the social VR prototype supported multiple users in different geographic locations to meet and reminisce together, 2) the prototype incorporated multiple techniques that were designed to scaffold reminiscence that combined personal and other artefacts, 3) the environment and scaffolding techniques were collaboratively developed with the older adults to respond to their needs.

3 PARTICIPATORY METHODOLOGY AND CONTEXT

The research described in this paper is a continuation of a larger participatory action research (PAR) project that explores how social VR might contribute to healthy ageing. In this section, we briefly outline the key methodological aspects of PAR before detailing the three major cycles of research that culminated in the development and trial of the School Days social VR application.

Methodologically, PAR is grounded in a critical realist stance that seeks to understand the "causal mechanisms" that underpin people's experiences of the world [36, p.109]. As with all variants of action research, the active participation and empowerment of the participants are central to this research orientation [18, 44]. PAR embraces the view that both the research team and the participants exert influence on the research and do not view this as contamination or bias, but rather as "an inevitable part of the social construction of scientific knowledge" [18, p. 7]. As such, rather than viewing the goal of research to be the development of generalisable results, PAR's approach to rigor is centred "on the notion of trustworthiness" [18, p. 7]. An important component of achieving trustworthiness is to involve research participants in all aspects of the research process. While other participatory methods typically incorporate some level of participant engagement, as Hayes notes in her examination of the relationship of action research to HCI, the full inclusion of participants in action research projects "does not end with the implementation of the research nor with the analysis of results. Rather, action research explicitly requires writing with engaged partners" [18, p. 11], including inviting participants to be co-authors on academic papers [18]. Our decision to adopt the PAR approach was based on a belief that as social VR is an emerging medium, it is important that early design work responds to the genuine interests of end users (older adults in our case).

The PAR process in this project involved three major cycles of planning, action and research with a single group of older adults. These cycles began with an interest in the design of social VR for healthy ageing and culminated in the School Days prototype. Adopting a PAR approach allowed the older adults to meaningfully direct the progress of the research and ensured that their design needs were paramount throughout each stage of the process.

In the first cycle, a group of 25 older adults aged 70 and above were recruited to participate in a series of three workshops. The outcomes from these workshops were previously reported by Baker et al. [2]. The workshops introduced the participants to social VR technology and provided insights into their views on social VR as a communication tool and whether they believed such technology could play a beneficial role in their lives.

In the second cycle, a subset of the same group of participants were involved in the participatory design of a social VR application concept that was used as the basis for the School Days prototype. Findings from this stage were reported by Baker et al. [4]. Over the course of three months, the participants were involved in focus groups and participatory design workshops that explored the types of social communication experiences that the participants felt would be well-suited to social VR. From this ideation work, a design concept emerged with the preliminary title of 'The Highway of Life'. This concept was for a social VR reminiscence application that would evoke reminiscence about the experience of school, a significant period in the participants' lives. The participants also wanted the application to include a human facilitator to support the reminiscence activities, and wanted the system to include specific features in order to scaffold reminiscence.

Finally, the PAR process continued to inform the user study reported in this paper. The participants were invited to try early builds of the prototype before the study in order to identify areas where improvements were needed. They also co-designed the avatars that were used in the system so as to ensure they responded to their requirements. In addition, the participants were invited to research meetings that occurred immediately after user study sessions. These meetings allowed

them to discuss any issues that were raised in their post-session interviews and changes to School Days were prioritised based on their comments. In a continuation of this commitment to ongoing participation and trustworthiness, we invited one of the participants to be a co-author on this paper (fifth author). This follows the recommendations of Hayes [18] and gives the participant an active voice in how the research is presented.

4 SCHOOL DAYS OVERVIEW

Our PAR project led us to create School Days, a high-fidelity social VR prototype that aims to scaffold reminiscence between older adults. School Days was built using Unity3D (Version 2017.3.0f3) and enables up to four people to meet simultaneously in a 3D virtual environment and reminisce about their school experiences.

We designed School Days for use with a head-mounted display. Figure 1 shows one of the participants using the system. The setup for each user consisted of an Oculus Rift VR system connected to a gaming PC and monitor, two Oculus Touch hand controllers, and two dedicated Rift room tracking sensors. The Rift sensors enable real-time tracking of the hand controllers and allow the system to map hand and torso movements onto the user's virtual avatar. Users are able to communicate over voice through a high-fidelity audio feed. Voice is captured by a microphone and relayed to other users via speakers in the VR headset. We designed School Days for use in a seated position to minimise the risk of simulator sickness [23] and to ensure it supports participants with mobility difficulties.

Each user in School Days is represented by a lifelike humanoid avatar. Previous research has found that older adults dislike avatars whose movements are too robotic or doll-like [2, 48]. In responding to this, we incorporated recommendations from prior work [2, 39] to improve the avatars' behavioural anthropomorphism. This included adding additional facial and body movements (via the FinaIK plugin by Root Motion), and lip movements (via the OvrLipSync plugin by Oculus). Each user had a choice of two avatars in School Days. The appearance of each avatar was tailored to the specific requirements of each participant through participatory design work (not reported here) led by the fourth author. In this paper we focus on the participants' responses to features designed to prompt reminiscence, as opposed to perceptions about the qualities of their designed avatars.

