



Designing for Inclusive Experiences: Investigating Opportunities for Supporting Older Adults in Community-based Social Programs

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ABSTRACT

Community-based social programs, such as interest groups and outings, provide valuable ways for older adults to maintain social connectedness. To understand how technology can be designed to support older adults in such programs, we conducted a four-month field study with a local community centre, involving: (1) observations of social program sessions, (2) interviews with staff, and (3) co-design workshops with staff and program participants. We found that staff used technologies in a situated way to make social programs more inclusive for older adults. Technology promoted incidental social interactions and group learning, but also excluded participants from some activities. Participants believed that future technologies to support community-based social programs should be designed to enable efficient communication, promote flexible interactions, and maintain the flow of social activities. We argue that technology interventions in this setting should not become the focus of an activity but instead support social interactions triggered by existing activities.

CCS CONCEPTS

• **Human-centered computing** → **Collaborative and social computing**; **Field studies**.

KEYWORDS

field study, older adults, community organization, social connectedness, design recommendations

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1 INTRODUCTION

Community-based social programs, such as digital literacy sessions, exercise classes, and interest groups, are important social outlets for many older adults living independently [18, 71]. These programs provide diverse opportunities for people to stay socially connected with others, including building new friendships, obtaining social support, and fostering a sense of belonging through participation in group activities [18, 42, 46]. These social connections are vital to help people maintain mental and physical health in later life, and prevent them from experiencing social isolation and feelings of loneliness [17, 42, 46].

These protective effects have attracted the attention of HCI and CSCW researchers who have explored how technology interventions can support independently-living older adults to participate in community-based group activities. Such studies focus on moving from the deficit model of alleviating social isolation to enriching and empowering social connectedness among older adults [60, 69, 79]. HCI research on this topic has ranged from supporting older adults' engagement in specific group activities [3, 34, 39, 76], to examining how technology can be designed to promote older adults' participation in the local community [41]. This prior work has identified crucial values and technology design considerations to promote the involvement of older adults in community-based activities, such as fostering a sense of belonging [34], promoting the sharing of expertise [3], and facilitating information sharing among program participants [41]. However, more research is needed to improve the design of technologies for enabling older adults' involvement in community-based social programs from the perspectives of program participants and staff responsible for running these programs.

In addition to investigating older adults' experiences, Xing et al. [73] interviewed staff members from multiple community-based organizations to understand how they used technology to continue running social programs for older adults online during COVID-19 restrictions. They argued that community organizations and the people who work there were important stakeholders to support the social connectedness of older adults in community-based social

programs, and they should be included when designing technology for supporting older adults in these programs. This work reinforces the design concept of ‘turning to community,’ that is, that technology should be designed to meet the situated needs of older adults and the communities to which they belong [59]. However, prior research has rarely examined the in-situ role of technology in social programs involving older adults, staff members, as well as the social, physical and community environments in which the programs are delivered.

Motivated by this, we conducted a four-month field study at a local community centre that offers social programs for older adults in a metropolitan region of Australia. We used ethnographic observations, interviews, and co-design workshops with staff and older adults to explore the following research questions:

- **RQ1.** How is technology being used to support older adults in community-based social programs?
- **RQ2.** What are the key considerations when designing technologies to support the social connectedness of older adults in community-based social programs?

Our ethnographic observations suggest that staff used technologies in a situated way to make social programs more inclusive for older adults. This included communicating program information based on participants’ varying technology preferences, and naturally integrating technology into social programs to increase participants’ digital literacy. However, the use of technology impacted group dynamics in social programs. We found that while technology prompted some incidental social interactions and group learning activities during program delivery, it also excluded some participants from participating in social activities. Following the observations and interviews, we conducted two rounds of co-design workshops with staff and older adult program participants (one staff member and nine older adults). The workshops aimed to understand participants’ views on social connectedness and their preferences for designing technology to support older adults in community-based social programs in the future. Participants saw three opportunities: simplifying interaction processes to improve communication efficiency, promoting flexible ways for people to interact with technology, and ensuring the continuity of the social contexts for program delivery.

Our work makes three contributions to the HCI literature. First, we provide a nuanced understanding of how technology is being used to support older adults in community-based social programs. This extends the prior literature [41, 73] by adding the perspective of situated technology usage in community contexts, and exploring its impacts on group dynamics. Second, we identify three key preferences for designing technology to support older adults in community-based social programs from the perspectives of staff members and older adult program participants. Third, we contribute a three-layered framework for informing the design of technology to foster inclusive social program experiences for older adults. We argue that rather than developing new programs centred around technology, future technology designs should promote social interactions embedded in existing program activities. Such technology should be designed and deployed in ways that do not disrupt the social contexts of these activities while aiming to improve the inclusiveness of community-based social programs for older adults.

2 RELATED WORK

Our study builds on HCI research about technology interventions to support social connectedness among older adults, and the importance of promoting older adults’ participation in community-based social programs.

2.1 Technology to Support Social Connectedness in Later Life

Social connectedness is an essential human need [20], and can bring numerous benefits to older adults’ health and wellbeing [5]. Staying socially connected can improve older adults’ life satisfaction [57], prolong independence and inclusion in community life [52], and help achieve active ageing [4]. However, many older adults face a decline in social connectedness as a result of life course changes, including reduced health and mobility conditions, retirement, and the loss of intimate relationships [16, 67]. These changes could further lead to social isolation and feelings of loneliness in later life [29], which are associated with a variety of detrimental health conditions [66] such as cognitive decline [54], heart disease [21], and early mortality [64].

With these issues in mind, prior work in HCI has considered digital technology as a promising way to enhance the social connectedness of many community dwelling older adults [15, 36]. Studies have shown that information and communication technologies (ICTs) enable older adults to maintain existing social connections with their family and friends [13, 35]. Social media platforms such as Facebook have been used by older adults for social connectedness, especially with younger family members [31, 32]. Other work has explored bespoke technology interventions to enhance inter-generational relationships [44, 45, 68]. For instance, Lindley [45] developed a touch-screen based design prototype, *Wayve*, to be used at home to enable the exchanging of photos, text messages, handwritten notes and drawings among older adults and their grandchildren. They suggested that the sharing of handwritten notes and drawings could facilitate creative and playful interactions for inter-generational connections. Similarly, Wallbaum et al. [68] designed a tangible device called *StoryBox* to facilitate the sharing of photos and recordings between grandparents and grandchildren, which enriched the inter-generational storytelling experiences through asynchronous communication.

In contrast to the studies that focused on strengthening existing social connections, another strand of HCI research explores the possibilities of using digital technology to assist older adults in building new social relationships. For example, Gaver et al. [24] implemented a movable photograph display called *Photostroller* in an aged care home, which promoted new communications among residents through playful discussions around the displayed photos. Similarly, Waycott et al. [70] investigated the use of an information and photo sharing application, *Enmesh*, among isolated older adults who did not know each other before the study. Their study demonstrated that *Enmesh* enabled new social connections within small peer communities through the creation and sharing of digital content. These studies demonstrate the significance of using visual elements such as photographs to facilitate reciprocal and playful social connections among older adults. More recent research has

explored how emerging technologies, such as social virtual reality (VR) [7–9] and video conferencing platforms [62, 77, 78] could connect older adults who live independently over geographical distance, enabling them to participate in meaningful social activities remotely.

While these studies have explored the potential of technology interventions to support social connectedness among older adults, fewer studies have involved other important stakeholders, such as community-based organizations and staff, in understanding the use of technology to support community-based social programs for older adults. Given the essential role that these programs can play in supporting older adults' social connectedness [1, 18, 73], our study aimed to involve staff members and older adults to understand how technology could be designed to better support older adults in community-based social programs.

2.2 Supporting the Participation of Older Adults in Community-based Social Programs

Participation in community-based social programs is often one of the most important ways for independently living older adults to achieve social connectedness [1, 71]. These programs are usually run by organizations such as local councils, public libraries, community centres, or established social groups to support the social lives of many people through a variety of group activities [42, 46, 63, 73]. Examples include book clubs, crafting groups, card games, and dancing and exercise classes [46]. Engaging in these activities enables older adults to build friendships and social support networks within the community [1, 18, 23, 42]. These benefits contribute to helping older adults maintain mental and physical wellbeing [17, 42, 46].

Given this, HCI researchers have explored ways to support independently living older adults to better participate in social programs. Much of this work has involved older adults in making and creative activities [3, 33, 34, 39], with a focus on empowering their experiences, knowledge, and values in technology design and production [60, 69, 70]. For example, Anderson and Vyas [3] conducted a co-design study with 13 older adults who attended an Australian 'Men's Shed' club, which is a type of community group where men can socialize, learn and share skills, and build craft work. Through the deployment of a card-based probe, Anderson and Vyas found that introducing novel concepts during co-designing processes prompted participants to learn more about each other's previously hidden expertise, which could help to strengthen their making community. Similarly, Kalma et al. [34] conducted a mixed methods study with older adults in two crafting communities. They found that a sense of belonging, creativity and the quality of crafting work were important values that could inform the design of technology for craft communities. Lazar et al. [39] studied the formation of an older adult-led makerspace using ethnographic approaches. They found that while technology in makerspaces could encourage more participants to engage with others and keep up with technical changes, the technology must first be appealing enough to generate interest in its use.

Researchers have also explored the role of technology in supporting older adults participating in volunteering activities [38, 76], as well as their general involvement in community life [41, 73, 77].

For instance, Yuan and Yarosh [76] conducted observations and interviews with older adults and teachers in an inter-generational mentoring program with primary school students. They argued that in addition to lowering the logistic and knowledge barriers of older adults to conducting mentoring activities, technology should provide opportunities to foster inter-generational relationships beyond the classroom through asynchronous communication. Instead of studying older adults' engagement in a particular activity, Lee et al. [41] sought to understand how ICTs could promote older adults' participation in community centres. Their ethnographic research highlighted the role of social networking platforms in supporting older adults' community involvement by promoting information sharing in 'activity circles' [41] (p. 161), where a group of older adults connected with each other based on their common interests and activities.

Collectively, these studies demonstrate promising ways in which technology could be used to support older adults in community-based social programs and group activities, especially those involving collaborative work among participants. However, there has been little research on how technology can be used by community organizations to support older adults in less creative activities, such as social groups, digital literacy classes, and gentle exercises. These programs may have different needs and opportunities for technology use compared to the activities studied in the literature to date. Considering the importance of these programs for the social connectedness of older adults [18, 43], we sought to involve staff members and older adults to understand how technology can be used in these community-based social programs, with a focus on in-situ technology usage in community settings, and its impact on group dynamics.

3 METHODS

We conducted a four-month field study at an Australian community centre using ethnographic [40] and co-design approaches [28]. Our goal was to understand how the organization currently used technology to support the older adults in its social programs, and to generate technology design considerations to support the social connectedness of older adults through community-based social programs in the future. The study was undertaken in three phases between March and July 2023, including initial site visits (Phase One), observations of social programs and staff interviews (Phase Two), and two rounds of co-design workshops (Phase Three). Figure 1 outlines the research activities and study timeline for each phase.

The study was approved by our institutional ethics committee. We use pseudonyms when referring to the local community centre and participants to protect their anonymity. Ethical considerations are discussed in Section 3.2 after we detail the research context.

