# Understanding Confidence of Older Adults for Embracing Mobile Technologies

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Confidence helps sustain people to use their mobile technology devices in daily life. However, there is little research that discusses how to build confidence among older adult users either when starting to use technology or broadening their existing technology use. To understand older adults' confidence in technology use, we conducted an exploratory study over six months with ten participants in a residential care setting. We investigated the relationship between confidence, experience, and personal interests to use technology in their embracing of technology. Our findings show that confidence can be gained from positive experiences of use and that confidence helps with subsequent technology engagement. Positive experiences encourage further and broader experimentation with their own devices. Activities using technology to support personal interests provide great motivation for participants to expand the use of their mobile technology devices. We provide insights on a facilitation process that is based on open exploration and mutual learning to build confidence of users in residential care settings.

## 1 INTRODUCTION

The concept of confidence has been widely acknowledged as a relevant factor that influences how people use technologies. For older adults, confidence is usually related to knowledge about technologies [22], defined and measured as self-efficacy [20, 36] or is assumed as an overall quality that is commonly not further detailed [41]. Our motivation is to provide more holistic insights into the factors that influence the confidence of older adults in technology use. This perspective focuses on the emotions that are related to learning about technologies, and ultimately on understanding how to build the confidence of older adults in technology use.

This study aims to explore the confidence of older adults in technology use, to understand the factors that influence confidence, and to get insights into how to build the confidence of older adults. To address these aims, we worked with older adults in residential care settings in Melbourne. We made weekly visits to collaborating aged care provider during six months and worked in group or individual settings with lifestyle staff members. Our participants included residents

of a nursing home, residents of assisted living apartments, and residents of a retirement village. Their motivations to join the sessions we conducted were diverse: some wanted to learn how to use technologies in their everyday lives, and others just wanted to have some fun during a group activity on offer. Following a Participatory Action Research approach [13], we assessed the situation each week and planned the activities or technologies that we would use in our next visit. Thus, instead of having an established structure for technology training, we used the sessions for exploring technologies together and learning about the interests of our participants in the process. We collected data through audio recordings, written observations, wrote memos after each visit, and conducted debriefing sessions [34] to reflect on the fieldwork.

Our findings show that confidence is influenced by the quality of the experiences that older adults have with technologies. While we observed that fun experiences for learning and careful facilitation contributed to their confidence, negative experiences such as not being able to solve an issue, not getting support for a period of time, or a lack of opportunities for reinforcement made older adults feel less confident. Personal interests also have a positive influence in confidence: older adults found more relevance in using technologies that related to their interests, and were able to learn to use devices and apps that were more closely related to tasks and skills they were familiar with. We also found that there were factors that contributed to a favourable setting for supporting the building of confidence: (1) there were differences when working in group activities or in individual sessions, (2) facilitation had to be patient, person-centred and with a willingness to reinforce, (3) older adults needed opportunities to try using technologies by themselves and go through the steps, (4) it was important to create a flexible plan that supported the interests of the older adults, and (5) a safe and positive environment for having pleasurable experiences with technologies needed to be provided.

We discuss that confidence is a complex concept that relates to multiple emotions, and that it can dynamically increase or decrease depending on the quality of the experiences with technologies that older adults have. We argue that the facilitation of activities with older adults to learn about technologies needs to be clear, patient and step-wise to contribute to building their confidence in technology use. This paper makes contributions to Human-Computer Interaction (HCI) in three ways. Firstly, we provide insights for participatory processes with older adults that can lead to technology choices that better fit with their emotional goals and personal interests. Secondly, our exploration of confidence of older adults presents an iterative process that allows co-exploration of digital technologies and co-production of digital materials with older adults. Finally, our research contributes to the growing body of literature that advocates against ageism and that shows that older adults are willing and capable to learn about and contribute through technologies.

## 2 RELATED WORK

### 2.1 Older Adults' Confidence in Technology Use

Previous research reveals that confidence of older adults in the use of technology is related to the emotions that they feel when using technologies [23, 27]. Some works define and measure confidence of technology use as self-efficacy, i.e. the user's belief in their capacity to use technologies and will achieve a positive outcome with it [20, 32, 36]. Confidence has been associated with the older adult users' knowledge and perceptions of technology [28], and these factors influence the decision of older adults to use a specific technology or not [36]. Furthermore, older adults' confidence in technology influences how they face difficulties encountered in technology use [36]. People with lower confidence in technology use feel more anxious when interacting with new devices, which adds extra difficulties for them to overcome issues encountered during the use [8, 19]. In this way, a lower confidence in technology use adds barriers to older adults to perceive the benefits of technology use [25].

From a psychological perspective, confidence is defined as a personality trait [32]. The confidence in technology use, which is mainly discussed in our study, is classified as a type of specific self-confidence, understood as the self-confidence in the ability to perform a specific task (versus general self-confidence, defined as the self-perception of capability and worthiness as an individual) [31, 39]. Specific self-confidence can be obtained from performing tasks and increased by training [14, 15]. Multidisciplinary research works have explored how to improve and measure students' confidence from an educational perspective [21, 40], and they stated that confidence is associated with increases in both learning responsibility and achievements. However, less research has focused on building older adults' confidence in learning and using technology. Therefore, there is scope for further discussion about the factors for building older adults' confidence in technology use.

## 2.2 Designing Technology for Older Adults

Multiple studies on HCI and technology design for older adults have focused on accessibility and usability [7, 9, 16, 19, 25, 36, 42]. However, this focus on the limitations caused by age can overlook what older adults would like to do with technologies, and how designing for the needs of older adults can enrich their life [17]. For instance, Lazar et al. [18] investigated a commercially available virtual pet system with older adults living independently. The system was designed for tablet devices and provided company and entertainment. The voice interaction was controlled by a teleoperator who spoke through the tablet and could hear and see the older adult. However, once the participants found out that a person was performing the interactions at the other side, they started rejecting the pet-like interactions and did not want to be treated like children. Moreover, participants wanted to build an equal relationship with the operators but they would often not reveal personal information to them. The childlike conversation and imbalanced relationship that appeared in the system led to a mismatch of the purpose of the design and the end-users actual use. Eventually, the majority of participants became uninterested to continue with the study. This example shows that, rather than desiring technologies for accessibility, older adults seek for their interests and motivations to be enriched by technologies in their everyday lives [4, 10].

Older adults are a demographic group with diverse life experience and knowledge [7, 9, 11]. They want to be treated as equal to other age groups instead of being considered as a vulnerable and fragile group in need of special care. There is a growing body of literature exploring perspectives that align design and the older adults' interests. Toolkits with electronic models and different sensors were used as technology interventions to understand older adults use experience for future technology design, such as the IoT Un-kit [3] and MakeyMakey [30]. Despite the different context of these two studies, the flexibility of the toolkits offered older adults freedom to explore meaningful use by themselves. These projects illustrated that older adults are not passive when facing new technologies, that they have the capability to use technologies with their own experience and knowledge, and that they can adapt usage to their personal situations.