We designed School Days to incorporate the role of a facilitator inside the virtual environment. We did this to meet the older adults' stated preference for an expert voice to guide them through social experiences, and to provide *in situ* technical support for the older adults while in the School Days prototype. The first author, who has a practice background in social work with older adults, acted as facilitator throughout the study.

4.1 Virtual Environment Description

School Days is comprised of two virtual environments, *The Hall* and *The Classroom*. The Hall is where users find themselves after putting on the VR headset and entering the application. It consists of a plain room containing a table and four chairs (see Figure 2). We designed The Hall to function primarily as a site for user onboarding, which has been shown to be an important feature for creating a pleasant user experience in social VR [35]. The Hall provides an opportunity for users to become familiar with the virtual environment, introduce themselves to one another, and explore the system's functionality, such as by passing virtual objects to each other.

Upon entering The Hall, each user initially appears as a humanoid 'ghost' avatar that has no discernible face or clothing. The user is then able to switch to an avatar of their choice by bringing up a 'virtual mirror' inside the environment (see Figure 3). Pressing a virtual button next to the mirror allows the user to switch to a different avatar, and the mirror can be removed once the user

Fig. 1. A participant using the Oculus system during the user study.

Fig. 2. Participants prepare to teleport from The Hall.

has decided which avatar to use. The mirror also allows the user to see how they appear to others in the virtual environment.

Once all users have selected an avatar, they are able to leave The Hall by completing a short group task in which each user has to simultaneously place their hand into a sphere in the middle of the table (see Figure 2). This is intended to enable users to collaboratively decide to teleport into the next environment, once everyone is ready. This type of synchronised group task has previously been demonstrated to promote social closeness among participants [53].

The second environment in School Days is *The Classroom* (see Figure 4). The Classroom is the primary site for reminiscence activities and consists of a room styled after a modern school environment, with desks, chairs and various paraphernalia (stationery, a world map, a globe) that

Fig. 3. A participant views himself in the virtual mirror inside *School Days*.

one might expect to find in a typical school. While in The Classroom, users are seated around a desk at the front of the room. The desk has another sphere that allows users to teleport back to The Hall if desired, and a red button that is used to generate objects that stimulate reminiscence about the users' time at school.

4.2 Reminiscence Scaffolds

We designed three bespoke features to scaffold reminiscence among our participants. Our selection of these features was grounded in the earlier participatory design work with older adults (see Section 3) that motivated the development of School Days, and informed our design as follows.

1. Conversation Starters. Participants desired features that would allow older adults to discuss common life experiences and listen to how others react to those experiences. We designed *Conversation Starters* as a response to this desire. Each conversation starter consists of a virtual placard that aimed to stimulate discussion between participants through open-ended questions (see Figure 5). Conversation starter examples included *'What school trips and excursions did you take?'*, *'Who were your favourite teachers and why?'*, and *'What extra-curricular activities did you do after school?'*. These questions were intended to kick-start conversation and scaffold reminiscence by allowing participants to compare and contrast their personal experiences.

2. Personal Artefacts. Participants asked for a means by which they could share personal effects from earlier life, including photos, written records and newspaper clippings. Some participants even wondered if it would be possible to share physical objects such as ink wells and school prizes. These ideas motivated the design of the *Personal Artefacts* feature, which enabled participants to share virtual recreations of physical objects from their own lives inside the Classroom. We did this by first implementing the ability for users to generate 'graspable' 3D objects within School Days by pressing buttons on the Oculus Touch controller, and by allowing users to exchange and pass these objects around. We then invited our participants to bring us their own physical objects that they would like to share in School Days. These objects included photographs, trophies, and pages from school textbooks. Members of our research team scanned these objects and recreated them

Fig. 4. The Classroom environment. Participants sat at the table in the bottom right corner.

virtually, such that they could be generated within the Classroom environment. Figures 6 and 7 show examples of these artefacts.

3. Avacasts. Participants requested a way to capture the details of individual life experiences and store these for later viewing. We responded to this request by designing the *Avacasts* feature. An Avacast is a three-dimensional holographic representation of a person telling a memorable story about their school experiences. As School Days was designed as an intimate space where only four participants could meet at any one time, the Avacasts served as a way to incorporate stories from participants who could not be present in real time during a social VR session. To create the Avacasts, we first audio recorded each of our participants telling a memorable story from their school experiences. We then created a hologram of the participant's avatar to 'beam in' and tell the story in social VR. The audio recordings were embedded into the hologram using CrazyTalk 8 by Reallusion and included facial and full body movements created in FinaIK plugin by Root Motion and OvrLipSync plugin by Oculus. Figure 8 shows an example of an avacast.

5 USER STUDY: METHOD

We conducted a user study to understand the types of experiences that were prompted by the reminiscence features and the overall success of School Days in scaffolding reminiscence for our participants. All procedures received ethics approval from our institutional ethics committee.

5.1 Participants

We recruited 16 older adults for our study. The participants were originally recruited for the larger project via advertisements disseminated in public forums targeting older adults, and through posters in public spaces such as libraries and community notice boards. The inclusion criteria stipulated that participants had to be over the age of 70, be able to speak English to a reasonable standard, and have an interest in technology. Each participant chose a pseudonym that would be associated with them during the research (listed in Table 1). These pseudonyms are used in this paper.