3.1 Research Context

3.1.1 Study Site. We worked with a local community centre, Connecting Well (a pseudonym), as our research partner through purposive sampling [22]. We first contacted several community-based organizations that provide social programs for older adults, and Connecting Well expressed an interest in participating in the research. We then set up an online Zoom meeting with Connecting

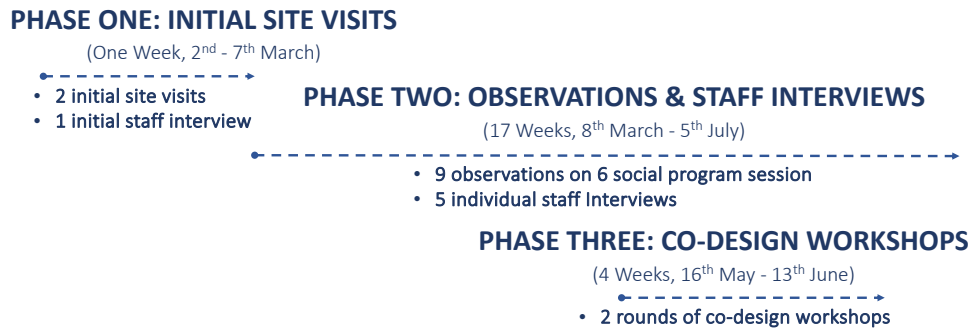


Figure 1: Study timeline and data collection activities.

Well's manager to discuss the study design and associated commitments, which led to our partnership.

Connecting Well is a not-for-profit organization located in a metropolitan suburb of Melbourne, Australia. The suburb has approximately 15000 residents (51.3% female and 48.7% male) [55]. According to the 2021 Australian Census [55], the median age of residents in the suburb is 31 years old, but 11.7% are 60 years old and above. The median weekly income per household is \$1718 AUD, which is slightly lower than the national median (\$1,746 AUD) [55]. Among residents aged 15 and over, 52.7% have a bachelor's degree or higher. Like many areas of Melbourne, the suburb is ethnically diverse. 48.8% of residents were born in Australia, compared to the national average of 66.9%. Other countries of birth include China (7.6%), Vietnam (2.8%), India (2.7%), Malaysia (2.7%), and England (2.3%) [55].

Connecting Well has been running for 40 years and receives government funding and philanthropic support to maintain its operations. The organization is managed by a team of 11 paid staff members and several volunteers. All staff members work part time based on the number of hours allocated in the financial budget.

According to Connecting Well's website, their mission is to provide an assortment of programs based on the needs of their clients. This includes programs for all age groups, and those specifically catered for people aged 60 and above, such as Older Adults Exercise classes. The focus of these programs is to deliver an inclusive agenda that promotes a sense of belonging in the community, reduces social isolation, and enhances the overall wellbeing of the residents.

3.1.2 Types of Social Programs Offered. Connecting Well provides diverse programs for its residents. These include educational sessions (e.g., digital literacy classes and language courses), interest groups (e.g., music clubs and community choir), social groups and outings (e.g., morning tea sessions and bus trips), and exercise-based activities (e.g., exercise classes and Pilates). The class size of these programs is flexible and usually depends on the actual needs of Connecting Well's clients. The number of people in social groups and educational classes is usually between four to eight, while exercise classes and community choir sessions usually have 12 to 20 clients. The programs are run to coincide with school terms, with class frequencies ranging from weekly to monthly based on

demand. The duration of each session lasts between one and three hours.

Connecting Well holds educational and social programs in its activity room, which is equipped with a large digital display and is furnished with tables, chairs and shelves (Figure 2). Laptops are also provided by Connecting Well for their clients to join digital literacy classes. Exercise and community choir sessions are held in larger venues outside of Connecting Well due to the need for large spaces. These venues are also equipped with comfortable chairs.

3.2 Ethical Considerations

The study procedures received approval from our institutional ethics committee. All members of the research team have experience conducting qualitative studies with older adults and had received ethics training. All participants read an information sheet at the beginning of each research activity (observations, staff interviews, and co-design workshops), and signed consent forms.

Ethical issues were carefully considered for observation and co-design workshop sessions. The first author observed entire sessions as a peripheral participant to avoid disrupting the programs [2, 51]. This enabled us to interact with program participants and gain an understanding of the setting, and how digital technologies were used, without being a core participant of the group or intervening in the activities [2]. We recorded social interactions that occurred during programs in field notes, but did not record participants' personal information, such as emails and home addresses mentioned during their conversations.

Photos were taken during some of observations to support later analysis. To uphold participants' anonymity, we did not photograph participants' faces and only took photos of the social activities and artefacts created during observations and co-design workshops. Participants could put green stickers we had prepared to their chests to indicate their consent to be recorded. All participants consented to be photographed in this study.

To ensure inclusiveness, we held the workshops at Connecting Well. This reduced participants' commuting requirements whilst allowing them to engage in research activities in an environment that they were familiar with [28]. We emailed a copy of the workshop procedure to the director of Connecting Well before each session. This was to ensure that the workshop activities could be conducted in accordance with the organizational regulations.



Figure 2: The activity room at Connecting Well, where most of the social groups and educational sessions take place.

3.3 Participants and Recruitment

We invited staff members from Connecting Well and older adult program participants to take part in our research. In total, 35 people (seven staff members and 28 older adult program participants) consented to be observed by the researcher while participating in social programs. Following this, 15 people (six staff members and 9 older adults) agreed to participate in further research activities including interviews and co-design workshops. Not all 28 program participants were available to participate in further activities due to personal interests, time conflicts, or health reasons. As we mainly discuss data collected from participants who took part in multiple research activities in this paper, we omit the demographic information of participants who only consented to the observations.

3.3.1 Staff Members. We recruited six staff members (two men, four women) based on the recommendation of Connecting Well. They were nominated either because the social programs for which they were responsible often included older adults, or because they had experience of working with older adults at Connecting Well. Their ages ranged from 36 to 71 years (mean = 49.7, SD = 12.3). As shown in Table 1, they were all experienced in running or supporting programs that are either specifically designed for older adults, or have many older adults as program participants. Most of them had worked at Connecting Well between four months and two years, whereas one staff member (Xianna) has been with Connecting Well for ten years as a board member. They all have some confidence in using digital technology.

3.3.2 Older Adults. We also recruited nine older adults (two men, seven women) as program participants. Inclusion criteria were: any

older adult who was interested in participating in any phase of this study, was involved in Connecting Well's social programs, and was over the Australian retirement age (67 years) [26].

As shown in Table 2, the ages of older adult program participants ranged from 76 to 88 years (mean = 74.3, SD = 7.4). One participant (Adeline) preferred not to disclose her exact age but said she was around 70 years old. All participants listed in Table 2 consented to be observed by the researcher while participating in social programs, and attended at least one round of co-design workshops. Participants' confidence levels in using digital technologies varied from not at all confident to somewhat confident. The social programs each participant attended at Connecting Well are also listed in Table 2.

Each participant received a \$20 AUD digital gift voucher for their participation in each type of research activity (i.e., observations, interviews, and co-design workshops), adding up to a maximum of \$60 AUD per person.

3.4 Data Collection

3.4.1 Phase One: Initial Site Visits. Our study began with a series of visits to Connecting Well spread over one week to obtain an initial understanding of the organizational context. We introduced the research team and objectives to staff members and received suggestions about which social programs to observe. We also conducted an interview with Yelena, the Communication Officer from Connecting Well. The purpose of this interview was to gain a preliminary understanding of the current social programs and their facilitators in preparation for subsequent research activities. The initial site visits lasted around four hours, including the one-hour interview. We wrote field notes to record information about the

Table 1: Demographics of staff members.

Pseudonym	Age	Gender	Roles and responsibilities	Work experience*	Facilitated/Assisted programs	Confidence in technology**	Research activities
Zavier	50	Man	Director. Manages the operations of Connecting Well and facilitates social programs.	2 years	Men's Afternoon Tea, Music Club	Very confident	Observation Interview
Yelena	43	Woman	Communication Officer. Assists with events and social programs management, creates and promotes materials for community events, and handles administrative work.	6 months	Seniors Morning Tea, Men's Afternoon Tea, Bus Trips	Very confident	Observation Interview Co-design Workshop I, II
Xianna	71	Woman	Volunteer, Board Member. Assists with social programs and manages student registration at front desk.	10 years (Board member)	Seniors Morning Tea	Somewhat confident	Observation Interview
Walter	54	Man	Education Coordinator. Facilitates social programs, coordinates and designs courses.	8 months	Digital Essentials, Making Your Phone Work for You	Very confident	Observation Interview
Valerie	35	Woman	Tutor. Facilitates social programs and evaluates training effectiveness.	4 months	Digital Essentials, Making Your Phone Work for You	Very confident	Observation Interview
Urena	45	Woman	Choir Leader. Facilitates social programs and community engagement.	18 months	Community Choir	Very confident	Observation Interview

*Work Experience of the current role at Connecting Well

**Confidence levels in using digital technologies: very confident, somewhat confident, neutral, somewhat unconfident, very unconfident

Table 2: Demographics of older adult participants.

Pseudonym	Age	Gender	Confidence in technology*	Involved programs	Research activities
Adeline	Around 70	Woman	Somewhat confident	Digital Essentials, Making Your Phone Work for You	Observation Co-design Workshop I, II
Blair	88	Woman	Very unconfident	Seniors Morning Tea, Bus Trips	Observation Co-design Workshop I, II
Cara	82	Woman	Neutral	Seniors Morning Tea, Older Adults Exercise, Bus Trips, Making Your Phone Work for You	Observation Co-design Workshop I, II
Dylan	76	Man	Very unconfident	Men's Afternoon Tea, Digital Essentials	Observation Co-design Workshop I, II
Enzo	67	Man	Somewhat confident	Men's Afternoon Tea	Observation Co-design Workshop I, II
Freya	72	Woman	Somewhat confident	Seniors Morning Tea, Bus Trips	Observation Co-design Workshop I
Grace**	67	Woman	Neutral to somewhat unconfident	Seniors Morning Tea, Pilates	Observation Co-design Workshop I
Helen	72	Woman	Somewhat confident	Older Adults Exercise	Observation Co-design Workshop I
Ida	70	Woman	Somewhat unconfident	Older Adults Exercise	Observation Co-design Workshop I

*Confidence levels in using digital technologies: very confident, somewhat confident, neutral, somewhat unconfident, very unconfident.

**Grace also volunteers at Connecting Well.

social programs involving older adults and the facilitators' experiences of working with older adults, which we used to inform the design of the observation template and interview questions for the upcoming research activities.

3.4.2 Phase Two: Observations and Staff Interviews. After the initial site visits, we conducted observations of nine individual sessions

of six social programs, and interviewed five program facilitators to understand more about the social interactions that occurred during these programs, and how technology was used within this context. Table 3 provides a summary of the observed social programs.

Field notes were taken during each session based on a predetermined semi-structured template, including entries such as "Observed social interactions", "Technology usage", and "Encountered

Table 3: Description of observed social programs.