## 2.3 Supporting Older Adults to Learn to Use Technology

Several studies have explored how to deliver appropriate training activities to support older adults to use technology [1, 2, 5, 8, 19, 38]. Goal-oriented training (the training based on tasks) is more effective than a standard training approach [1]: older adults become more conscious of their mistakes and can adapt their behaviour according to the expected goals. In relation to the setting of the supporting activities, individual assistance has been found to be more efficient than group activities for learning as the competition between group members can cause anxiety and frustration to some participants [2]. Lee and Coughlin [19] provide a different perspective on group settings: they found that older adults rely on peers in the group to validate their behaviour and that a champion in the group can demonstrate to others what

can be achieved through technology use. The champion can also provide help to others for overcoming barriers and failures in the adoption process [38]. Hence it seems that the relevant factor is not whether there is a group setting or not, but how the groups are set up and function. This is an aspect we explore in our research. Furthermore, the language used has a substantial influence on older adults' confidence in using technology [8]. Jargon and technical terms used in activities hinder the adoption process but can easily be overlooked by designers and researchers [25]. Language should be straightforward when a technology concept is communicated to older adults [25, 37]. In this study, we considered language and activity setting as aspects in our work and also explored other factors related to facilitating older adults to build confidence in using technology.

### 2.4 Summary

In this section, we have identified that it is unclear what factors influence the building of confidence of older adults in technology use, that older adults can be active users of technologies, and that the setting of the sessions can influence the motivation and interest of older adults to learn about technology. By focusing on older adults living in residential care settings, and following the participants' needs and interests, this six month study was designed with flexible sessions rather than through formal training sessions or workshops. Our iterative plan created opportunities to collaborate with older adults, get participants' feedback and provide room for self-reflection to improve the plan. The next section details the research aims and research design of this project.

## 3 METHODOLOGY

This paper presents an exploratory study about older adults' confidence in technology use in residential care settings. It aims to 1) understand how to build confidence of older adults in technology use; 2) explore factors that influence technology confidence through an HCI lens; and 3) provide insights into how to build older adults' confidence within a residential care setting.

The study applied a Participatory Action Research approach [13] as it offers a flexible and reflective research process. In this study we collaborated with residents and staff from a residential care provider based in Melbourne. Participants and research activities are detailed in the following subsections.

### 3.1 Participants

As this study aims to understand technology use of older adults and helping them gain confidence in technology use in residential care settings, we sought to include a diverse range of participants at various levels of technology use. Age and health status have not not been included in the criteria for recruiting participants. Some lifestyle staff are also involved in the research. They helped us to acquire a thorough understanding of the residents, and also played an important role for organising and facilitating the group activities.

A total of 10 residents (see Table 1) and two lifestyle staff members have been involved in our study, including residents from the nursing home, residents of assisted living apartments, and residents of the retirement village - all life settings offered by the one provider.

Irma, Walter, Therese and Ryan are residents living in the nursing home and usually participate in the "Learn about technology" group activity (detailed in the following section). Irma does not have any mobile technology. Walter has an old smartphone which he does not use. Therese and Ryan are married, and usually just join the group activity when they have specific questions to ask about their devices. Therese has an iPad and iPhone, but she only uses her iPad

often for listening to music from YouTube, and she uses Facebook and Messenger to connect with her family. Ryan uses a laptop for banking, sending emails and taking notes in Microsoft Word. He also looks up information that is of interest to him on Google, such as chess openings and classic chess games.

Bobby and Wendy live in the assisted living apartments and they also participate in the "Learn about technology" activity. Bobby has a smartphone and he uses it to make phone calls, send messages and take photos. He also has a laptop and a desktop computer, and he is a skilled user of these two devices. He usually brings his laptop to the group activity. Wendy uses an iPad that was provided to her by the church at the beginning of the COVID-19 pandemic. She uses it mostly for watching the church services on YouTube. Her son bought her a new Smart TV, but she has had issues to connect the TV to the Internet.

Alice, Catrin, Mary and Hannah live in the retirement village. They participate in the "Telling our story" sessions (detailed in next section). All of them use a smartphone in their everyday life. Alice is tech-savvy and a fast learner, she has an iPhone, a MacBook and also bought an iPad after the start of the group activity. Catrin uses a smartphone and a tablet, she is curious about technology and willing to learn new things. Besides her smartphone, Mary also uses an iPad and a laptop. She is interested in taking photos and editing them. Hannah is a new user of an iPhone and she has struggled with it, she wants to learn to use it for making phone calls, sending messages and searching for information.

| Living Unit | Resident | Devices | Most used features | Activity |
|---|---|---|---|---|
| Nursing Home | Irma | - | - | Learn about technology |
| | Walter | An old smartphone | - | |
| | Therese | iPhone and iPad | YouTube, Facebook and Messenger | |
| | Ryan | Laptop | Banking, email and Word | |
| Assisted living apartments | Bobby | Smartphone, PC and laptop | skilled user of PC and laptop | Learn about technology |
| | Wendy | iPad and Smart TV | YouTube | |
| Retirement village | Alice | iPhone, iPad, Macbook | skilled user | Telling our story |
| | Catrin | Smartphone, Samsung tablet | Basic use | |
| | Mary | iPhone, iPad and laptop | Basic use | |
| | Hannah | iPhone | phone call and messages | |

Table 1. Overview of participants

## 3.2 Group Activities and Individual Activities

Residents living in different units participate in different activities. In this section, we describe each of the activities where we interacted with the participants.

1) The "Learn about Technology" sessions were offered to the residents of the assisted living apartments and the nursing home. This group activity was conducted by Maggie, a lifestyle staff member of the residential nursing home. We helped Maggie facilitate these sessions and sometimes we proposed activities and technologies to show to the

participants. During the sessions, every participant was provided with a tablet to follow our suggested activities or to explore by themselves.

Maggie based the sessions on her experience of technology use in daily life. Instead of having a learning agenda she offered topics of interests and discussion, Maggie introduced devices, websites, software and applications to participants in this activity. She aimed to match familiar and common everyday activities of interest to residents that can be supported by technology applications. Therefore, she constantly prepared new materials for the residents to spark their curiosity and generate discussions in the sessions, such as the spreadsheet shown in Figure 1. One example of a technology shown in the sessions is a website that tracked information about buses to help her plan her trip: Maggie showed how she used it to get from her home to the care provider, and she showed the live information of the buses nearby.

| Topic | Apps, Websites |
|---|---|
| Art & Culture | Virtual Museums, e.g. British Museum |
| (Video) Calls | WhatsApp, Messenger, Telegram, Skype, Zoom |
| Audiobooks | Audible |
| Directions | Google Maps |
| Do it yourself/Instructions | Youtube, Blogs |
| General Research | Search Engines (Googles, Ecosia, etc.) |
| Languages | Duolingo, etc. |
| Messaging | E-Mails, WhatsApp, Messenger, Telegram |
| Movies & Series | Youtube, Netflix, Prime Video, etc. |
| Weather | Google, Bom |
| Writing | Words, ... |
| ... | |

Fig. 1. Apps and Websites for the "Learn about Technology" activity created by Maggie

2) "Telling our story" is a long-term program conducted weekly that was planned in collaboration between the research team and the residents from the retirement village. Our intention was to create a group activity that helped participants to learn about technologies and to create meaningful content in the process. At the beginning of the activity session, we discussed with our participants about what they wanted to do in this group activity. Some of the group members mentioned that during a COVID-19 lockdown period in Melbourne, they shared life stories with other residents through Zoom meetings, and that it helped them connect with others during those difficult times. Inspired by this experience and as they looked forward to having a shared project, we started the storytelling program through the use of technology. Similarly to Maggie in the "Learn about technology" sessions, we attempted to link the individual interests of participants in storytelling with technology learning, while focusing on creating a digital design outcome. We asked the participants to share short, meaningful and memorable small snippets of their life that were significant to them. Each week we discussed the individual progress and we helped them learn the technology through actual use and how to create digital content for their stories.