Eleven participants identified as male and five identified as female. Our participants were aged between 70–81. The participants were geographically distributed across two sites: eleven (7 male, 4 female) lived in a metropolitan area (a large Australian city) and five (4 male, 1 female) lived in a

Participant Pseudonym	Number of Social VR Sessions	Location
Gordon	4	Regional
Klaus	5	Regional
Len	3	Regional
Tina	3	Regional
Wes	4	Regional
Amy	4	Metropolitan
Bernard	7	Metropolitan
Carl	2	Metropolitan
Cleo	6	Metropolitan
Evan	1	Metropolitan
Harry	4	Metropolitan
Herb	5	Metropolitan
Herbert	5	Metropolitan
Holly	5	Metropolitan
Samuel	4	Metropolitan
Yulia	4	Metropolitan
Total	66	

Table 1. User study participant and session information.

regional centre located 150km (93 miles) from the metropolitan group. The metropolitan group had not met members of the regional group prior to the user study. All participants were retired or semi-retired, and all but one lived independently in the community. Eight participants reported specific age-related health issues. Four male participants had hearing difficulties that required hearing aids, two female participants used mobility aids when walking, and one participant reported a mental health condition that at times impacted on their ability to socialise. In addition, one participant was living with Parkinson's disease and required medications to assist with communication and movement. While we took these impairments into account when preparing our procedures and risk management strategies for the study, none of these health issues had a noticeable impact on participants' use of the School Days application.

5.2 Procedure

We conducted a total of 26 social VR sessions, each of which lasted 27–56 minutes (average = 44 minutes). Each session involved two or three participants using School Days alongside a facilitator (the first author). The sessions were distributed over a five-month period, running to a fortnightly schedule in which two to three sessions took place over a single day during the scheduled week. We did this to provide a structured and regular schedule for our participants while also giving them ample opportunities to try School Days. Participants were free to self-enrol in as many sessions as they wished at their own convenience. As shown in Table 1, participation ranged from one session to seven uses of School Days. The different degrees of participation were due to scheduling constraints and because some participants went on vacation during the study period.

User study sessions were conducted at two locations: a metropolitan university campus (for the metropolitan participants), and a regional university campus. These sites were chosen as they had dependable network infrastructure and were easy for the participants to access. Each

participant was located in a different physical location (a quiet research laboratory or office) at either the metropolitan or regional sites. Members of the research team were present alongside each participant at all times. These researchers provided instructions and assistance while the sessions took place, observed the participants while they were using the environment, and collected data about each participant's experience during the session.

Each session began with each participant sitting in a chair and putting on the VR gear. The accompanying researcher then loaded the School Days application on a laptop. Participants proceeded to meet each other virtually in The Hall and select the avatar that they wanted to use for the session. When required, the facilitator initiated introductions between the participants. Participants were also guided through a range of movements designed to familiarise them with their avatar's characteristics [27]. The participants then collectively made the decision to transition to The Classroom by placing their hands into the sphere.

Once they had teleported into The Classroom, participants were encouraged to reminisce freely and use the scaffolding features as they saw fit. The facilitator was available to assist with this if need be or to introduce a scaffolding feature if there was a 'lull' in the conversation. Each session concluded with the participants being invited to place their hands into the sphere and teleport back to The Hall, where they said goodbye.

At the end of each session, members of the research team helped the participants to remove the VR gear. Each participant then filled out an adapted version of Witmer and Singer's presence questionnaire [62] to measure their perceived feeling of 'being there' in the virtual environment. This was followed by a semi-structured interview that probed each participant's views about the reminiscence session, the conversations that had taken place, and their thoughts about the social VR technology.

5.3 Data Collection and Analysis

Our study produced 66 responses to the presence questionnaire, 66 interviews comprising over 12 hours and 15 minutes of audio, and 18 hours and 26 minutes of screen-captured video of the social VR sessions. The video was recorded from the perspective of the facilitator's HMD and, in later sessions, a dedicated virtual camera embedded in the virtual environment. Members of the research team also took observation notes, photographs and short video recordings to capture notable interactions during each session. In total, the research team recorded 8 hours and 30 minutes of video footage of participants using School Days.

We transcribed all data when necessary and then imported it into NVivo (version 12) for analysis. We conducted a thematic analysis of the data following Braun and Clarke's six phase approach [7, 8]. Having transcribed, read and re-read the data (Phase 1), we adopted an inductive approach to coding the data (Phase 2), resulting in 101 codes. We began searching for themes (Phase 3), by collating the codes into potential thematic areas. Phases 4 through 6 involved refining the themes through thematic mapping, consolidation of codes and discussion among the authors. This resulted in three themes that we describe in the results section below.

6 RESULTS

Our results demonstrate how specific aspects of the design of the School Days application scaffolded reminiscence amongst the participants. In our first theme, we analyse how the virtual classroom environment supported the social reminiscence that took place in School Days. In themes two and three, we examine how the specific features we designed for the application—conversation starters, personal artefacts and Avacasts—scaffolded social reminiscence in different ways.