Program	Program description	Participants description	Technology usage	Observation duration
Digital Essentials	Weekly group sessions of helping participants learn basic skills for using computers (e.g., sending emails, searching for PDFs, learning about Internet scams).	Open to all ages. Most of the participants are older adults. Session size: 4-8 people	Facilitator: digital display, laptop Participants: personal or public laptop provided by Connecting Well	2 sessions for 4.3 hours
Making Your Phone Work for You	Weekly group sessions of assisting participants in using their smart phones (e.g., phone set-ups, app selections, cloud usage, security issues).	Open to all ages. Most of the participants are older adults. Session size: 4-8 people	Facilitator: digital display, laptop, smart phone Participants: smart phone	2 sessions for 3.8 hours
Older Adults Exercise	Weekly general strengthening classes. Cover activities such as low impact aerobics, balance and strengthening exercises, and resistance band exercises.	Open for individuals over 60. Most of the participants are women. Session size: 10-20 people	Facilitator: smart phone, music player Participants: N/A	1 sessions for 1 hour
Seniors Morning Tea	Monthly group social sessions of multicultural older adults for an informal chat over morning tea. Sometimes with a guest speaker.	Open for older adults. Initially open to all genders, gradually all participants became women. Session size: 6-8 people	Facilitator: N/A Participants: smart phone (occasionally)	2 sessions for 5 hours
Men’s Afternoon Tea	Fortnightly casual get-together events for food and chats with other men from the neighbourhood. Joint program with local Homelessness Resource Centre.	Open for all ages and men only. Some of the participants are older adults. Session size: 6-8 people	Facilitator: N/A Participants: smart phone (occasionally)	1 sessions for 1.8 hours
Community Choir	Weekly choir sessions that allow people to sing music from around the world and across decades. No experience is required.	Open for all ages. Most of the participants are retired women. Session size: 12-17 people	Facilitator: speaker, music player, smart phone, digital piano, iPad, Google Drive, email Participants: smart phone (occasionally)	1 sessions for 1.7 hours

struggles.” We also asked participants follow-up questions after the observation when clarification or further inquiry was needed. The observation duration for each session ranged from 60 to 160 minutes, and the total observation time was around 18 hours across the nine sessions.

After completing the first observation of each social program session, we conducted interviews with the staff member who facilitated the observed session. We conducted five such interviews in total. All interviews were one-to-one and were conducted either online via Zoom or in-person at Connecting Well. The interviews followed a semi-structured protocol based on the observation reflections. During the interviews, we asked questions about the basic information of facilitated programs, the social interactions that normally occurred, and the facilitator’s opinions about the future technology usage for these programs. Example questions included: “What challenges (if any) did you face when running social programs for older adults?”, “How do you usually use digital technologies in your social program delivery?”, and “From your perspective, what technologies would help you to enhance the social connections with older participants through social programs in the future?”. We collected the interview data either by making audio recordings (four interviews) or taking notes (one interview), depending on the preference of the participant. The interviews varied from 28 to 46 minutes (mean = 40.6), with a total duration of 3.4 hours.

3.4.3 Phase Three: Co-design Workshops. After completing the first 10 weeks of field observations and staff interviews, we conducted two rounds of co-design workshops with staff members and older adult participants to further probe their views on social connectedness and technology design preferences for supporting social programs. The first round involved two separate workshop sessions, each with five participants, and the second round involved one session with six participants. Four participants did not attend the second round due to time constraints or short-term illness. All workshops were conducted in-person at the activity room of Connecting Well.

The workshops were inspired by Harrington et al.’s research on community-based design workshops with older adults [28], and the diverse engagement considerations for supporting co-design experiences proposed by Chivukula et al. [14]. For the first round of workshops, we aimed to understand what aspects of social connectedness were important to participants, and what were the main challenges participants encountered when trying to achieve these while participating in social programs. Each workshop started with a small icebreaker activity for participants to become acquainted and to create a relaxed environment. We then asked participants to brainstorm individually about what kinds of social interactions were important to them, what challenges they encountered while

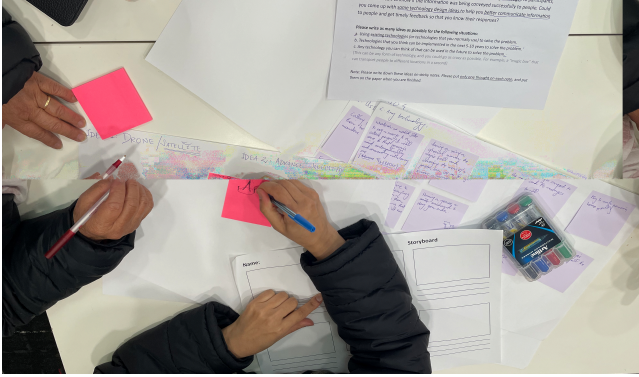


Figure 3: Participants brainstorming in Co-design Workshop II.

trying to achieve these through social programs, and what technologies they had used to overcome these challenges. Participants wrote down their thoughts on sticky notes. We provided prompts to help participants explore their thoughts during this activity [14]. These included word cards of different social interactions (e.g., meet new people, reminiscing, and share information), pictures of social programs run by Connecting Well (e.g., Seniors Morning Tea, Digital Classes, and Bus Trips), and labels of digital technologies (e.g., emails, SMSs, and laptops). After this, we invited the whole group to discuss the content of the sticky notes, and created an affinity diagram depicting their thoughts on the relationships between technologies and different types of social connectedness.

In the second workshop, we aimed to generate and visualize design concepts based on the benefits and challenges that participants discussed in the previous workshops. We first briefly introduced some digital technologies to help participants explore the diverse technology options. This was achieved by presenting some slides of general ICTs such as social media and email, and playing videos of some emerging technologies such as tangible interfaces (e.g., Tovertafel Table [25], Reactable [72]), and augmented reality (AR)). We also used Meta Quest 2 to demonstrate some potential uses of virtual reality (VR), such as conducting a virtual city walk using YouTube 360 videos.

Following this, we provided participants with six scenarios to generate design concepts. Each scenario contained one type of challenge about social programs that built on the research activities of the first and second phases of this study. (All scenarios are included in the Appendix.) Participants were asked to work in pairs to choose one or two scenarios and generate technology-related solutions. This included brainstorming for design concepts, prototyping, and storyboard development. Participants worked in three groups to come up with design solutions based on four scenarios: improving communication with older adult program participants about time-sensitive program delivery information (e.g., last minute changes to the time and locations of program delivery); supporting group learning in digital classes; inviting a friend to join a bus trip over a distance; and sharing a video with others in a morning tea session.

We encouraged participants to generate two types of technology-related solutions for each scenario: one that they thought could be realized using existing technology or in the near future (five to ten years), and one that was any idea they could think of, even if it could not be realized soon. This use of context-based scenarios with speculative design questions contributed to helping participants bridge their design ideas from current technology use practices to technology use to support social programs in the future [6]. As a result, participants created eight storyboards. Each storyboard consisted of six frames in which participants illustrated how their technology ideas would address the chosen scenario and wrote a description in the text field below each frame. We invited each pair of participants to present their ideas to the group. We then facilitated a whole group discussion around the presented storyboards and ideas. The first round of workshops lasted 160 minutes on average, while the final workshop took about 180 minutes. We used voice recorders and smartphones to record the workshop discussions and take pictures of the outcomes.

3.5 Data Analysis

Our data included written field notes, audio recordings of interviews, photos from observations and workshops, as well as paraphernalia collected from Connecting Well’s premises, such as program flyers.

We first standardized all the data into text format by transcribing the audio recordings into text. For the paraphernalia, we extracted information relevant to social programs and consolidated it into field notes. For example, we took pictures of the program flyers and newsletters, and copied the relevant texts, such as program overviews into field notes. This led to a total of 71 pages of interview transcriptions and 39 pages of field notes.

We used open and axial coding techniques from grounded theory methodology [65] to make sense of and interpret the data. The first author read through the entire dataset and conducted two rounds of open coding at the sentence level to generate initial codes that related to the research questions. Some example codes were “Tension between group discussions and small screen”, and “Technology design should keep everyone engaged in group activities.” Alongside the open coding, the first author wrote short memos to record reflections and interpretations to inform the subsequent axial coding process. This included ideas such as the author’s impression that the use of technology in social programs was noticeably subtle, and the importance that participants placed on social interactions.

The first author then axially coded the initial codes with raw data to identify relationships among them, and to create candidate categories that could reflect these related codes. Analytical memos with category diagrams were created to identify connections among core codes and categories. These candidate categories were then iteratively discussed and reviewed by the research team to ensure their relevance to this study. Some sample categories were “situated use of technology to enhance the inclusiveness of social programs,” and “technology impacted group dynamics during program delivery.” After two rounds of axial coding with research team discussions, we finally generated categories that reflected the interpretation of the whole dataset.

4 FINDINGS

We begin by providing an overview of program delivery practices at Connecting Well, and then present the findings of this study. Our observations and interviews revealed that staff used technologies in a situated way in response to requirements that emerged during the organization and running of the programs. We further observed the impacts of technology on group dynamics in social programs, finding that while technology promoted some incidental social interactions and group learning activities during program delivery, it could also exclude some participants from participating in social activities. Finally, the co-design workshops revealed that when designing future technologies to support social programs in community organizations, participants preferred to simplify interactions to improve communication efficiency; promote flexible ways for people to interact with the technology; and not disrupt the social environment for program delivery.

To denote the data collected from different research activities, we use different notations: "Obs" with numbers representing field notes taken during observation sessions; "I" with numbers to refer to interview quotes; and "W" with numbers for quotes from co-design workshop discussions.

4.1 Overview of Observed Program Delivery Practices at Connecting Well

We observed four types of social programs at Connecting Well, including educational sessions (Digital Essentials and Making Your Phone Work for You), social groups (Men's Afternoon Tea and Seniors Morning Tea), exercise classes (Older Adults Exercise), and interest groups (Community Choir). All of these sessions were facilitated by staff members except Seniors Morning Tea sessions—in this program, participants had known each other for a long time, and did not need staff to facilitate conversations. In contrast, the Men's Afternoon Tea sessions were relatively new and the facilitator was vital for helping newcomers join the group and keeping the conversations going. Many participants took part in multiple programs at Connecting Well.

We found that although the structure of each program varied, the typical flow of each session we observed was as follows: at the start of the session, staff usually greeted program participants and introduced new members to the group. They would then lead the activity according to the agenda, with breaks and social activities scheduled at appropriate times. Before the end of the session, staff debriefed participants and reminded them of the arrangements for the next session. In addition, staff usually prepared refreshments based on participants' preferences, which helped to create a relaxed and friendly social environment. It is worth noting that socialization was a very important part of the program flow in all observation sessions. When social interactions occurred, staff usually did not interrupt them and further facilitated these interactions among participants.

As shown in Table 3, the extent to which technology was used varied in different programs. We observed that participants used technology actively in digital literacy classes and community choir sessions. This included the use of a large display in the activity room, personal devices such as a digital piano, laptops, smartphones, and digital resources in online platforms. In social groups and exercise

classes, technology was used occasionally by participants on an as-needed basis, which often involved the use of smartphones.

4.2 Situated Use of Technology to Enhance the Inclusiveness of Social Programs

During the first two phases of our study, we observed that while technology usage varied in different programs, staff members used technology in a situated way to maximize the inclusiveness of social programs for older adults. Often, rather than directly facilitating technology-based activities, staff used technology in a more emergent way to meet requirements as they occurred during the program delivery.