At the start of the program, we discussed with participants which features they were interested to learn, which story they wanted to tell, and with whom they wanted to share the story. We then introduced them to different apps based on their interests. If the introduced app matched their interests and needs, we facilitated them to use it and apply to their stories. For instance, we introduced a digital painting tool to them as some participants wanted to draw pictures or alter a photo to create a specific visual or scene for their stories.

3) Some residents were visited in their personal living space which provided them with a safe place to talk about their own technology experiences and needs. Every two weeks, Maggie organised individual visits by request. As some residents have difficulties with their own devices, such as a Smart TV, tablet, a computer or a smartphone, the individual visits allowed us to access all of their devices to provide help. We were able to explain in some detail about how to fix issues with their devices and we provided instructions to them if needed.

### 3.3   Study Procedure

We planned weekly regular visits to the residential care provider, unless we can not access one of the setting due to COVID restriction. The findings presented in this study are based on data collected for six months. The "Learn about Technology" session and individual visits were conducted fortnightly in an alternating manner, and the "Telling our story" session was conducted every week. The duration of the group sessions was between 60 and 90 minutes, and individual visits were generally for about 30 minutes. There were regular participants for each session, but the number of participants varied. During the lockdown caused by COVID-19, the first two weeks' activities were conducted online. There was always a staff member to initiate and maintain communication, and to mediate our interactions with residents. In total, during the six months we conducted seven "Learn about Technology" sessions, thirteen "Telling our story" sessions and eleven individual visits.

Our research has been approved by the Swinburne University Human Research Ethics Committee (Ref: 20216077-8657). Participating residents and staff members signed a consent form. Pseudonyms have been used throughout this paper.

### 3.4   Data Collection and Analysis

During the regular visits, the following data was collected: 1) we recorded audio for each activity; 2) since it was often hard to write notes about observations, we conducted debrief meetings after each visit as suggested by Taylor et al. [34]; and 3) photographic documentation.

After each visit, memos were written to catch researchers' initial thoughts and organise ideas. Writing memos is an intermediate step between data collection and data analysis [6]. For instance, after one "Learn about Technology" session, the first author reflected on the experience of facilitating the use of Microsoft Word to Ryan (more detail in 4.2.3) in the memo-writing. This memo brings up the relationship between a positive experience and building confidence, and how to provide proper facilitation to older adults when learning to use technology.

We continued analysing the data by focusing on residents' experience of technology use and their emotions revealed in the use. The first two authors selected the most relevant sessions to get full transcriptions, and the first author listened to the audio recordings and selected relevant excerpts for transcription. We coded the transcriptions, the memos and the debrief session using the methods of initial coding and focused coding as described by Charmaz [6] to generate themes.

After that, we applied Motivational Modelling to understand diverse goals of participants about how they want to use technology in daily life [33]. Similarly to Muñoz et al. [24], we used Motivational Modelling to organise the data in functional goals, quality goals and emotional goals that would be represented in a Motivational Model. We built our Motivational Model based on two main sources of data: firstly, we explicitly asked participants as part of the sessions about what they wanted the sessions to do, how they wanted them to be, and what they wanted to feel when participating in them using technology. Secondly, we refined the goals in the model based on the analysis of the memos, debrief sessions, observations and interviews we conducted. With this procedure, our Motivational Model

would represent the functional goals that participants wanted to achieve from technology use, how these functional goals should be achieved, and their feelings related to use.

## 4 FINDINGS

In this section, we present our findings from two perspectives: firstly, we present the factors that related to older adults' confidence in technology use, and then we detail how we provided suitable support to build confidence in technology use.

### 4.1 Factors for Building Older Adults' Confidence in Technology Use

*4.1.1 Having a Positive Experience when Learning about Technology.* Our findings show that the experiences of participants with technologies impacted their confidence in technology. With positive experiences, participants became more confident and spontaneously looked for strategies when facing difficulties. However, we observed that residents who were frustrated with technology felt more stressed and anxious when interacting with their devices. Frustrating experiences not only could make participants lose confidence to use technology, but also lead them to abandon the use of it. We illustrate our findings with examples of positive and negative experiences from our fieldwork.

Many participants reported that they had new laptops or smartphones for even more than a year and did not use them. Some of them started to bring these devices to the group activities after several sessions. Walter regularly attended the "Learn about Technology" session and he started to use the tablet for diverse things, such as searching for information in Google, using Google Maps, and playing Kahoot. During an individual session, he told us that a resident gave him a smartphone and asked us to help him make it work because he wanted to try it in his own time. Over time, we showed him how to take photos and add stickers to the photos. After not seeing Walter for a while due to COVID-19 restrictions in the nursing home, Walter mentioned he had been playing with the phone trying to take photos as we showed him; lifestyle staff member Maggie was surprised and completely unaware that Walter was still trying to use the device on his own.



Fig. 2. Irma's taught Walter use Sketchbook

Before Easter, we organised a digital painting activity for the "Learn about technology" session: we prepared one bunny and one Easter egg outline on the iPad and Android tablets using *Sketchbook*, a digital painting app, for participants to add coloured decorations. Irma was delighted by the painting activity. Besides painting in the templates provided, she created a new canvas to draw with our assistance (see Figure 3).

Two months after this session, she still remembered how to use Sketchbook even though we did not use it again with this group, and she was able to teach another resident how to use it. During a session, Walter opened Sketchbook by mistake and did not know what it was, and Irma was sitting next to him. She started to share her experiences from the Easter drawing session and taught Walter how to draw and paint step by step (see Figure 2). Walter became curious about the app and wanted to keep drawing on it instead of following the activities that the rest of the group were doing during that session.



Fig. 3. Irma's work using Sketchbook in the Easter painting event

We have also observed some negative experiences with technologies. During an individual visit, Wendy asked us to help her with the internet connectivity of her new Smart TV. Her son had recently bought her a Smart TV so that she could watch the church service livestreams comfortably in the living room instead of watching it on the iPad. He configured the TV to connect to the WiFi provided by the care facility. However, the WiFi signal was poor at her place and streaming was not possible, so we tried to use her iPad as a hotspot for the TV. We wrote down instructions for her to set up the connection again if needed (see Figure 4), and went through the steps with her. However, when we followed up after a few weeks, she told us she gave up as the process was too complicated for her. Eventually, she decided not to use the Smart TV for that purpose.