6.1 Theme 1. The Classroom as a scaffold for reminiscence

Prior work has established that the virtual environment plays an important role "as a contextual scaffold for social interactions and activities" [35, p. 10]. Our participants reported that The Classroom elicited meaningful conversation and supported both a sense of physical presence — "being in one place or environment, even when one is physically situated in another" [62, p. 225] — and social presence — "being together with another person in a social environment" [50, p. 282]. This is supported by the questionnaire data. Of the 66 responses to the question 'Were you engaged with the virtual environment in terms of visual information?', 51 responses (77%) were in agreement (agree or strongly agree), with only two responses across all the sessions choosing 'disagree' or 'strongly disagree'.

We deliberately designed The Classroom to be reflective of a modern school environment. This was partly due to practical reasons: it would not have been feasible to design a general 'historical' schoolroom that matched all of our participants' experiences. As it turned out, we found that the Classroom environment became a 'blank slate' for participants to 'decorate' with their own recollections of a typical school environment from their era. Some participants did say they would have preferred an 'old style school room', but most supported this design decision, as reflected by Harry: *"I find the environment really good...[it's] a conversation starter, and I am sure if you tried to replicate something from 50 years ago, people would still have an issue with it, as it still wouldn't be exactly as theirs was"*.

A key component of familiarising the participants with the classroom was for the facilitator to ask the participants to look around the environment and then describe how it differed from the classrooms they had experienced. Recollections ranged from the generic *"I think we had radiators"* or *"The desks would have had ink wells"* to the very specific *"We had a world war one German officer's helmet with a spike on it!"*. This helped to generate memories of the participants' school experiences, and regularly served as an icebreaker to begin a broader conversation. Even comments about the mundane features of the environment sparked reminiscence. One participant noted that *"the windows in my classroom were much smaller"*. This initiated a long conversation about how windows were placed high *"because they [teachers] were trying to discourage you from looking out [of] them"*. This in turn led to reminiscence among the participants about the similarities and differences of their school room environments. Analysis of the video data revealed many similar instances where the initial discussion of the virtual environment scaffolded further reminiscence between participants on topics ranging from the difference between schoolrooms in different countries, the role of the 'ink monitor' (a person responsible for refilling ink wells each morning before school), and the differences between primary and secondary school experiences.

Despite these positives, the video data also revealed that some participants wanted the environment to be more dynamic. On multiple occasions, participants commented that the wall mounted clock only displayed a fixed time and that they would have liked it to reflect the actual real-world time. A practical benefit of this would be that all participants would have had a clearer view of how long they had been in The Classroom. The lack of knowledge about the real-world time had tangible negative impacts on the conversation in the schoolroom environment. Towards the end of sessions, the facilitator would temporarily lift the HMD so he could check the elapsed session time, and on several occasions participants misinterpreted this movement as a sign the facilitator was disinterested in the conversation. On several occasions, participants also commented they would have liked to have been able to write on the chalkboard that stood at the front of the classroom. The inability to move away from the desk in School Days prevented this, but it is possible that enabling the ability to write on the board might have facilitated a different mode of storytelling and reminiscence.

Overall, however, participants' interview comments reinforced the view that the environment played an effective role in surfacing memories and scaffolding reminiscence. Samuel contrasted his experiences in The Classroom with his real life conversations with other members of the metropolitan participant group:

> "We've had over a year together [as participants in the project] but we haven't had that much, you know, meaningful conversation. This [Classroom] has allowed us to [access] areas of memories... that explore things a bit more."

Klaus felt that the virtual environment played a key role in acclimatising people to conversation in a virtual world, *"it's interesting...with the visual environment, you've got the facility to interact more naturally with the people you're talking to, and you're not distracted by the fact they're not there [in real life]"*. Acclimatising people to the virtual environment has been shown to play a pivotal role in social VR [35]. Our results suggest that drawing users' attention to the virtual environment, and prompting them to reflect on how the virtual world corresponds to their real-world memories of a similar space, can play a vital role as an ice breaking activity and technique for scaffolding reminiscence.

6.2 Theme 2. The role of conversation starters and personal artefacts

This theme describes how two of the features of School Days (conversation starters and personal artefacts) helped to scaffold social reminiscence in differing ways. When asked to reflect on the impact these techniques had on the social VR experience, Samuel remarked that they were all *"Triggers to keep the conversation going...and you can either [embellish] it, or learn from it, or just comment on it."*

6.2.1 *"It sort of all went from that": Conversation starters.* The conversation starters feature, involved the use of 3D objects with specific school related questions that could be passed around to each participant (see Figure 5). Users generated conversation starters by pushing a red button on the table (see Figure 4). The conversation starters were visible to all participants in the virtual environment.

Like the classroom environment, conversation starters provided a 'blank slate' that participants could 'decorate' with their memories. However, the classroom environment prompted unstructured reminiscence, whereas conversation starters acted as a more formal, structured scaffold. Conversation starters acted as stepping off points for a wide range of discussions. Klaus described one such example:

> "Well the question said 'What did you want to be when you were at primary school?'. [It] sort of all went from that... Samuel told us about his life, [how] he went through wanting to be different things as he got older and older. And then when he left school, he got into a job, came out here with the same company, and he took up teaching later on."

Conversation starters were often the only social lubricant needed to generate wide ranging social reminiscence. For example, analysis of the video footage for the exchange above revealed the discussions that flowed from this single conversation starter lasted over 27 minutes as the participants reminisced about different aspects of their lives. Conversation starters generated stories spanning a variety of school experiences. For example, Yulia described how, on a school vacation to the beach, she first discovered that the nuns running her school *"had feet!"* beneath their religious attire. Similarly, Wes described returning to his home country to find that his school was now a police station, and Gordon, Herb and Cleo discussed school prizes and how these impacted on their views about what they were good at in later life.