4.2.1 Conveying Program Information Based on Participants' Varying Technology Preferences. We found that conveying timely and accurate program information to program participants was essential for successfully involving them in social programs. To achieve this, staff needed to select the appropriate medium for different kinds of information sharing, including distribution of curriculum materials, notification of changes in the schedule, and advertisements about the program.

Choosing the appropriate medium often depended on the shared preferences for technology use among participants in different groups. Staff often needed to select different digital tools to distribute program materials to participants from different social programs. For example, Urena, the leader of Community Choir, usually distributed choir songs via a Google Drive folder, email, or a Facebook page to ensure that the program participants could access and continue practicing these songs as needed outside of the choir sessions. This reveals one of the coordination roles that technology could play in supporting social programs, which is the distribution of program resources to meet participants' needs of continuing doing activities outside of the sessions.

In addition, Urena explained in a subsequent interview that Google Drive worked best with this choir group, as it was easy to learn for this group and not many of the older adult participants were on digital music platforms:

I05 - Urena: "When I first introduced it [Google Drive], they were all a bit like, what is this? This is too much. But I was like, here's the direct link. If you click on this, here's all the songs that we're doing. When they go into it, they can see the different tracks and then they can practise with those tracks at home. They really appreciate that. Some of the younger ones have put them into playlists on Spotify, but for most of them they just go and click into the Google Drive and that's been really successful."

However, Valerie, the facilitator of digital literacy classes, decided to use email to share class workbooks with the program participants, as most of the older adults in this program found email comfortable to use. These examples suggest that in social program settings, even something as seemingly simple as distributing curriculum materials requires careful consideration by staff members, based on their knowledge of the participants.

To ensure that the registered older adult participants could attend scheduled programs, staff also needed to make sure that schedule

updates were successfully communicated to them in a timely manner. Yelena, the Communication Officer, noted that she usually chose different platforms depending on the type of messages she needed to convey. She added that this selection was based on her knowledge of the communication preferences and digital literacy of older adult program participants. For example, when sending information that did not require participants' responses such as the program timetable, she usually sent it through email. However, when time-sensitive information was required, such as reminders and impromptu location changes, she tended to text or call participants directly.

Moreover, staff mentioned the need to widely advertise programs to the community to increase the overall inclusiveness of social programs, particularly to include some older adults who might be less used to using digital technology. Staff participants stated that they used various digital means for this advertisement, including the Connecting Well website, Facebook pages, Instagram posts, and digital program flyers. However, for older adults in Connecting Well, these digital means, especially social media, were limited for advertising. Traditional communication technology, such as email, a digital screen in Connecting Well's foyer, and non-digital means, such as community newspapers, program flyers, and word of mouth worked better in this case. They were more aligned with the living experiences and technology preferences of older adults in the Connecting Well community.

These examples demonstrate that program participants' technology preferences and varying digital literacy were important considerations when choosing information sharing technology to support program delivery. After all, as mentioned by Zavier, the director of Connecting Well, "there's no real point in putting something where the [older] people who are on that channel are not gonna respond."

4.2.2 Technology Was Naturally Integrated into Social Programs to Increase Participants' Digital Literacy. Some staff firmly believed that older adults needed digital skills to maintain and expand their social connectedness. However, older adult program participants at Connecting Well often lacked a certain level of digital literacy. Facing this challenge, staff endeavoured to artfully provide participants with opportunities to be exposed to and use technology in social programs, even for programs that did not usually involve technology.

Both staff members and older adult program participants acknowledged the importance of digital literacy for older adults, particularly in helping them keep up with the evolving world. Walter, the Education Coordinator at Connecting Well, noted that people who have less digital literacy might even become "disadvantaged" in modern life. Therefore, digital skills are essential "life skills" for older adults:

102 - Walter: "Because so many of these digital skills are now life skills, like you can't pay a lot of bills now unless you have an email and use the Internet, etc. I think they're (digital skills) absolutely necessary these days because anyone who is digitally unaware or unable to move in the digital world is very disadvantaged, even if they are advantaged in other ways in terms of the day-to-day of life."

Given this, staff subtly incorporated technology into some social programs to increase older adults' digital literacy. For instance, we observed that Urena introduced participants to the choir's Facebook page during a Community Choir session:

Obs07 - Community Choir: In the middle of this session, Urena used her iPad to play a video of another choir to program participants, and people enjoyed watching it. This made some participants curious to know how to access the video by themselves. Therefore, when asked where to find the video, she did a detailed walk-through on her iPad to show program participants how to navigate the Facebook page. Several participants tried to follow this using their phones.

Under Urena's thoughtful facilitation, learning about technology became a natural byproduct of program participants' social activities during the session, rather than an abrupt disturbance to the Choir activity.

Similarly, we observed that some program participants learned more about Uber when the program facilitator, Zavier, tried to help one participant call a taxi during a Men's Afternoon Tea session. In this case, the use of technology did not interrupt the normal flow of social programs, and technology knowledge was naturally passed on to the program participants by the facilitators as and when required. These examples demonstrate that with the appropriate guidance from staff members, older adult program participants could gain greater exposure to the digital world by participating in social programs other than just digital literacy classes.

Notably, Walter, who ran the digital literacy classes, believed that rather than just teaching people to use technology in certain social programs, such as digital literacy classes, it would be better to integrate technology into the life of the community. This would enable people to learn and practice digital skills while attending any of Connecting Well's social programs, and help them to be more involved in the community while expanding their digital lives.

4.3 Technology Impacted Group Dynamics During Program Delivery

Some uses of technology appeared to affect group dynamics during the program sessions. While technology facilitated ad-hoc social interactions in some cases, it also prevented some participants from joining group activities in other cases.

4.3.1 Technology Promoted Incidental Social Interactions and Group Learning Activities. We found that older adult program participants' spontaneous use of technology promoted some incidental social interactions that occurred during program delivery, particularly when program participants wanted to find and share some information relevant to their conversations. For example, during a Men's Afternoon Tea session, we observed that when the group was discussing bakeries, they could not remember the address of a particular bakery that had been open for a long time. At this point, Dylan (a program participant) searched for the address on his smartphone and then read the bakery's address out loud, and participants continued their discussions and recalled more about this bakery.

Similarly, during Seniors Morning Tea sessions, participants occasionally used their smartphones to share photos relevant to the current conversations, such as family photos and a picture of a jigsaw table. Since their smartphones had relatively small screens, program participants usually passed their phones around the table to involve more people in the conversation. These additional visual elements often promoted more discussions within the group and further provoked more people to show similar photos to others. These examples further imply a potential role for technology in social groups, which is in enabling ad-hoc multi-media information sharing to stimulate group social interactions.

In some cases, discussions centred on technologies and shared challenges participants had encountered. That is, when one person talked about the issues they had faced, even outside the digital literacy classes, this often triggered a broader discussion among the group:

Obs02 - Older Adults Exercise: This session was delivered in a very social and conversational way. Participants usually chatted with each other while doing the exercises. During this session, some participants mentioned problems with the use of some digital platforms, such as some government websites and e-commerce platforms, which most of them required a login to use. Subsequently, more people started to talk to the group about the technology issues they had experienced, such as difficulties in remembering passwords for different platforms.

Such discussions also occurred frequently in digital literacy classes, where most program participants were older adults. We found that these discussions often promoted peer support among participants, which helped them build confidence around using technology:

Obs09 - Digital Essentials: One older adult participant had some difficulty in finding a particular URL about online scams. Another older adult who was more tech-savvy helped her find it in the class workbook and visited the destination website. At the end of this session, participants were talking about how they found it hard to learn technology as older adults, but then they said that this was not for everyone, as they just saw that some older adults could do the technology things well in this class.

4.3.2 Some Participants Were Excluded from Social Activities. While technology sometimes promoted social interactions, it could also make it challenging for some participants to engage in certain activities during the sessions. For example, in digital literacy classes, facilitators often needed to pause the group teaching to work one-on-one with individuals to solve their specific issues on different devices, which often required them to move back and forth between the podium area and participants' seats. While this helped to address individual issues, it created a lot of waiting time for others. We observed that although participants sometimes engaged in small conversations with their neighbours, many times they simply waited and stared at their screens. This inevitably led to the exclusion of some participants from the group lessons. Valeria,

another facilitator of digital literacy classes, reported that some participants even “got irritated” at times with the delays, which was consistent with our observations:

Obs03 - Making Your Phone Work for You: Valeria usually tended to provide one-on-one support to solve individual issues during the session. However, there were some issues today that took her longer to resolve. When the waiting time got longer, some participants started to get bored. And one older adult started to keep tapping his fingers on the table after waiting for around ten minutes.

While such long waits can sometimes be problematic, these situations also reveal a technology design opportunity to leverage these waiting times to continue engaging participants in more meaningful social activities during digital literacy classes.

Another common challenge around group dynamics in digital literacy classes was the tension between group learning activities and the small screen of digital devices:

Obs08 - Making Your Phone Work for You: Valeria was trying to help Cara understand a problem using her smartphone. At first, she was standing at the right side of Cara explaining the problem. Then another older adult heard about the conversation and wanted to join, but she mentioned that the screen was too small for her to look at. Valeria then stepped between the older adult and Cara so that they could get a clear view on her phone.

The small size of the screens on personal devices often limited the class learning activities to a smaller group of two to three people, and sometimes prevented others from joining the conversations, as participants often needed to clearly view the screens to understand the actual problem. This demonstrates a need to support multiple participants to join in such small learning activities when needed, relieving them from the constraints of not being able to share content on their personal devices to multiple participants at the same time in a co-located space.

We also noted that some participants might be excluded from information sharing across different social programs because they did not use the same platforms as other participants:

Obs04 - Seniors Morning Tea: During this session, Freya used her smartphone to show Blair some pictures of the recent bus trip. They had a great conversation about the garden that Freya visited during this trip. Freya mentioned that she wanted to show Blair these photos earlier. However, unlike others who were on WhatsApp, Blair did not use any social media applications, she was not able to share these photos with Blair until today.

In this example, a choice not to use WhatsApp prevented Blair from participating in Freya's photo sharing activities with others from the bus trip. This reinforces our previous finding in Section 4.2.1 that participants' differing preferences for technology can affect their social connections with others and their participation in community life.

Table 4: A summary of selected scenarios in co-design workshop II.

Scenario	Summary	Chosen group
Group learning in digital literacy classes	You are taking a digital literacy class. Your classmate is discussing with the teacher about an issue he is having. You hear about this problem and want to join the discussion. However, it can be very difficult to keep up with the discussion when a group of people are looking at the small screen that is held by others.	Blair and Cara
Invite a friend to join a bus trip over a distance	You are now on a bus trip to Sovereign Hill. You really like the historical architecture and atmosphere here, and want to involve Mary, your best friend who couldn't come today due to family commitment, to join over distance.	Enzo and Dylan
Share a video with others in a morning tea session	You are attending a morning tea session. People are talking about their travel experiences. You show everyone the videos you stored in your smartphone of the vintage cars. Another participant, George, wants you to share them with him. However, he doesn't have a smartphone, and he does not like to use social media platforms.	Enzo and Dylan
Communicate time-sensitive program delivery information with older adult program participants	You do some volunteer work and manage events registration. You've just been told that there have been some last-minute changes of today's activities, and you need to notify people about it. You have tried emailing, calling, and sending messages to participants, but it is difficult to know if the information was being conveyed successfully to people.	Yelena and Adeline

Collectively, these examples demonstrate that the uses of technology are interconnected with the social environment in community-based social programs. While some spontaneous uses of technology by program participants promoted incidental social interactions among social groups, other uses affected group dynamics. This indicates that a delicate balance needs to be achieved when designing technology for community-based social programs.