In addition, we found that experiences in how to deal with issues encountered in technology use also have great impact on the participants' confidence. Some participants doubted their technology skills when they could not overcome difficulties, even if the issue was caused by a system bug and not by them not using the devices correctly. On the other hand, if they figured out how to address the issue, their confidence could be built up. Catrin commented that "if something works, it's actually a boost to your self-esteem, (it) makes my day if I managed to do something after a long time." Learning from others is another positive factor for them to build confidence in technology. After Alice taught Hannah how to make and get a phone call, she said "Now I know how to make a phone call, that really makes me confident".
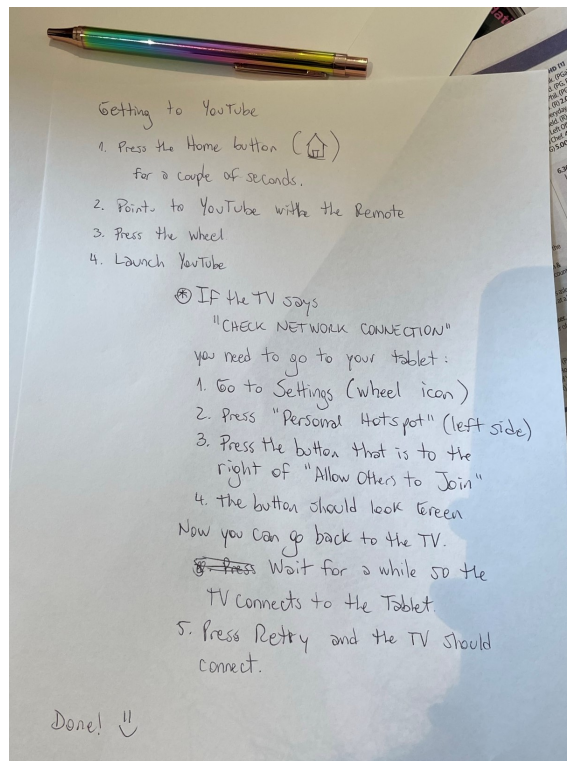
Fig. 4. Note for Wendy: How to connect her Smart TV to the Internet by using the iPad as a hotspot

*4.1.2 Interests as a Pathway to Build Confidence.* During the sessions, when our participants found that technology could support their interests they felt empowered to learn new features. They also reacted more positively when facing difficulties during the use. In this section we show examples of participants combining technology use with their interests. Catrin discovered during the group activities that she could use an iPad to paint, and Bobby learned to use Excel to organise information and to save records of his bird-watching trips - one of his passions.

In the "Telling our story" sessions, we attempted to link individual interests with technology use in their storytelling. Catrin wanted to tell a story from her childhood, and she wanted to include some drawings as there were no available photos for the experiences she had lived through during the War. The initial plan was that one member of the team who is good at digital painting would draw that image for her story. However, two of the participants expressed a strong interest in having an active role in every step of the production of digital materials for the stories, and not to be passive recipients of the work done by the research group. We then decided to introduce a digital painting application (*Procreate*) for the iPad to Catrin. She told us then that she had painting experience which she had never mentioned before. She learned to use some features of the app quickly and got her first digital work in 20 minutes (Figure 5). She was so delighted about her work and wanted to have a similar application on her Android tablet for practising in her own time. Since that particular session, and after testing apps that were compatible with everyone's devices, we decided to use *Sketchbook* to create digital art with our participants. After months using this app, both with us during the sessions and by herself at home, Catrin told us "you have brought such joy to my life".

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Fig. 5. Catrin's first digital painting using Sketchbook

As facilitators of the sessions, we initially hesitated to introduce digital painting tools to Catrin because we were worried that the complexity of the app would bring her confidence down. Interestingly, we observed that when we introduced the tool to Catrin, she was braver than we thought in exploring the tool, which was motivated by her interest in watercolour. Inspired by Catrin, other participants followed her example to explore the use of Sketchbook by themselves (Mary added a photo on top of a photo, Alice started creating a collage), and some even asked their families for help to discover new things in the app (Catrin's grandchild taught her about a feature that she later taught to the first author).

Bobby, who lives in an assisted living apartment, was an avid bird watcher who went to several locations in Australia and kept record of the birds he watched. He learned to use a desktop computer about twenty years ago because he wanted to organise his records. He learned to use Microsoft Excel and is now a skilled user.

> I'm largely self-taught. What I've picked up [computer], I did a course I think on Microsoft Word. I never really got on top of values, set things out and all this sort of stuff, but sometimes I must have gotten involved with Excel. And that's really where most of my early, my computer stuff started because I started putting my bird lists and things on the Excel. So I'm reasonably good with Excel, I can do limited sort of [things], I've been doing it for quite a number of years.

He started going to computer classes without even having a computer, which in his own words was "useless" so he later bought one to start trying it by himself. He persevered when trying by himself, and eventually mastered using Excel for keeping records of his bird watching as shown in Figure 6. Now he also uses Excel to sort his annual budget.

Both examples of Catrin and Bobby's technology learning experience showed how interests acted as a pathway to empower older adults to develop confidence in technology use.

Fig. 6. Bobby's birds observation records in Microsoft Excel

## 4.2 Support for Building Confidence in Technology Use

Our activities revealed four important factors for facilitating older adults using technology and building their confidence of technology use. Our iterative and flexible approach to organise the group sessions helped to make them engaging. Individual visit settings provided a safer environment to focusing on residents' personal experience and specific questions. During these facilitated activities, residents required that instructions were delivered slowly as well as repeating tasks if needed in later sessions. They expected to use mobile technology by themselves or followed our guidance rather than us just demonstrating tasks step by step to them.

*4.2.1 Group and One-on-One: Building a Comfortable and Safe Learning Environment.* The circumstances of the settings influenced how the participants' experiences with technology affect their confidence in it. We observed that group activities that were engaging provided a more positive user experience, participants built a closer relationship with each other and this allowed them to collaborate and compete within the group. We played Kahoot([1]) together in the "Learn about Technology" sessions (figure 7). In discussions with Maggie, she mentioned the idea of playing an interactive game during the sessions and she trialled it during one of the sessions with us. Participants always discussed the answers to try getting more points. After the leader board was shown at the end of each quiz, some participants (particularly the most competitive ones) were excited and calling out to others "I'm coming!" or "I got ya"; the competition among the group engaged them to be active and they were expecting to play a Kahoot quiz by the end of each session.