While participants were overwhelmingly positive about the role that conversation starters played as a social scaffold, there were usability issues that impacted on their use. In particular, the red

Fig. 5. Klaus' view of a conversation starter.

Fig. 6. Herb passes a photograph from his childhood to Harry.

button that generated the conversation starters was situated on the side of the school desk closest to the facilitator. This was helpful when demonstrating the feature, but it meant that the user sitting on the opposite side of the table was sometimes unable to reach the button as doing so would cause them to reach beyond the tracking boundary of the Oculus Rift system. To overcome this issue, the facilitator had to generate the conversation starter and then pass it to this user. While only a minor irritation, this process did undermine the ability of some participants to use this feature without assistance.

6.2.2 "It gives you something to key into": Personal artefacts as social catalysts. Like conversation starters, the personal artefacts we digitised and included in the environment were effective at triggering wide-ranging conversations. Unlike conversation starters, however, artefacts could

only be generated by the person to whom they belonged. While the classroom environment and conversation starters allowed participants to metaphorically decorate the space with their memories, personal artefacts were 'concrete' objects that personalised the experience of social reminiscence. Figure 6 shows Herb passing a childhood photograph to Harry for closer inspection. Another participant, Samuel, later reflected that he felt the artefacts were valuable because they *"[gave] you something to key into"* during social interactions, meaning they acted as personalised prompts to recall memories. Amy summarised her experience using artefacts by commenting, *"I think they worked. In fact... we probably talked too much!"*.

Our analysis revealed that, beyond social reminiscence, the artefacts often appeared to support the building of closer social bonds between participants. The artefacts also helped to initiate conversations between the participants without requiring any encouragement or support from the facilitator. A good example of this occurred after Holly introduced her artefact, a cooking book that she had used in home economics class (see Figure 7). In one session, Holly passed the book to Cleo, who immediately recognised that she had used the same book and still cooked the 'ice-cream and ice-fudge' recipes. This led to both participants sharing stories about their school experiences in other classes. After Holly recalled making a *"big pair of bloomers"* (underwear) in sewing class, Cleo laughed and said that she remembered making them too.

While the artefacts often generated positive memories and experiences (*"It was a good life back then"* [Wes]), participants also spoke about the bittersweet feelings that the personal artefacts sometimes generated. For example, the artefacts at times conjured memories of corporal punishment, loss of family members, and being sent to boarding schools or homes for 'destitute' children. Reflecting on this aspect of the conversations, Bernard commented:

> *"It's inevitable that* [an artefact is sometimes] *going to cause, you know, whether it's a bit of sadness, or a bit of joy...but it's OK. It's stirring up the emotion in you... I actually think that's good as long as the person who is doing the* [reminiscing] *has a choice whether they say anything or not."*

Several participants commented that the artefacts helped them recollect forgotten memories. As Bernard commented, *"A couple of things have come up that I had forgotten about...I mean it has been a long time...I've been thinking about them"*. Bernard reflected on the fact that as a result of the conversation in School Days, he had been thinking about the support a teacher had given to him and other children who had lost parents in World War II.

Herbert suggested that the use of artefacts was a key benefit of a social VR system: *"Using [artefacts]... you can't really do that with Skype [or] phone, or any other technology."* This emphasises the unique value of social VR for creating rich interactions that closely approximate face-to-face sharing experiences [30].

While these comments demonstrate that participants were generally positive about the role personal artefacts played as a social scaffold, as with the conversation starters, there were usability issues that consistently impacted on the experience. These related in particular to the use of hand controllers to both generate and manipulate the virtual objects. In earlier prototype testing that used Microsoft Kinect sensors rather than hand controllers to map the users' movements, participants had called for more fine grained control of hand movements to aid both non-verbal expressiveness and improve the dexterity of their avatars [2]. The School Days application addressed this by adopting the Oculus Rift Hand controllers. However, the added complexity of adjusting to use the hand controllers caused numerous challenges, especially when trying to generate, grasp and hold virtual objects. Several participants expressed frustration at trying to master the skill of pressing on the hand controllers' function buttons to generate their personal artefacts. Even after successfully generating artefacts, some participants struggled to use the hand controller to close their avatar's

Fig. 7. A page from Holly's cooking book.

fingers around objects in order to pass them around in the virtual classroom. Herbert commented that although there was time built in before each session to practice the hand movements, he was surprised that the level of *"familiarity was less than I would have thought"* when he tried to use the controllers in the Classroom environment. He suggested allowing even more time *"to get used to the hand controls"* before beginning each VR session. While difficult to quantify from the data, it is clear these usability issues caused frustration for some and thus negatively impacted on the reminiscence experience in the School Days application.

6.3   Theme 3. Avacasts: Hologram storytellers that fostered passive interactivity

Avacasts introduced the stories of participants who were not present in the classroom, populating the virtual space with reminiscence from other older adults. This made Avacasts different from the conversation starters and personal artefacts that were designed to foster reminiscence from those present in the classroom. The Avacast's stories, while representing the views of someone who was not present in the environment, helped to scaffold social reminiscence by inspiring those present to respond to the Avacast stories. An example of an Avacast playing in The Classroom can be seen in Figure 8.