4.4 Design Preferences for Technology Used in Community Context

After spending some time observing social program sessions and interviewing staff members, we conducted two rounds of co-design workshops. These aimed to understand the views of staff and older adult program participants on social connectedness and their preferences for designing and using technology to support community-based social programs. During the workshop activities, we invited participants to explore existing technologies, and encouraged them to brainstorm technology design ideas in response to six design scenarios (see Appendix). These scenarios were developed based on our observations and staff interviews, with each depicted one type of challenge associated with social program delivery.

All participants worked in pairs, and each group selected one or two scenarios. Brief summaries of the selected scenarios are shown in Table 4.

We found that participants tended to come up with futuristic technologies to offer simple and direct solutions for improving communication efficiency, providing flexible interactions, and promoting the continuity of the social context in programs sessions.

4.4.1 Streamlined Interaction Process to Improve Communication Efficiency. Participants generated diverse ideas about how to better use technology to communicate information about social programs. Among them, we found that participants preferred a streamlined interaction flow with straightforward operations. They felt that this would help to interact with technology, which contributed to increasing the communication efficiency among Connecting Well and program participants.

For instance, participants were provided with a scenario of better communicating with older adult program participants about time-sensitive program information. In response, Yelena and Adeline came up with a 'mental telepathic' technology design to send program notifications to others. They felt their notification system could make the communication between Connecting Well and program participants more efficient over a distance:

W02 - Yelena & Adeline: "The world will be so advanced that if I want to convey an idea to you, I'll think it in my mind, 'Blair, you should know that today the plan has changed.' And Blair would be sitting in her home, she'll get the idea in her brain that Yelena is saying that the change of plan has happened. So the one idea that is in my brain, will automatically be conveyed to Blair who's sitting in her home."

This example further demonstrates a desire to support more direct communication channels between Connecting Well and its program participants.

In addition to improving the efficiency of communication, it was equally important that program participants would not miss out on important messages from Connecting Well. Given this, Yelena and Adeline further imagined that these notifications should be seen directly on the screen by program participants, so that people could notice them more easily. They first sketched their design as a storyboard, shown in Figure 4. Then they explained the system as follows:

W02 - Yelena & Adeline: "So we'll use satellite to convey idea to people in such a way that even if they are not looking at their mobile screens, the mobile will start blinking, the television or the computer screens, they all will start blinking the message. If anybody's even passing by their mobile or television, even if they are not on, the satellite is going to send a message to the screens automatically."

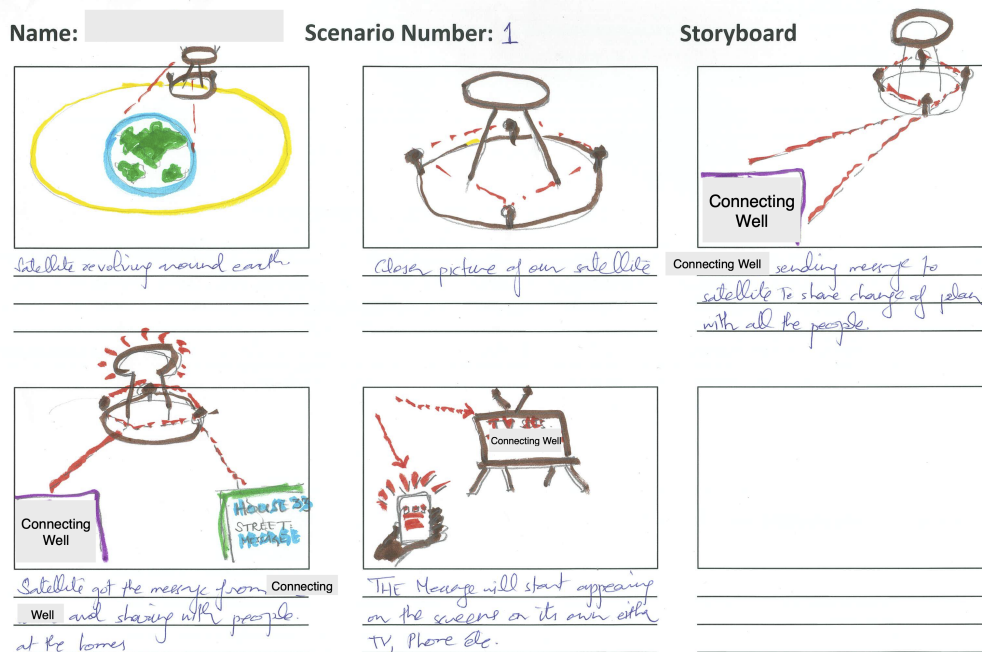


Figure 4: Storyboard: communicating better with older adult program participants about social program information and receiving timely feedback (Yelena & Adeline). Captions on the storyboard: Satellite revolving around earth; Close picture of our satellite; Connecting Well sending message to satellite to share change of plan with all the people; Satellite got the message from Connecting Well and share with people at their homes; The message will start appearing at the screens on its own either (on) TV, phone, etc.

Enzo and Dylan, who worked on the scenario of older adult program participants sharing a video with others in a Men’s Morning Tea session, also developed an idea about microchip-implanted communication:

W02 - Enzo & Dylan: “People have a chip in their brain to receive the video. Sender connects with each chip to send the video, and the receiver views video in head.”

Their storyboard is shown in Figure 5. They noted that such a straightforward communication method could ensure that everyone in the group would receive the same message, preventing the situation where a message “starts one thing that ends up something else,” such as on some social media (Dylan).

4.4.2 More Flexible Ways for People to Interact With Technology. However, the preference for streamlined operations did not mean that there should be a single way of interacting with technology. In fact, we found that technologies used in community social programs should support group use in different programs by providing flexible interaction options, including voice interactions and tangible interfaces.

For example, Blair and Cara chose a scenario of designing technology to support group learning in digital literacy classes, where

the program participants often had varying levels of digital literacy. During brainstorming activities, they generated an idea about getting help from a robot by simply speaking to the technology:

W02 - Blair & Cara: “We came up with the thing of having a robot, and we ask the robot to help us. So, [the robot could] ask ‘How can I help?’ [We could say] ‘tell me how to find Connecting Well.’ ‘Follow Woods Street, next door to post office.’ and that’s the end.”

They explained that they knew very little about technology. They designed it this way because it made them feel like they could get help just as if they were talking to a real person, which is easier and more intuitive for them than using (other) technology. This example suggests that voice interfaces can help reduce barriers to technology use for program participants with relatively low digital literacy, and to engage them more in the activities in digital literacy classes.

Participants also had a fruitful discussion around tangible interfaces based on the video introduction of Reactable [72] during the second workshop. Reactable is a music interface that combines physical objects and multi-touch surfaces to create a collaborative music experience for users to manipulate sound in an intuitive way [72]. One program participant, Adeline, commented that such

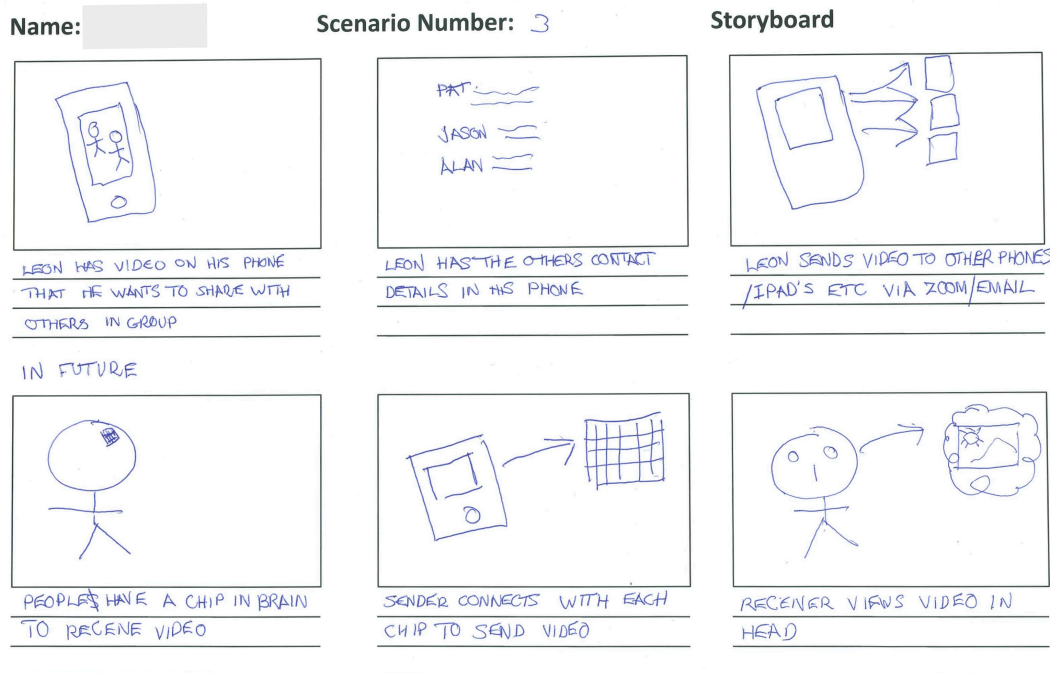


Figure 5: Storyboard: sharing a video with others in a morning tea session (Enzo & Dylan). Captions on the storyboard: Leon has video on his phone that he wants to share with others in group; Leon has the others' contact details in his phone; Leon sends video to other phones/iPads etc via Zoom/email; People have a chip in brain to receive video; Sender connects with each chip to send video; Receiver views video in head.

interfaces provided various tactile and visual elements for older adults to enjoy some fun activities through simple interactions.

Moreover, participants suggested that such tabletop design was suitable for group settings, as it was easy to learn and manipulate for many people simultaneously by simply playing with the concrete physical objects. This was important as any extra learning burden might prevent people from engaging in group activities. Some participants added that it would be even better if these technologies could utilize the “five senses” of sound, hearing, smell, touch and taste to provide multiple interaction options for people (Adeline).

4.4.3 Non-intrusive in the Social Program Environment. During the first round of co-design workshops, participants discussed several key benefits they receive from participating in social programs. They considered the social programs in Connecting Well to be an essential outlet for them to obtain social interactions with others. This included meeting with new people, talking with like-minded others, keeping in touch with old friends, doing something accompanied by others, and providing support to each other.

With these social benefits in mind, participants in co-design workshop II expressed the view that new technology for social programs should aim to foster more group social interactions through playful activities among participants, rather than diverting attention to individual interactions with technology. This suggests that

technology should be designed to ensure the continuity of social interactions embedded in existing program activities, especially when those activities are face-to-face.

For instance, in workshop II, participants discussed the potential use of VR in social programs, after they watched a brief VR headset demonstration given by the researcher. During the discussion, Enzo highlighted the importance of being able to see real-world social cues during co-located group activities:

W02 - Enzo: “I can imagine maybe a lot of people being less comfortable wearing the [VR] goggles, than if they're looking at something on a table and they can see other people's expressions. See that they're enjoying it, rather than being sort of closing [experience].”