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[1]https://kahoot.com/, accessed 1 September 2022

Fig. 7. Residents playing Kahoot in the "Learn about Technology" activity

The individual visits provided participants with a comfortable space to talk about their own goals and interests, as they were conducted in participants' personal spaces (their own room or apartment). Some residents did not like to reveal much in the group activities and preferred to talk more about their experiences privately. We observed this behaviour in Therese and her husband, Ryan, who would often arrive by the end of the "Learn about Technology" session because they had specific questions about their personal devices. However, Therese would sometimes join the group session because she enjoyed the activities and had fun during the activities.

Visiting the rooms and apartments of the residents allowed both participants and researchers to learn more about each other. Some participants (Bobby, Irma, Walter, Therese, Wendy) would ask us about our personal lives, and we would learn about their life stories and their interests. During the visits to Wendy, we learned about her interest in the church services livestreams and about the Smart TV that her son had bought for her. This device was a novelty not only for her, but also for us in the research team and for Maggie. Figure 8 shows the second author, Maggie and Wendy learning together how to use the Smart TV.



Fig. 8. Maggie and us helping Wendy use her smart TV

Meanwhile, sometimes when participants saw facilitators make the same mistakes as they do or forget how to get some features, it made them aware that it is normal to learn new technologies and it helped them to overcome their hesitation.

*4.2.2 Facilitators Slowing Down and Explaining Again if Needed.* We provided clear and step-by-step guidance to our participants when we facilitated their use of mobile technology. Some residents complained to us about not learning anything from others when they quickly solved their issues without showing them how they did it. Walter grabbed the opportunity to complain about the quick help he got once from Maggie by telling us how she grabbed his device, fixed the issue but did not explain him how to solve it in case it happens again, so he said "Do you want to teach me or not?". Similarly, Hannah complained about her family failing to teach her to use her iPhone: "They just do it quickly, and I don't learn anything".

Meanwhile, we found that a facilitation process that is open to repetition should be available to the participants when they are learning new features. We constantly reminded participants that we could go through a process again from the beginning in the upcoming weeks, and they were aware that they could reach out to us for support during the activities. We used the "Telling our story" sessions as an opportunity to introduce new features to participants, expecting to bring more inspiration to them about how technology generated material and effects (e.g. animations or sounds) could contribute to their stories. Some participants told us that they learned how to use the new features in the sessions, but they would quickly forget and not be able to use them at home by themselves. Then, as requested by the participants, we created a simplified version of a manual that referred to information from the *Sketchbook* official website and handed it out to every group member, and reminded them that they could ask us any questions during the session.

*4.2.3 Participants Practising by Themselves.* Our participants highlighted the importance of practising by themselves when they learned to use new technology features. It helped them reinforce what they actually learned during the sessions and that they knew how to use their devices. If participants did not have their own devices, we provided tablets to them to create opportunities for them to interact with technologies and participate in the sessions. We also decided to use the Sketchbook app for drawing because it was free to download and it was available for iOS and Android. Hence participants with different devices could download it and learn together.

After we showed participants how to import photos into *Sketchbook* in the "Telling our story" session, Mary found out the app allows to import multiple photos in one project and started to play around with it. She took one photo of the view from the window of the activity room and another photo of Catrin in the group. Then, she edited the two photos and made Catrin look like sitting under the tree in the window view (figure 9). The image caused lots of laughter in the group. We were also surprised as none of us knew about this feature. Then, she taught us how she did it and the rest of the group practised on their own devices.



Fig. 9. Mary's work using Sketchbook: Catrin sitting under a tree

Some participants explicitly told us that they wanted to interact with the tablets when they asked for help, instead of us touching the screen to show them how to do things. For instance, in one "Learn about Technology" session, Ryan asked us to show him how to change the keyboard language setting from American English to British English, he said that Maggie had shown him how to change it but he had forgotten it. The first author showed him step by step and explained what happened, and he asked to watch him practise twice. After this, he was satisfied that he learned how to change the setting by himself.

*4.2.4 Flexible Plan Following Participants' Interests.* Our weekly debriefs and memos helped us understand that we needed to follow an adaptable approach to the sessions instead of having a fixed structure. This flexibility allowed us to follow and support the interests of participants and to plan experiences that would be positive for the participants of the sessions. In both group activities, participants were supported to use different apps, software and websites. We showed some usage of technology to participants, and then we followed up based on their feedback and interests to plan the next set of activities.

In the "Telling our story" session, we discussed how participants could present their stories. We introduced the personal website, PowerPoint/keynote, and flyer/post to them. Some showed interest in the personal website but were concerned about privacy issues, and some picked PowerPoint/Keynote as it can produce animations.

The lifestyle staff member, Maggie, who facilitates the "Learn about Technology" sessions commented on the aim of the activities:

> This is what (technology) is now... So I'm hoping this will give them (residents) some input to give them an interesting hour, an hour and a half. And then if it sparks the interest, and if they then say, oh, I want to look more into this... and this.. we can do the one-on-one session with them.

For instance, *Kahoot* at the beginning was just a fun website that we wanted to try with participants. They enjoyed playing with it so much that it became part of the routine in the sessions. All participants are looking forward to play a game of *Kahoot* by the end of the session, so it became the unofficial ending activity of the "Learn about Technology" session. This activity became so popular that even the residents from the retirement village found out and asked about it, without knowing what it was about.

## 5 DISCUSSION

The findings provide an understanding of the factors related to the older adults' confidence in technology use, and the features of the activities that contributed to provide suitable support for older adults to build confidence in a residential care setting. We further discuss the insights gained in regard to confidence under the lens of HCI. We focus on older adults' technology use and how to conduct appropriate activities for supporting older adults embracing mobile technology. In this section, we present the Motivational Model that comes from the continuous data analysis we conducted. This model does not intend to represent what confidence means to older adults when using technologies, but to provide a representative snapshot of the actual goals of the group on how to use technologies and the emotions related to become a confident user.

### 5.1 The Concept of Confidence in Technology Use

This study provides an insight into the concept of confidence in technology use. We state that confidence in technology use can be linked to a group of emotions, and that confidence is a dynamic concept that is highly related to the user experiences with technologies. As our participants commented, positive experiences can boost their confidence because

they become more open to new technology functions and applications. On the other hand, negative experiences can make them feel anxious about using technologies, which reduces their confidence.