Avacasts introduced a new reminiscence scaffolding technique without increasing the complexity of the environment by introducing larger numbers of real-time users. During one of the later user study sessions, Yulia commented on this advantage: *"they feel... intimate isn't the right sort of word, but it's something* [where] *you're not giving us too many people at the same time"*. Yulia's comments were echoed by others who felt that a group of four was the ideal group size for a conversation in School Days. The only negative experiences related to the Avacasts came from sessions earlier in the study, when some participants mistakenly thought they could communicate with the Avacasts in real time. This led to awkward moments where a participant began trying to communicate with the Avacast and ask it questions before realising that it was only a hologram.

Even though Avacast stories were a pre-recorded form of communication, our analysis revealed that they, like personal artefacts, acted as a strong social catalyst for reminiscence between participants who were in the social VR sessions. For example, Gordon's Avacast, which involved a story

Fig. 8. Wes watches an Avacast.

about boys sneaking into an underground space to smoke cigarettes, prompted a long conversation between participants about how social norms around smoking have changed over the years. Similarly, Holly's Avacast, which reflected on her negative experiences with a teacher, prompted Bernard and Cleo — who had both enjoyed long professional careers as teachers — to reminisce about their approach to teaching and dealing with younger teachers who required mentoring.

Our interview data also revealed that the Avacasts prompted powerful experiences of self-reflection. For example, in one interview, Klaus commented:

> *"One of the [Avacasts] that I saw, told us about his experience at school. He was influenced to a great extent by [this] experience... [however] when I came out of school, and in fact for many years afterwards, I didn't know what I wanted to be...[during this] part of my life...I probably wasn't the best sort of father...[my jobs] took away my time with the children...on sharing a lot of the children growing up that I should have participated in".*

Klaus' comment demonstrates how the Avacasts prompted participants to reflect on their own life experiences and choices. Studies examining the effect of reminiscence on the psychological wellbeing of older adults have found that although reminiscence can prompt profound emotional reactions such as those demonstrated by Klaus, such reactions may ultimately "have a greater effect on psychological well-being." [6, p. 297]. We see this as a powerful endorsement of the effectiveness of the reminiscence scaffolding techniques we designed into School Days.

7 DISCUSSION

Our empirical results demonstrate the potential value that social VR can provide as a communication medium for older adults. More specifically, we contribute a range of co-designed reminiscence scaffolding techniques that demonstrate how social VR can be an ideal platform to support immersive social reminiscence experiences.

Consistent with the PAR methodology adopted for the study, our results privilege the voices of the older adults who collaborated in every stage of the project. This is an important aspect of the research. It responds to calls within HCI to include older people's voices "throughout the design and research process" and ensure that the results of this engagement are "meaningful to those individuals engaged in the research" [57, p. 21]. While this choice necessitates some trade-offs with

respect to generalisability, in our view, these are more than compensated for by the richness and trustworthiness of the insights we gained.

7.1 Social VR as a Communication Medium for Older Adults

Our research contributes knowledge about how social VR applications can play a positive role in supporting meaningful communication between groups of geographically dispersed older adults. Our regional participants were located 150km (93 miles) from those in the metropolitan group but reported feeling high levels of presence while using School Days. As we live in societies where older adults are increasingly socially isolated [3], our study demonstrates that an appropriately designed social VR experience can contribute to feelings of relatedness, particularly when the application triggers a discussion that allows users to get to know each other better. The School Days application is an example of a new type of technology artefact that we believe points toward the potential for future innovations in social VR applications aimed at addressing social isolation. The global Coronavirus epidemic has led to an increased appreciation for the role that social technologies can play in supporting social connections, especially for older adults. Our results demonstrate that Social VR applications like School Days can provide unique features – such as the ability to share personal 3D artefacts and inspect these objects up-close – that are not possible with other social technologies. Based on these findings, we believe that appropriately designed social VR applications can contribute greatly to the wellbeing of older adults into the future.

Just as importantly, our results highlight some of the usability challenges that are related to the use of this emerging technology by older adults. In designing the School Days application, we sought to respond to our participants' earlier calls for levels of gesture control that would facilitate improved non-verbal cues and greater control over manipulating 3D objects and their avatar's movements [2]. Our study demonstrates that these calls must be carefully balanced with the added complexity that such features can entail, especially in regard to hand movements. Some of our participants struggled in particular to grasp non-intuitive hand control gestures to the hand movements of their avatars, suggesting that older users may be more comfortable with hand mapping accessories that facilitate more natural movements [19]. As such, this research draws attention to the work that will be needed to ensure that social VR technology can be more fully embraced by older users into the future. Furthermore, the School Days application itself is an example of a new type of technological artefact that contributes to HCI by pointing to how future social VR applications might be designed that "enable new explorations, facilitate new insights, or compel us to consider new possible futures" for older adult users [63, p. 40].