Yelena, the Communication Officer at Connecting Well, emphasized that the use of technology should not prevent participants from being aware of and engaging in group activities, especially when they were face-to-face.

She imagined a tabletop group game with touchable digital components for Seniors Morning Tea sessions. In this game, participants could touch the digital components on the table to get different topics as social prompts for conversations:

W02 - Yelena: “We might have a game in which we put in ideas, like children, like topics. And they [older

adults] select the topic by clicking [on the technology]...they're putting their hands on [the] children [topic], and then they discuss [what] they've experienced with their children. So they choose the idea with their hands, that will involve all of them. And then everyone will have a chance to discuss what that person would like to discuss....and then choosing a next idea. It can be used in that way. Not just the game, but game of ideas, like idea in a gaming way."

This game design indicates that technology should support multiple needs of older adult participants in social groups. This includes prompting topics to elicit group conversations, ensuring that each participant can be genuinely engaged in group social activities, providing intuitive human-technology interactions, and enriching the existing group activities in a playful way.

Collectively, participants' ideas suggest that technology should be implemented as an aid to foster group dynamics and enrich social interactions embedded in existing social activities, rather than replacing or compromising them.

5 DISCUSSION

This study aimed to understand how technology can be used and designed to support older adults in community-based social programs. Through ethnographic approaches, we provide a nuanced understanding of the in-situ use of technology by staff members to support older adults in social programs, and show how staff used technology in subtle ways to enhance the inclusion of older adults in social programs. This extends previous HCI research [41, 73] by considering the perspectives of staff who are responsible for organizing and facilitating these programs, the organizational environment, and the social contexts of program delivery. Prior research has focused on social programs for older adults that support specific collaborative and creative activities [3, 34, 39]. We add to this body of knowledge by examining how technology impacted group dynamics of older adult participants in other programs, particularly in supporting incidental social interactions in social groups and digital literacy classes.

In this section, we discuss the significance of understanding the 'program ecology', comprising technological, social, and organizational contexts as part of technology design practice to support older adults in social programs. We then present a three-layered design framework for informing technology interventions to promote inclusive experiences for older adults in community-based social programs.

5.1 Understanding the 'Program Ecology' to Inform Technology Design Practices

Collectively, our findings pinpoint three intertwined factors that contribute to the use of technology in community-based social programs: the technological, social, and organizational contexts for the delivery of each program. Inspired by Cerna and Müller's work on digital ecology [12], we argue that a 'program ecology' is formed by these three factors. Cerna and Müller argued that online participatory design workshops need to be designed to work with the "digital ecologies" of older adults—that is, the range of

devices they own, their individual practices and preferences, and the collaborative tools used to support workshop participation.

Expanding this idea, we can see in our findings evidence of a 'program ecology' comprising technological, social, and organizational considerations. *Technological issues* include the devices participants own and their level of comfort and familiarity with using new technologies. In our study, staff actively generated knowledge of the varying technology preferences and digital literacy of older adults, and shaped the use of technology based on their interpretations of this knowledge. This technological context may be mutually shaped by older adults and staff members, and varies between groups. *Social issues* include the interplay between group social norms during program sessions and the use of technology in these sessions. Like Liu et al.'s work on creating enjoyable co-located interactions [47], our study suggests that the spontaneous use of technology promoted some incidental interactions, such as sharing information among co-located program participants, but also negatively affected participants' engagement in certain activities. Lastly, the *organizational context* includes how the social programs are structured by organizations, the physical environment in which the programs operate, and what organizational resources are available for these programs. Much of this varies from organization to organization, and often involves limited financial and human resources for program delivery [73].

HCI researchers argue that designing technology for enjoyable social interactions involves understanding the context in which these interactions occur [47] and the dynamic and heterogeneous nature of the communities to which people belong [37, 59]. Following this, we argue that an understanding of program ecology should be established when designing technology to support older adults in community-based social programs, rather than 'parachuting' technology directly into its use context [53]. Researchers can leverage ethnographic and co-design approaches to generate this knowledge, as program ecologies may vary at the individual, group and organization levels. This reinforces the 'turn to community' design concept [59] by incorporating the dynamic needs of older adults, associated stakeholders, and organizations into design process, helping to promote a more sustainable technological intervention [37]. In addition, by involving researchers, organizations, and older adults throughout the process, such ethnographic study can create a mutual learning space to explore technology usage in the long term, especially when the technology is new to the organizational contexts [58].

5.2 A Three-layered Framework for Designing Future Technology to Create Inclusive Social Program Experiences for Older Adults

Through co-design workshops, we identified three key preferences for technology designs to support older adults in community-based social programs. While participants created some designs that were very futuristic, the values embodied within them reveal participants' views on opportunities for technological interventions. These include the desire to streamline interaction processes to improve communication efficiency, the ability to flexibly interact with technology, and the need to promote the continuity of social contexts embedded in program activities.

Table 5: Framework for designing future technology to create inclusive social program experiences for older adults.

Goals for program delivery	Design opportunities for future technology	Technology should support
Layer 1: Facilitating articulation work for program delivery	Improve communication efficiency between the organization and program participants	Coordination and distribution of program resources Streamlined communication process to enable participants' rapid responses
Layer 2: Fostering social interactions during program sessions	Prompt incidental social interactions embedded in existing activities Create multi-sensory inclusive program experiences	Ad-hoc information sharing in group settings Social prompts with visual and verbal cues Multi-sensory, seamless, and intuitive interaction options
Layer 3: Promoting community-wide involvement and social connections	Promote social connections between participants from different programs Foster community involvement through hybrid communication channels	Asynchronous information sharing among participants Local connection building and event discovery Online participation in community life

However, the current uses of technology observed in social programs demonstrate that supportive efforts are needed at multiple layers to ensure the inclusiveness and participation of older adults in these programs. Given this, we present a three-layered framework for informing the design of future technology to support older adults in community-based social programs, with a focus on leveraging on their design preferences to create inclusive experiences. As shown in Table 5, the framework describes three supportive goals for program delivery, each of which is aligned to different design opportunities.

5.2.1 Layer 1: Facilitating Articulation Work for Program Delivery.

Our study reveals diverse situated uses of technology by staff members to make the programs more inclusive for older adults. Instead of using technology to directly facilitate program sessions, staff used it in a more covert way to support program delivery. As well as using technology when required to support program delivery, staff needed to do a certain type of 'articulation work' in the background. This included the coordination and distribution of curriculum resources, and other activities required to make programs more inclusive for older adults. Articulation work refers to the work that is required to 'make work work' [61, p. 19]. In our study, articulation work was apparent in staff members' efforts to support older adults' participation in social programs, including coordinating program resources and sharing program delivery information. However, while staff in our study achieved this work by using general ICTs based on their knowledge of older adults' technology preferences and digital literacy, our co-design workshops suggest that more efficient communication channels are needed to streamline this process. One possible way to support this articulation work is to augment general ICTs and online digital platforms with customized operations. For instance, body gesture shortcuts [27] could enable streamlined communication between the organization and program participants.

5.2.2 Layer 2: Fostering Social Interactions Embedded in Existing Social Programs.

A second role for technology is to support the social interactions among participants during program sessions. Our study indicates that multiple needs could be addressed by new designs.

First, the participants in our study believed that rather than developing new programs and social activities centred around technology, it would be better to promote the incidental social interactions

embedded in existing programs. Second, as discussed in Section 4.3.2, some participants were excluded from certain small group activities, such as group learning, due to the use of technologies with small screens. Therefore, future technology needs to support small co-located group learning activities during program sessions, especially in digital literacy classes. Moreover, the conversational tabletop game proposed by Yelena indicates another design opportunity to create playful technology to enrich the social interactions among older adults in co-located group settings, especially in social groups.

In this context, we see three possible directions for designing future technology: supporting ad-hoc information sharing among participants in small groups, providing more social prompts with visual and verbal cues during program sessions, and creating multi-sensory, seamless, and intuitive interaction options to ensure the continuity of social interactions in program sessions.

Supporting ad-hoc information sharing in group settings.

First, we argue that collaborative information and screen sharing technology [11, 48, 49] has the potential to expand program inclusiveness by enabling synchronized information sharing and more equitable participation among group members. This is particularly the case for programs that involve group learning and sense-making through diverse personal devices. Screen sharing would enable participants to view the actual problem that others are experiencing. However, such technology needs to be carefully designed and employed to avoid ethical issues such as the invasion of privacy and exposure of personal information. We also believe that such screen sharing technology can be combined with gesture-based interfaces [10, 19] to create more convenient and straightforward information sharing experiences among older adults in co-located group activities. For example, organizations could utilize MyoShare [19], a mid-air gesture-based data sharing system, to support participants to share digital content with others during programs sessions. Using this system, older adults can apply simple mid-air gestures, such as a wave-out and finger-spread, to send pictures to a laptop or broadcast the files to all registered devices in the system.

Promoting social prompts with visual and verbal cues.

Aligning with previous reports on co-located social interactions [47], we observed instances when technology added visual elements to enrich conversations, with program participants sometimes sharing photographs relevant to the conversation taking place. Given

this, we contend that a social prompts generator to foster and encourage incidental social interactions could be valuable during program sessions. A possible way to achieve this is to use digital displays that can prompt conversational topics in public spaces [56]. For example, Memarovic et al. [50] installed a public display, Fun-Square, with self-generated local fun facts and quiz games, in a city market square and a library to cultivate spontaneous interactions among people. Likewise, Gaver et al.'s Photostroller system [24] had a similar intention. While these technologies primarily aimed to facilitate new communications among people, we see potential for their use within social programs due to the rich prompts they can provide and the ease of installation.

Enabling multi-sensory, seamless, and intuitive interaction options to ensure the continuity of social interactions. We also posit that technology could be used to create multi-sensory experiences for supporting playful co-located group interactions during program delivery. Participants expressed an interest in incorporating tangible and voice interfaces to enrich their existing social experiences in group settings. However, these technologies should be easy to learn and manipulate for participants with different levels of digital literacy. This is to ensure that participants will not be excluded from existing social and group activities due to lack of digital literacy or as newcomers.

More importantly, our study suggests that, on some occasions, participants' individual interactions with technology should be visible to other group members, and technology should not distract people from continuing to participate in face-to-face group interactions. This aligns with previous work that people considered technology as undesirable when it disrupts the ongoing socialization in co-located settings [47]. Given this, we believe that rather than designing technology as the focus of activity, technology should be designed and deployed in a seamless and non-intrusive way to support the continuity of social interactions embedded in existing activities.

Technologies with intuitive interaction options could meet these needs. Tumbler [30], an audio player consisting of physical components with simple interaction options (e.g., shaking, rolling, and tumbling) could be a sample design solution in this context. Fish-Pong [75], a tabletop tangible interface that allows people to control a fish-themed video game using coffee mugs, could also promote non-intrusive social opportunities for participants as needed, such as filling in the waiting times when they are excluded from some group activities.

5.2.3 Layer 3: Promoting Community-wide Involvement and Social Connections. In our study, staff strove to help older adults extend their social connections beyond the particular programs that they were involved in, such as Urena's effort to create closed Facebook groups to refer people to other social events. However, we found that some participants were excluded from these social connections due to their personal choices of technology. This suggests a need to design technology to promote additional social connections among program participants, and to increase their involvement in community life.