*5.1.1 Confidence can be Linked to a Group of Emotions.* Our participants expressed a wide range of emotions and feelings during the activities. Through a continuous analysis process, we created a Motivational Model to represent the emotional goals of older adults when using technology (see Figure 10). Participants have different feelings and expectations for technology use. Our findings show that older adults not only want to sustain the use of technology to support their everyday life, but also use it for leisure activities such as photo editing or digital drawing. These goals are represented as the functional goals in the model. During the sessions, the participants expressed their goals for the sessions by describing that they would like the sessions to be "interesting" and "joyful" (represented as quality goals), and that they would like to feel joy and wonder (represented as emotional goals). Some participants expressed their frustration when using technologies to do the tasks they want to, and they thought the devices were not designed for them. These negative feelings are represented as Concerns in the model, and they provide us a point to reflect on how we can provide support for them to experience technology positively. How to define the boundaries between using specific concepts as qualities or emotions is still evolving. The model we presented in the paper echoes the voices of our participants. They stated that the sessions should "be interesting" and they should "feel interesting." Whether it would be better to "correct" their terms is a subject for future research.
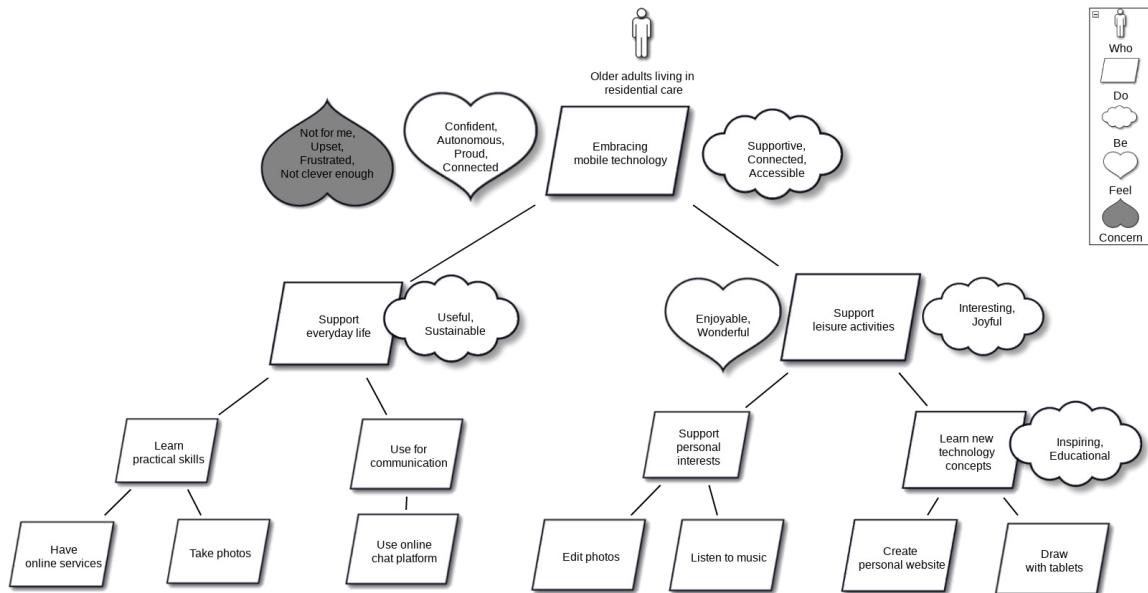


Fig. 10. Motivational Model build from the data analysis that represent our participants' use of mobile technologies

While participants did not use the term "confidence" directly to express their feelings, the model shows that their confidence could be related to the words they used when describing their feelings. For example, Alice used the words "handy", "love it" to describe her feeling of achievement when she learned how to use Apple Pay and read E-books. In contrast, Hannah used words such as "scared" and "hard" when she told us about her experience with her iPhone. She even mentioned in the first session that she could not sleep at night because she was so scared about using her iPhone.

Confidence in technology use is not a simple emotion or feeling, it is related to the quality of experience, and expressed as a group of emotions. As Mendoza et al. [23] pointed out, emotions are revealed during the use of a system, and they are associated with the qualities of the system, such as the feeling of control, security and independence related to the quality of usefulness. Tsai et al. [36] stated that when older adults use tablet they feel connected to their families, and this feeling engaged them to keep using the devices.

*5.1.2 Dynamic Nature of Confidence.* Our findings show examples of how the participants' experiences when using technologies influenced their confidence in technology use. These findings are in line with research from psychology that argues that specific self-confidence can change over time [31, 39]. When our residents have a quality time with technology use or overcome difficulties, that will boost their confidence. Thus, the dynamic nature of confidence in technology use is highly related to how older adults experience technology. The next subsection discusses how to help older adults have positive technology experiences and to help them maintain and increase their confidence in technology use.

### 5.2 Building Older Adults' Confidence in Technology Use

Many research projects have focused on designing and introducing new prototypes or devices to older adults (e.g. [12, 41]). However, the focus of this study was to introduce mobile devices and technologies such as apps, websites and software that are popular for older adult users and understand how they build their technology confidence during use.

We conducted our activities following the participants' interests, which engaged them to be more active in the sessions. This process is different to a technology training process in which participants would be taught about specific technology skills in a structured manner [2, 8, 19, 38]. As an example, *Sketchbook* is an app with many complex features, but all the participants in the "Telling our story" group wanted to learn to use it and created many beautiful and creative works (e.g. Figures 5 and 9). Personal interests worked as a pathway that provided our participants with more opportunities to explore and experience mobile technologies, increased their perceived benefits of technology use so they were more willing to explore the usage, similarly to the model described by Tsai et al, [35].

When facilitating older adults' use of technology, it is important to find a balance between exploring technologies and providing instructions or manuals when participants need them. We experienced this issue when the participants of the "Telling our story" group asked us for a manual to use *Sketchbook*, and when Wendy requested instructions for setting up the WiFi connection. Our participants also revealed that quick help or solving an issue for the older adults instead of showing them the steps is not helpful for them to use technology, or even could add to feelings that they are "not clever enough" to use technology. At the same time, jargon should be avoided or clearly explained at the beginning, which is easily overlooked by facilitators [8, 25]. Thus, when helping older adults using technologies, repetition and patient support contributes to their learning experience [5].

Our approach was designed in the spirit of participatory approaches that emphasise mutual learning between researchers and participants [29]. This mutual learning approach helped us create a safe and comfortable environment for our participants to use technology, then foster the quality experience of the participants. It is also stated by Waycott et al. [41] that a supportive environment can help build participants' confidence in technology use. At the same time, the mutual learning went beyond our initial idea of participants learning about technologies and researchers learning about the research topic: we were sharing a journey to learn about technologies with our participants too. When participants started perceiving the benefits of these sessions and built a relationship of trust and mutual learning with us, some started bringing their devices that they had not used for a long time to the activities and explored the technologies

with us and their peers. Another participant bought a iPad Pro inspired by using the Sketchbook app. Appropriate support and a safe environment can help older adults overcome negative experiences with technologies, thus not losing confidence if they make mistakes when using their devices. We also built a relationship of trust with participants by being part of the sessions before we conducted any research. The role that staff members played, and particularly Maggie, were important to establish those relationships and making the residents feel that we were also part of the activities that were conducted.

## 5.3 Exploratory Process: Matching Technology Use with Interests

It is not a linear process to match a technology facilitation plan with participants' interests. In this exploratory study, we introduced various technology websites, software and applications used by smartphones and tablets that might be interesting to our participants. After that, we discussed and planned together with participants what they want to learn next. *Kahoot* is a successful example in the "Learn about Technology" group. After the first trial, all the participants had fun with *Kahoot* and eventually they were expecting, and even requesting, to play a Kahoot quiz by the end of the group activity. The quizzes have now become a regular favourite activity. The experience of older adults with Kahoot confirms that a responsive and expressive interaction of older adults having an active role can engage the participants with each other in the moment while enjoying the moment with technologies. This has also been described by [26] in using game apps with older residents. It was important that this exploration was supported by Maggie, who was willing constantly looking for websites, devices and apps to try with the "Learn about Technology" group and was also open to new ideas that the research team brought or that the residents requested.