7.2 Reminiscence Scaffolds and Older Adults

The reminiscence scaffolding features that were implemented into the School Days application were the result of an extended engagement with a group of older adults that spanned multiple action research cycles of planning, action and reflection, lasting over 18 months. As such, each feature was bespoke to the needs of our participants stemming from multiple stages of participatory design and prototype evaluation [2, 4]. Thus, while our results may not be directly generalisable as specific design guidelines, they are extremely trustworthy as reflections of an extensive design collaboration with a group of older adults over the age of 70. In the section below we revisit each of the reminiscence features that were implemented in the School Days application and attempt to distil our key learning from each feature. In doing so, we hope these design reflections will serve as inspiration for others considering how to implement reminiscence features into future social VR applications aimed at older users. Further, we believe these learnings may translate to other

reminiscence tools and therefore see them as making a broader contribution to technology-mediated reminiscence applications.

7.2.1 *Reflections on the Role of the Social VR Environment as a Reminiscence Scaffold.* Our study shows that the virtual environment can be a valuable contextual scaffold for social reminiscence [35]. In this paper, we have illustrated the benefit of designing a virtual environment that is relevant enough to the reminiscence topic that it supports a sense of *physical presence* [62]. However, we also show the importance of designing a virtual environment in such a way as to empower the user to decorate the space with their own experiences. In a social context, this delicate balance allows each person to project their personal reflections onto the virtual canvas while sharing in the reminiscence of others.

Design Reflection 1: The virtual environment has a major role to play in providing users with comfortable and stimulating surroundings that make reminiscence seem natural. The choice to base our virtual environment on a modern classroom achieved this goal while giving the participants the ability to reflect on the differences between this environment and their memories, thus stimulating conversation and reminiscence. Those wishing to design reminiscence environments in the future can benefit from our work by considering the diverse experiences of their users and then choosing settings upon which each user can *project* their individual experience. For example, if the reminiscence activity is to be based on experiences in the home, it may be best to ensure the virtual environment contains elements that are common to a broad range of home environments such as a dining table, oven, sofa and family portrait, while keeping the basic architecture of the virtual environment fairly nondescript. This allows users to reflect on the similarities and differences of the basic elements of the home without impacting on their ability to feel a strong sense of physical presence. Furthermore, users can be prompted to reflect on how their memories of the home environment differed from the nondescript virtual 'home', thus providing a stimulus to prompt further reflection and reminiscence between groups of users.

7.2.2 *Reflections on Specific Scaffolding Techniques.* In our study, the conversation starters, personal artefacts and Avacasts acted as reminiscence scaffolds. Each feature contributed to social reminiscence in unique ways.

Conversation Starters

In their paper describing how creators of commercial social VR platforms shape pro-social interaction, McVeigh-Schultz and colleagues report that their participants saw value in having "stuff lying around that you can fool with" in the virtual environment [35, p. 25]. Our results build further on McVeigh-Schultz's insights by demonstrating that the 'stuff lying around' in a virtual environment will be more effective if the user can both interact with it and use it in a meaningful way, thus ensuring it will act as a social lubricant. Our conversation starters fulfilled this 'social lubricant' role, and in so doing, supported deeper and more meaningful reminiscence.

The role of conversation starters also changed over the course of the user study. In early sessions, where regional and metropolitan participants were meeting for the first time, acclimatising to the technology, and navigating an unfamiliar social environment, the conversation starters proved valuable in stimulating multiple new topics of conversation that prevented the awkward silences that can be a problem when establishing new social groups. However, as the participants became more familiar with the prototype and each other, their role became one more akin to setting a topic upon which an entire reminiscence session could be based. In later sessions of our study a single conversation starter was all that was needed to initiate an almost 30 minute conversation. An added advantage of conversation starters in the context of social VR is that they could be randomly generated by pushing a virtual button and were not directed at any specific user. This allowed participants to choose if they wanted to generate a new topic *and* whether they wanted to

respond. This decreased the social pressure on the participants to contribute, a feature that some less outgoing participants said they appreciated.

Design Reflection 2: Designers of reminiscence-based applications can use social scaffolding features – such as conversation starters – to introduce topics that will stimulate discussion and empower users to choose how and when to contribute. The School Days application involved users sitting around a table where the conversation starters appeared; it would be interesting to see how future applications could embed conversation starter questions into the virtual environment itself (perhaps as pictures on a wall) so as to encourage people to initiate conversations as they collectively teleport around the virtual space.

Personal Artefacts

Our study reveals the complex ways in which incorporating virtual items based on real world artefacts can enhance the social experience, generate memories, and bring people closer together. Personal artefacts not only helped the individual who brought the artefact to contribute to a conversation, but also served to bring people closer together as they recognised common interests. This feature also served as a way to transfer control over the conversations from the facilitator to the participants. Results from the analysis of the video data demonstrated multiple occasions where the introduction of a personal artefact led to interactions between participants that no longer required input from the facilitator.

We also demonstrate the powerful role artefacts can play in helping people to recollect previously forgotten memories. Given the immense interest in the use of technology-mediated reminiscence as a technique to assist people living with dementia [9, 17, 28, 47, 51], we believe that reminiscence-focused social VR applications that incorporate personal artefacts may be beneficial in assisting memory recall. However, we also note there is some evidence to suggest that head mounted displays may be distressing for people living with dementia [5]. Future research on these aspects of social VR based reminiscence are worthy of future investigation.