One approach is to support the inter-program communication among participants through asynchronous information sharing,

combining digital and non-digital means. This could alleviate potential communication barriers in situations where participants cannot share information because they do not use the same platform, or cannot meet in-person during the same program session [73]. Another direction is to enable both in-person and online connection building and event discovery in community settings. For example, organizations could utilize instant messaging-based awareness systems, such as StudioBRIDGE [74], to notify program participants of nearby people, locations, and events of the local community based on their preferences.

6 CONCLUSION

This paper reports findings from a four-month ethnographic study to understand how technology can be designed and used to support older adults in community-based social programs. By observing social program sessions in community settings and interviewing staff members, we found that in order to improve the inclusiveness of social programs, staff used technology in an emergent way to meet the dynamic requirements of program delivery. However, while certain uses of technology by older adults supported some incidental social interactions during program sessions, others negatively affected the dynamics of group activities. Through two rounds of co-design workshops, we identified key preferences for designing future technology to support older adults in community-based social programs. These included streamlining the interaction process to improve communication efficiency, fostering flexible ways for people to interact with the technology, and not disrupting the social environment for program delivery. Building on these, we developed a three-layered framework for informing the design of technology to promote inclusive social program experiences for older adults in the future.

We conclude that a 'program ecology'—comprising the technological, social, and organizational contexts of each program—should be considered when designing technology to support older adults in community-based social programs. We argue that instead of developing technology-centred programs and activities, future technology should be designed and deployed to ensure the continuity of social interactions embedded in existing activities, with an ultimate goal of improving the inclusiveness of community-based social programs for older adults.

REFERENCES

- [1] 2021. Social support in your community. <https://www.agedcareguide.com.au/information/social-support-in-your-community>
- [2] Patricia A Adler and Peter Adler. 1994. Observational techniques. (1994).
- [3] India Anderson and Dhaval Vyas. 2022. Shedding Ageist Perceptions of Making: Creativity in Older Adult Maker Communities. In *Proceedings of the 14th Conference on Creativity and Cognition*. 208–219.
- [4] Urtamo Annele, K Jyväkorpi Satu, and E Strandberg Timo. 2019. Definitions of successful ageing: a brief review of a multidimensional concept. *Acta Bio Medica: Atenei Parmensis* 90, 2 (2019), 359.
- [5] Sato Ashida and Catherine A Heaney. 2008. Differential associations of social support and social connectedness with structural features of social networks and the health status of older adults. *Journal of aging and health* 20, 7 (2008), 872–893.
- [6] James Auger. 2013. Speculative design: crafting the speculation. *Digital Creativity* 24, 1 (2013), 11–35.
- [7] Steven Baker, Ryan M Kelly, Jenny Waycott, Romina Carrasco, Roger Bell, Zaher Joukhadar, Thuong Hoang, Elizabeth Ozanne, and Frank Vetere. 2021. School's Back: Scaffolding Reminiscence in Social Virtual Reality with Older Adults. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW3 (2021), 1–25.

- [8] Steven Baker, Ryan M Kelly, Jenny Waycott, Romina Carrasco, Thuong Hoang, Frances Batchelor, Elizabeth Ozanne, Briony Dow, Jeni Warburton, and Frank Vetere. 2019. Interrogating social virtual reality as a communication medium for older adults. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–24.
- [9] Steven Baker, Jenny Waycott, Romina Carrasco, Ryan M Kelly, Anthony John Jones, Jack Lilley, Briony Dow, Frances Batchelor, Thuong Hoang, and Frank Vetere. 2021. Avatar-mediated communication in social VR: an in-depth exploration of older adult interaction in an emerging communication platform. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. 1–13.
- [10] Jan Bobeth, Susanne Schmehl, Ernst Kruijff, Stephanie Deutsch, and Manfred Tscheligi. 2012. Evaluating performance and acceptance of older adults using freehand gestures for TV menu control. In *Proceedings of the 10th European conference on Interactive tv and video*. 35–44.
- [11] Karolina Buchner, Roman Lissermann, and Lars Erik Holmquist. 2014. Interaction techniques for co-located collaborative TV. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems*. 1819–1824.
- [12] Katerina Cerna and Claudia Müller. 2021. Making online participatory design work: Understanding the digital ecologies of older adults. In *Proceedings of 19th European Conference on Computer-Supported Cooperative Work*. European Society for Socially Embedded Technologies (EUSSET).
- [13] Yi-Ru Regina Chen and Peter J Schulz. 2016. The effect of information communication technology interventions on reducing social isolation in the elderly: a systematic review. *Journal of medical Internet research* 18, 1 (2016), e4596.
- [14] Shruthi Sai Chivukula and Colin M Gray. 2022. What Do I Need to Design for Co-Design? Supporting Co-design as a Designery Practice. *arXiv preprint arXiv:2210.02986* (2022).
- [15] José Coelho and Carlos Duarte. 2016. A literature survey on older adults' use of social network services and social applications. *Computers in Human Behavior* 58 (2016), 187–205.
- [16] Caitlin E Coyle and Elizabeth Dugan. 2012. Social isolation, loneliness and health among older adults. *Journal of aging and health* 24, 8 (2012), 1346–1363.
- [17] Nicole Dalmer, Meridith Griffin, Kaitlin Wynia Baluk, and James Gillett. 2020. Aging in (third) place with public libraries. *Public Libraries* 59, 4 (2020), 22–30.
- [18] Julie Dare, Celia Wilkinson, Ruth Marquis, and Robert J Donovan. 2018. "The people make it fun, the activities we do just make sure we turn up on time." Factors influencing older adults' participation in community-based group programmes in Perth, Western Australia. *Health & Social Care in the Community* 26, 6 (2018), 871–881.
- [19] Linda Di Geronimo, Marica Bertarini, Julia Badertscher, Maria Husmann, and Moira C Norrie. 2017. Exploiting mid-air gestures to share data among devices. In *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services*. 1–11.
- [20] Edd Easton-Hogg. 2013. *An investigation of the associations between social connectedness and internet usage for older adults*. Spalding University.
- [21] Patricia M Eng, Eric B Rimm, Garrett Fitzmaurice, and Ichiro Kawachi. 2002. Social ties and change in social ties in relation to subsequent total and cause-specific mortality and coronary heart disease incidence in men. *American journal of epidemiology* 155, 8 (2002), 700–709.
- [22] Ilker Etikan, Sulaiman Abubakar Musa, Rukayya Sunusi Alkassim, et al. 2016. Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics* 5, 1 (2016), 1–4.
- [23] Sydney Ann Fulbright. 2010. Rates of depression and participation in senior center activities in community-dwelling older persons. *Journal of Psychiatric and Mental Health Nursing* 17, 5 (2010), 385–391.
- [24] William Gaver, Andy Boucher, John Bowers, Mark Blythe, Nadine Jarvis, David Cameron, Tobie Kerridge, Alex Wilkie, Robert Phillips, and Peter Wright. 2011. The photostroller: supporting diverse care home residents in engaging with the world. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1757–1766.
- [25] Alice Good, Omobolanle Omisade, Claire Ancient, and Elisavet Andrikopoulou. 2019. The use of interactive tables in promoting wellbeing in specific user groups. In *Human Aspects of IT for the Aged Population. Social Media, Games and Assistive Environments: 5th International Conference, ITAP 2019, Held as Part of the 21st HCI International Conference, HCII 2019, Orlando, FL, USA, July 26-31, 2019, Proceedings, Part II 21*. Springer, 506–519.
- [26] Australian Government. 2023. Age Pension age is changing on 1 July 2023. <https://www.servicesaustralia.gov.au/age-pension-age-changing-1-july-2023>
- [27] Tiago Guerreiro, Ricardo Gamboa, and Joaquim Jorge. 2008. Mnemonical body shortcuts: improving mobile interaction. In *Proceedings of the 15th European conference on Cognitive ergonomics: the ergonomics of cool interaction*. 1–8.
- [28] Christina N Harrington, Katya Borgos-Rodriguez, and Anne Marie Piper. 2019. Engaging low-income African American older adults in health discussions through community-based design workshops. In *Proceedings of the 2019 chi conference on human factors in computing systems*. 1–15.
- [29] Julianne Holt-Lunstad. 2021. Loneliness and social isolation as risk factors: The power of social connection in prevention. *American Journal of Lifestyle Medicine* 15, 5 (2021), 567–573.
- [30] Maarten Houben, Rens Brankaert, Gail Kenning, Inge Bongers, and Berry Eggen. 2022. Designing for everyday sounds at home with people with dementia and their partners. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. 1–15.
- [31] Adam N Joinson. 2008. Looking at, looking up or keeping up with people? Motives and use of Facebook. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 1027–1036.
- [32] Eun Hwa Jung and S Shyam Sundar. 2016. Senior citizens on Facebook: How do they interact and why? *Computers in Human Behavior* 61 (2016), 27–35.
- [33] Anna Kalma, Bernd Ploderer, Laurianne Sitbon, and Margot Brereton. 2019. Probing Yarns about Ageing and Making. In *Proceedings of the 31st Australian Conference on Human-Computer-Interaction*. 173–183.
- [34] Anna Kalma, Bernd Ploderer, Laurianne Sitbon, and Margot Brereton. 2020. Understanding Older Adult Values through Technologies Used for Crafting. In *Proceedings of the 32nd Australian Conference on Human-Computer Interaction*. 602–613.
- [35] Azmina Karimi and Carman Neustaedter. 2012. From high connectivity to social isolation: communication practices of older adults in the digital age. In *Proceedings of the ACM 2012 conference on Computer supported cooperative work companion*. 127–130.
- [36] Pouria Khosravi, Azadeh Rezvani, and Anna Wiewiora. 2016. The impact of technology on older adults' social isolation. *Computers in Human Behavior* 63 (2016), 594–603.
- [37] Gwen Klerks, Nicolai Brodersen Hansen, Daisy O'Neill, and Ben Schouten. 2020. Designing Community Technology Initiatives: A Literature Review. In *Proceedings of the 32nd Australian Conference on Human-Computer Interaction*. 99–111.
- [38] Tiffany Knearem, Xiyang Wang, and John M Carroll. 2021. Constructing Well-being Together: Older Adults Engagement in Coproduction Through Volunteering. In *Proceedings of the 10th International Conference on Communities & Technologies-Wicked Problems in the Age of Tech*. 169–178.
- [39] Amanda Lazar, Alisha Pradhan, Ben Jelen, Katie A. Siek, and Alex Leitch. 2021. Studying the formation of an older adult-led makerspace. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. 1–11.
- [40] Jonathan Lazar, Jinjuan Heidi Feng, and Harry Hochheiser. 2017. *Research methods in human-computer interaction*. Morgan Kaufmann.
- [41] Young S Lee, Shirley Chaysinh, Santosh Basapur, Crysta J Metcalf, and Hiren Mandalia. 2012. Active aging in community centers and ICT design implications. In *Proceedings of the Designing Interactive Systems Conference*. 156–165.
- [42] Noah Lenstra, Fatih Oguz, Christine D'Arpa, and Lindsey S Wilson. 2022. Exercising at the Library: Small and rural public libraries in the lives of older adults. *The Library Quarterly* 92, 1 (2022), 5–23.
- [43] Noah Lenstra, Fatih Oguz, Joseph Winberry, and Lindsey S Wilson. 2021. Supporting social connectedness of older adults during the COVID-19 pandemic: the role of small and rural public libraries. *Public Library Quarterly* (2021), 1–21.
- [44] Anna Liaquat, Benett Axtell, and Cosmin Munteanu. 2022. "With a hint she will remember": Collaborative Storytelling and Culture Sharing between Immigrant Grandparents and Grandchildren Via Magic Thing Designs. *Proceedings of the ACM on Human-Computer Interaction* 6, CSCW2 (2022), 1–37.
- [45] Siân E Lindley. 2012. Shades of lightweight: supporting cross-generational communication through home messaging. *Universal Access in the Information Society* 11 (2012), 31–43.
- [46] Gabrielle Lindsay-Smith, Grant O'Sullivan, Rochelle Eime, Jack Harvey, and Jannique GZ van Uffelen. 2018. A mixed methods case study exploring the impact of membership of a multi-activity, multicentre community group on social wellbeing of older adults. *BMC geriatrics* 18, 1 (2018), 1–14.
- [47] Szu-Yu Liu, Brian A Smith, Rajan Vaish, and Andrés Monroy-Hernández. 2022. Understanding the role of context in creating enjoyable co-located interactions. *Proceedings of the ACM on Human-Computer Interaction* 6, CSCW1 (2022), 1–26.
- [48] Andrés Lucero, Jussi Holopainen, and Tero Jokela. 2012. MobicComics: collaborative use of mobile phones and large displays for public expression. In *Proceedings of the 14th international conference on Human-computer interaction with mobile devices and services*. 383–392.
- [49] Mark McGill, John Williamson, and Stephen A Brewster. 2014. Mirror, mirror, on the wall: collaborative screen-mirroring for small groups. In *Proceedings of the ACM International Conference on Interactive Experiences for TV and Online Video*. 87–94.
- [50] Nemanja Memarovic, Marc Langheinrich, Florian Alt, Ivan Elhart, Simo Hosio, and Elisa Rubegni. 2012. Using public displays to stimulate passive engagement, active engagement, and discovery in public spaces. In *Proceedings of the 4th Media Architecture Biennale Conference: Participation*. 55–64.
- [51] Sharan B Merriam and Elizabeth J Tisdell. 2015. *Qualitative research: A guide to design and implementation*. John Wiley & Sons.
- [52] Yvonne L Michael, Lisa F Berkman, Graham A Colditz, and Ichiro Kawachi. 2001. Living arrangements, social integration, and change in functional health status. *American journal of epidemiology* 153, 2 (2001), 123–131.
- [53] Claudia Müller, Cornelius Neufeldt, David Randall, and Volker Wulf. 2012. ICT-development in residential care settings: sensitizing design to the life circumstances of the residents of a care home. In *Proceedings of the SIGCHI Conference*