At the beginning, we were hesitant to bring complicated tools and concepts to the groups, but we found that our participants would engage with technologies if they related to their interests and when the technologies could be immersed in their routines, which is in line with previous research [3, 30]. For instance, after we introduced *Sketchbook* to Catrin, she applied her experience in painting with real pen and paper to the digital tool, then she created her first digital painting quickly. This is one of the examples that has shown to us that we still have some pre-conceived ideas of what older adults can or cannot achieve with technologies, and our participants have helped us challenge those ideas. We then vowed to ourselves that we would now introduce any technologies to older adults if they relate to their interests, regardless of their complexity, and that we would be prepared to provide support when it was needed.

Many residents tried to use Sketchbook to edit photographs inspired by Catrin's experience, such as making collages and adding a frame. Although Sketchbook is not the best tool to edit photos, it has provided an opportunity for us to learn about our participants' interests. After that, we started to bring more usage of technology in the group to explore with them what they could be interested in, such as ideas of how to use the PowerPoint/Keynote and tools to create flyers/posts. There is not a quick match of participants' interests and facilitate them to use technology, particularly when they know less about it. However, once they perceived the usefulness of technology, they became more open to try different tools.

## 6 CONCLUSION

Building confidence in the use of mobile technologies for older adults is a challenging process that requires understanding their interests, emotional goals and helping them to learn about technologies in engaging activities. This paper presents an exploration of the concept of confidence and offers insights into how to contribute to older adults to embrace mobile technologies. By conducting activities to learn about technologies in different settings, we offer a perspective that sees confidence as a dynamic concept that is linked to a group of emotions. We present our understandings of factors

that influenced how to build confidence of older adults, such as to follow the participants' personal interests, having a flexible approach for learning about technologies that gives room to written instructions when needed, fostering mutual learning and relationships of trust, and providing a safe and supportive environment to explore and trial mobile technologies. These factors can help to provide an environment that provides older adults a pleasurable social time and creates positive experiences that contribute to build their confidence in technology use.

## 7 ACKNOWLEDGEMENTS

## REFERENCES

[1] Harvey L. Sterns Lisa A. Hollis-Sawyer. 1999. A NOVEL GOAL-ORIENTED APPROACH FOR TRAINING OLDER ADULT COMPUTER NOVICES: BEYOND THE EFFECTS OF INDIVIDUAL-DIFFERENCE FACTORS. *Educational Gerontology* 25, 7 (1999), 661–684. https://doi.org/10.1080/036012799267521

[2] Nahdatul Akma Ahmad, Fariza Hanis Abdul Razak, Azaliza Zainal, Saliyah Kahar, and Wan Adilah Wan Adnan. 2013. Teaching Older People Using Web Technology: A Case Study. In *2013 International Conference on Advanced Computer Science Applications and Technologies*. IEEE, Kuching, Sarawak, Malaysia, 396–400. https://doi.org/10.1109/ACSAT.2013.84

[3] Aloha Hufana Ambe, Margot Brereton, Alessandro Soro, Min Zhen Chai, Laurie Buys, and Paul Roe. 2019. Older People Inventing Their Personal Internet of Things with the IoT Un-Kit Experience. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–15. https://doi.org/10.1145/3290605.3300552

[4] Aloha Hufana Ambe, Margot Brereton, Alessandro Soro, and Paul Roe. 2017. Technology Individuation: The Foibles of Augmented Everyday Objects. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, New York, NY, USA, 6632–6644. https://doi.org/10.1145/3025453.3025770

[5] Tim Broady, Amy Chan, and Peter Caputi. 2010. Comparison of older and younger adults' attitudes towards and abilities with computers: Implications for training and learning. *British Journal of Educational Technology* 41, 3 (may 2010), 473–485. https://doi.org/10.1111/j.1467-8535.2008.00914.x

[6] Kathy Charmaz. 2006. *Constructing grounded theory : a practical guide through qualitative analysis*. Sage Publications, London ; Thousand Oaks, Calif. xiii, 208 pages : illustrations pages.

[7] Sara J. Czaja and Chin Chin Lee. 2007. The Impact of Aging on Access to Technology. *Univers. Access Inf. Soc.* 5, 4 (mar 2007), 341–349. https://doi.org/10.1007/s10209-006-0060-x

[8] Anna Dickinson, Roos Eisma, Peter Gregor, Audrey Syme, and Scott Milne. 2005. Strategies for teaching older people to use the World Wide Web. *Universal Access in the Information Society* 4, 1 (2005), 3–15. https://doi.org/10.1007/s10209-003-0082-6

[9] Peter Gregor, Alan F. Newell, and Mary Zajicek. 2002. Designing for Dynamic Diversity: Interfaces for Older People. In *Proceedings of the Fifth International ACM Conference on Assistive Technologies* (Edinburgh, Scotland) *(Assets '02)*. Association for Computing Machinery, New York, NY, USA, 151–156. https://doi.org/10.1145/638249.638277

[10] Dave Harley and Geraldine Fitzpatrick. 2008. YouTube and intergenerational communication: the case of Geriatric1927. *Universal access in the information society* 8, 1 (2008), 5–20. https://doi.org/10.1007/s10209-008-0127-y

[11] Eulàlia Hernández-Encuentra, Modesta Pousada, and Beni Gómez-Zúñiga. 2009. ICT and Older People: Beyond Usability. *Educational Gerontology* 35, 3 (feb 2009), 226–245. https://doi.org/10.1080/03601270802466934

[12] Tejinder K Judge, Carman Neustaedter, Steve Harrison, and Andrew Blose. 2011. Family Portals: Connecting Families Through a Multifamily Media Space. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 1205–1214. https://doi.org/10.1145/1978942.1979122

[13] Stephen Kemmis and Mervyn Wilkinson. 1998. *Participatory Action Research and the Study of Practice* (1 ed.). Routledge, London, England, 21–36. https://doi.org/10.4324/9780203024478-6

[14] Sabina Kleitman, Jessica Sik-Wai Hui, and Yixin Jiang. 2019. Confidence to spare: individual differences in cognitive and metacognitive arrogance and competence. *Metacognition and Learning* 14, 3 (2019), 479–508. Publisher: Springer.