Design Reflection 3: Our experiences lead us to believe that the ability of social VR to support users to import personalised 3D artefacts into a social space is one of the most valuable aspects of the technology. This is especially so for reminiscence-based applications such as School Days. Personal artefacts allow users to express their individual personalities and take ownership of the social reminiscence activity. This is an area that future design work can improve on by using more robust 3D scanning technology so as to allow users to introduce more complex personal artefacts. For example, after engaging with personal artefacts during the School Days study, many of our participants expressed a desire to introduce new items, such as school bags, writing paraphernalia and textbooks.

Moreover, prior work by Sas has demonstrated that while the real-world possessions of older adults can facilitate emotionally rich reminiscence, "their unique material fragility" can severely limit people's willingness to interact with them [46, p. 157]. This suggests that scanning real-world personal artefacts and making them available to older users in social VR may be an ideal way to explore the richness of these "autobiographical memories" [46, p. 157]. Based on this, we believe those designing future reminiscence-based social VR applications for older users should consider asking specifically whether there are fragile objects that the user would like to have scanned so they can engage with these objects and be empowered to share them with others.

Avacasts

Avacast holograms proved to be an excellent way of introducing multiple perspectives and new stories into social VR that prompted social reminiscence. The stories also elicited powerful self-reflection after the sessions had concluded, an aspect of reminiscence that can be very beneficial to older adults [6]. Importantly, the Avacasts did this without increasing complexity to the point that it would impact negatively on the intimacy of the small group activities that were valued by

our participants. Prior research examining social media use by older adults has noted that they value interfaces that are easy to use [13, 32] and which provide social communication that enables "depth of thought, reflection, and personalization." [21, p. 3911]. Our analysis suggests that Avacasts accomplished these goals within the medium of social VR.

Design Reflection 4: Our participants were adamant that they did not want the reminiscence sessions to become too crowded. They valued the intimacy provided by having no more than four people in the social VR environment at any one time. However, the use of Avacasts demonstrates how designers can still introduce new perspectives into a virtual environment. Social VR is particularly well suited to innovation in this space. We suggest that others building social VR applications consider novel ways to include multiple voices without increasing complexity.

7.2.3 The Role of the Facilitator. As mentioned in the School Days Overview section, one of the results of earlier work with our participants was that they valued having a facilitator in the reminiscence sessions (see [4]). Our results demonstrate the particular importance that facilitation plays in social VR, especially in applications targeting social reminiscence. At the practical level the facilitator also played an important role as a technical support, helping the participants to resolve technical issues during the sessions. This type of technical support is very difficult for those not present in the VR environment [58].

At a deeper level, having a facilitator in a social reminiscence application takes on added importance due to the nature of the activity being undertaken. As our results show, reminiscence activities can generate a range of complex feelings and emotions. This is a well documented characteristic of reminiscence [6, 51, 52] that has been found to play a beneficial role in assisting older adults to "learn something from their past problems to shape their present life" [52, p. 373]. However, this characteristic of reminiscence does raise ethical questions about whether social VR-based reminiscence applications should require a facilitator who is sufficiently trained to deal with the types of complex emotions that reminiscence can bring to the surface. The School Days application shared many similarities with traditional group reminiscence therapy, which has been described as "the discussion of past activities, personally significant people, events and experiences, usually with the aid of tangible prompts" [51, p. 107]. In our case, the facilitator in School Days [first author] has a practice background in social work, specialising in work with older adults. This background proved valuable in structuring the conversations that occurred in School Days in such a way as to allow time for the participants to consider the meaning these events have for them [25].

Design Reflection 5: Facilitators in reminiscence-based social VR applications provide vital technical and emotional support. Not every implementation of a reminiscence-based technology will be able to include a professional facilitator. Nevertheless, we believe that designers of reminiscence applications have an added ethical responsibility to carefully consider the potential impacts of reminiscence on the users and that they take steps to ensure adequate supports are made available during and after the reminiscence sessions.

7.3 Limitations and Future Work

Our results demonstrate the potential of social VR as a reminiscence platform, yet VR is still in its infancy as a consumer technology. As such, existing systems are complex, expensive and require significant technical expertise to configure and control. This technical complexity is amplified when multiple systems are in use over various locations, as in our study.

The complexity of VR motivated us to conduct a controlled user study. By having participants take part on a university campus, we were able to resolve technical issues and prevent Internet drop outs that could otherwise have severely impacted on the feasibility of the social VR sessions. However, we are mindful that a field study may have yielded additional information about how

social VR sessions work within the context of the users' home environment. Future work should explore the use of social VR 'in the wild' with older adults to further our understanding of how this technology should be designed to play a positive role in older adults' lives.

8 CONCLUSION

In this paper we explored the potential for social VR to support reminiscence among older adults. We implemented School Days, a social VR prototype that includes scaffolding techniques to support social reminiscence. In an evaluation with 16 older adults, we found that the design of the virtual classroom environment acted as a prompt to stimulate memories while allowing participants to project their own experiences onto it. In addition, our scaffolding techniques of conversation starters, personal artefacts and Avacast holograms contributed to powerful experiences of social reminiscence and self-reflection for the older adults. Based on the results of our empirical research, we contribute five design reflections that can inform future HCI work on social VR based reminiscence applications aimed at older users. Overall, our study stresses the potential for social VR to enable novel experiences for older adults as a contribution to healthy ageing.

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