- on *Human Factors in Computing Systems*. 2639–2648.
- [54] Nicholas R Nicholson. 2012. A review of social isolation: an important but underassessed condition in older adults. *The journal of primary prevention* 33, 2 (2012), 137–152.
- [55] Australian Bureau of Statistics. 2021. 2021 Census All persons QuickStats. <https://www.abs.gov.au/census>
- [56] Thomas Olsson, Pradthana Jarusriboonchai, Paweł Woźniak, Susanna Paasoara, Kaisa Väänänen, and Andrés Lucero. 2020. Technologies for enhancing collocated social interaction: review of design solutions and approaches. *Computer Supported Cooperative Work (CSCW)* 29 (2020), 29–83.
- [57] Hannah M O'Rourke and Souraya Sidani. 2017. Definition, determinants, and outcomes of social connectedness for older adults: a scoping review. *Journal of Gerontological Nursing* 43, 7 (2017), 43–52.
- [58] Richard Paluch and Claudia Müller. 2022. "That's Something for Children" An Ethnographic Study of Attitudes and Practices of Care Attendants and Nursing Home Residents Towards Robotic Pets. *Proceedings of the ACM on Human-Computer Interaction* 6, GROUP (2022), 1–35.
- [59] Valeria Righi, Sergio Sayago, and Josep Bort. 2017. When we talk about older people in HCI, who are we talking about? Towards a 'turn to community' in the design of technologies for a growing ageing population. *International Journal of Human-Computer Studies* 108 (2017), 15–31.
- [60] Yvonne Rogers and Gary Marsden. 2013. Does he take sugar? Moving beyond the rhetoric of compassion. *interactions* 20, 4 (2013), 48–57.
- [61] Kjeld Schmidt. 2011. Remarks on the complexity of cooperative work (2002). *Cooperative Work and Coordinative Practices: Contributions to the Conceptual Foundations of Computer-Supported Cooperative Work (CSCW)* (2011), 167–199.
- [62] Frances Sin, Sophie Berger, Ig-Jae Kim, and Dongwook Yoon. 2021. Digital social interaction in older adults during the COVID-19 pandemic. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW2 (2021), 1–20.
- [63] Ceara Somerville, Caitlin Coyle, and Jan Mutchler. 2020. Responding to COVID-19: How Massachusetts Senior Centers Are Adapting. (2020).
- [64] Andrew Steptoe, Aparna Shankar, Panayotes Demakakos, and Jane Wardle. 2013. Social isolation, loneliness, and all-cause mortality in older men and women. *Proceedings of the National Academy of Sciences* 110, 15 (2013), 5797–5801.
- [65] Anselm Strauss and Juliet Corbin. 1990. *Basics of qualitative research*. Sage publications.
- [66] Panagiota Tragantzopoulou and Vaitsa Giannouli. 2021. Social isolation and loneliness in old age: Exploring their role in mental and physical health. *Psychiatriki* 32, 1 (2021), 59–66.
- [67] Christina Victor, Sasha Scambler, and John Bond. 2008. *The social world of older people: Understanding loneliness and social isolation in later life: Understanding loneliness and social isolation in later life*. McGraw-Hill Education (UK).
- [68] Torben Wallbaum, Andrii Matvienko, Swamy Ananthanarayan, Thomas Olsson, Wilko Heuten, and Susanne CJ Boll. 2018. Supporting communication between grandparents and grandchildren through tangible storytelling systems. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–12.
- [69] Jenny Waycott, Frank Vetere, and Elizabeth Ozanne. 2019. Building social connections: a framework for enriching older adults' social connectedness through information and communication technologies. *Ageing and digital technology: Designing and evaluating emerging technologies for older adults* (2019), 65–82.
- [70] Jenny Waycott, Frank Vetere, Sonja Pedell, Lars Kulik, Elizabeth Ozanne, Alan Gruner, and John Downs. 2013. Older adults as digital content producers. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 39–48.
- [71] Bei Wu. 2020. Social isolation and loneliness among older adults in the context of COVID-19: a global challenge. *Global health research and policy* 5, 1 (2020), 1–3.
- [72] Anna Xambó, Eva Hornecker, Paul Marshall, Sergi Jordà, Chris Dobbyn, and Robin Laney. 2013. Let's jam the reactable: Peer learning during musical improvisation with a tabletop tangible interface. *ACM Transactions on Computer-Human Interaction (TOCHI)* 20, 6 (2013), 1–34.
- [73] Yushan Xing, Ryan M Kelly, Melissa J Rogerson, and Jenny Waycott. 2023. "Keeping the Program Going": Technology Use by Community Organizations to Support the Social Connectedness of Older Adults During the COVID-19 Pandemic. *Proceedings of the ACM on Human-Computer Interaction* 7, CSCW2 (2023), 1–26.
- [74] Susan Yee and Kat S Park. 2005. StudioBRIDGE: using group, location, and event information to bridge online and offline encounters for co-located learning groups. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. 551–560.
- [75] Jennifer Yoon, Jun Oishi, Jason Nawyn, Kazue Kobayashi, and Neeti Gupta. 2004. FishPong: Encouraging human-to-human interaction in informal social environments. In *Proceedings of the 2004 ACM conference on Computer supported cooperative work*. 374–377.
- [76] Ye Yuan and Svetlana Yarosh. 2019. Beyond tutoring: Opportunities for inter-generational mentorship at a community level. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. 1–14.
- [77] Wei Zhao, Ryan M Kelly, Melissa J Rogerson, and Jenny Waycott. 2022. Understanding Older Adults' Participation in Online Social Activities: Lessons from the COVID-19 Pandemic. *Proceedings of the ACM on Human-Computer Interaction* 6, CSCW2 (2022), 1–26.
- [78] Wei Zhao, Ryan M Kelly, Melissa J Rogerson, and Jenny Waycott. 2023. Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of Self-Determination Theory. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–17.
- [79] Wei Zhao, Ryan M Kelly, Melissa J Rogerson, and Jenny Waycott. 2024. Older Adults Imagining Future Technologies in Participatory Design Workshops: Supporting Continuity in the Pursuit of Meaningful Activities. *arXiv preprint arXiv:2401.11628* (2024).

A APPENDICES

A.1 Co-design Workshop II Scenarios

A.1.1 Scenario 1: Group learning in digital literacy classes. You are taking a digital literacy class at Connecting Well to explore the use of iPhone. Your classmate is discussing with the teacher about an issue he is having - how to send a secret copy of an email to himself. You hear about this problem and want to join the discussion. However, it can be very difficult to keep up with the discussion when a group of people are looking at the small screen that is held by others. What kind of technology could you design to solve this problem and help everyone be involved?

A.1.2 Scenario 2: Invite a friend to join a bus trip over a distance. You are now on a bus trip to Sovereign Hill, an open-air museum in Golden Point, a suburb of Ballarat, Victoria, Australia. You really like the historical architecture and atmosphere here, and want to involve Mary, your best friend who couldn't come today due to family commitment, to join over distance. What kinds of technology design ideas can you come up with to achieve this?

A.1.3 Scenario 3: Share a video with others in a morning tea session. You are attending a morning tea session at Connecting Well. Today, people are talking about their travel experiences, and you show everyone the videos you stored in your smartphone album of the vintage cars that you encountered in UK. Another participant, George, really likes this video and wants you to share them with him. However, he doesn't have a smartphone, and he does not like to use social media platforms. In this case, what kinds of technology design ideas can you think of to make this sharing experience easier for George and others in the morning tea session?

A.1.4 Scenario 4: Communicate time-sensitive program delivery information with older adult program participants. You do some volunteer work at Connecting Well and manage events registration. You've just been told that there have been some last-minute changes of today's activities, and you need to notify people about it. You have tried emailing, calling, and sending messages to participants, but it is difficult to know if the information was being conveyed successfully to people. Could you come up with some technology design ideas to help you better communicate information to people so that you know their timely responses?

A.1.5 Scenario 5: Participate in a Community Choir from a distance. You really enjoy participating in Community Choir at Connecting Well and singing with this lovely group. However, you have recently needed to move out of the neighbourhood to some place far away from Connecting Well. What kind of technology could you design

to help you continue participating in the Community Choir at Connecting Well from a distance?

A.1.6 Scenario 6: Retain and practise learnt digital skills. You joined technology classes at Connecting Well recently, and have learnt

many digital skills. However, as the class progresses, it becomes hard to retain the learnt knowledge. Could you design some technologies to help you retain and practise these digital skills?