[15] Sabina Kleitman and Lazar Stankov. 2005. Self-confidence and metacognitive processes. *Zbornik Instituta za pedagoska istrazivanja* 37, 1 (2005), 45–69. https://doi.org/10.2298/ZIPI0501045K

[16] Bran Knowles, Vicki L. Hanson, Yvonne Rogers, Anne Marie Piper, Jenny Waycott, and Nigel Davies. 2019. HCI and Aging: Beyond Accessibility. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI EA '19)*. Association for Computing Machinery, New York, NY, USA, 1–8. https://doi.org/10.1145/3290607.3299025

[17] Bran Knowles, Vicki L. Hanson, Yvonne Rogers, Anne Marie Piper, Jenny Waycott, Nigel Davies, Aloha Hufana Ambe, Robin N. Brewer, Debaleena Chattopadhyay, Marianne Dee, David Frohlich, Marisela Gutierrez-Lopez, Ben Jelen, Amanda Lazar, Radoslaw Nielek, Belén Barros Pena, Abi Roper, Mark Schlager, Britta Schulte, and Irene Ye Yuan. 2021. The harm in conflating aging with accessibility. *Commun. ACM* 64, 7 (2021), 66–71. https://doi.org/10.1145/3431280

[18] Amanda Lazar, Hilaire J. Thompson, Shih-Yin Lin, and George Demiris. 2018. Negotiating Relation Work with Telehealth Home Care Companionship Technologies That Support Aging in Place. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 103 (nov 2018), 19 pages. https://doi.org/10.1145/3274372

[19] Chaiwoo Lee and Joseph F Coughlin. 2015. PERSPECTIVE: Older Adults' Adoption of Technology: An Integrated Approach to Identifying Determinants and Barriers. *Journal of Product Innovation Management* 32, 5 (sep 2015), 747–759. https://doi.org/10.1111/jpim.12176

[20] Anja K Leist. 2013. Social Media Use of Older Adults: A Mini-Review. *Gerontology* 59, 4 (2013), 378–384. https://doi.org/10.1159/000346818

[21] Mark J Macgowan and Stephen E Wong. 2015. Improving Student Confidence in Using Group Work Standards: A Controlled Replication. *Research on Social Work Practice* 27, 4 (may 2015), 434–440. https://doi.org/10.1177/1049731515587557

[22] J C Marquié, L Jourdan-Boddaert, and N Huet. 2002. Do older adults underestimate their actual computer knowledge? *Behaviour & Information Technology* 21, 4 (jan 2002), 273–280. https://doi.org/10.1080/0144929021000020998

[23] Antonette Mendoza, Tim Miller, Sonja Pedell, and Leon Sterling. 2013. The role of users' emotions and associated quality goals on appropriation of systems: Two case studies. In *Proceedings of the 24th Australasian Conference on Information Systems*. Association for Information Systems, Melbourne, Australia, 1 – 11.

[24] Diego Muñoz, Sonja Pedell, and Leon Sterling. 2022. Evaluating Engagement in Technology-Supported Social Interaction by People Living with Dementia in Residential Care. *ACM Transactions on Computer-Human Interaction* (jan 2022), In press. https://doi.org/10.1145/3514497

[25] Barbara Barbosa Neves and Geoffrey Mead. 2020. Digital Technology and Older People: Towards a Sociological Approach to Technology Adoption in Later Life. *Sociology* 55, 5 (dec 2020), 888–905. https://doi.org/10.1177/0038038520975587

[26] Sonja Pedell, Stu Favilla, Andrew Murphy, Jeanie Beh, and Tanya Petrovich. 2020. Promoting Personhood for People with Dementia Through Shared Social Touchscreen Interactions. In *Design of Assistive Technology for Ageing Populations*, Andree Woodcock, Louise Moody, Deana McDonagh, Ajita Jain, and Lakhmi C Jain (Eds.). Springer International Publishing, Cham, 335–361. https://doi.org/10.1007/978-3-030-26292-1_18

[27] Sonja Pedell, Antonio A Lopez-Lorca, Tim Miller, Leon Sterling, Anastasius Moumtzoglou, Madjid Tavana, Amir Hossein Ghapanchi, and Amir Talaei-Khoei. 2014. Don't Leave Me Untouched: Considering Emotions in Personal Alarm Use and Development. In *Healthcare Informatics and Analytics: Emerging Issues and Trends*, Madjid Tavana, Amir Hossein Ghapanchi, and Amir Talaei-Khoei (Eds.). IGI Global, Hershey PA, 96–127. https://doi.org/10.4018/978-1-4666-6316-9.ch006

[28] Jari Pirhonen, Luciana Lolich, Katariina Tuominen, Outi Jolanki, and Virpi Timonen. 2020. "These devices have not been made for older people's needs" – Older adults' perceptions of digital technologies in Finland and Ireland. *Technology in Society* 62 (2020), 101287. https://doi.org/10.1016/j.techsoc.2020.101287

[29] Toni Robertson, Tuck W Leong, Jeannette Durick, and Treffyn Koreshoff. 2014. Mutual Learning As a Resource for Research Design. In *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium Papers, and Keynote Abstracts - Volume 2 (PDC '14)*. ACM, New York, NY, USA, 25–28. https://doi.org/10.1145/2662155.2662181

[30] Yvonne Rogers, Jeni Paay, Margot Brereton, Kate L. Vaisutis, Gary Marsden, and Frank Vetere. 2014. Never Too Old: Engaging Retired People Inventing the Future with MaKey MaKey. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (Toronto, Ontario, Canada) *(CHI '14)*. Association for Computing Machinery, New York, NY, USA, 3913–3922. https://doi.org/10.1145/2556288.2557184

[31] Morris Rosenberg, Carmi Schooler, Carrie Schoenbach, and Florence Rosenberg. 1995. Global Self-Esteem and Specific Self-Esteem: Different Concepts, Different Outcomes. *American Sociological Review* 60, 1 (1995), 141–156. http://www.jstor.org/stable/2096350

[32] Lazar Stankov, Sabina Kleitman, and Simon A Jackson. 2015. Measures of the Trait of Confidence. In *Measures of Personality and Social Psychological Constructs*, Gregory J Boyle, Donald H Saklofske, Gerald B T Measures of Personality Matthews, and Social Psychological Constructs (Eds.). Academic Press, San Diego, Chapter 7, 158–189. https://doi.org/10.1016/B978-0-12-386915-9.00007-3

[33] Leon Sterling, Sonja Pedell, and Grainne Oates. 2020. Using Motivational Modelling With an App Designed to Increase Student Performance and Retention. In *Early Warning Systems and Targeted Interventions for Student Success in Online Courses*, Danny Glick, Anat Cohen, and Chi Chang (Eds.). IGI Global, Hershey, PA, USA, 161–176. https://doi.org/10.4018/978-1-7998-5074-8.ch008

[34] Jennyfer Lawrence Taylor, Alessandro Soro, Paul Roe, Anita Lee Hong, and Margot Brereton. 2018. "Debrief O'Clock": Planning, Recording, and Making Sense of a Day in the Field in Design Research. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3173574.3173882

[35] Hsin-Yi Sandy Tsai, R. V. Rikard, Shelia R. Cotten, and Ruth Shillair. 2019. Senior technology exploration, learning, and acceptance (STELA) model: from exploration to use – a longitudinal randomized controlled trial. *Educational Gerontology* 45, 12 (2019), 728–743. https://doi.org/10.1080/03601277.2019.1690802. doi: 10.1080/03601277.2019.1690802.

[36] Hsin-yi Sandy Tsai, Ruth Shillair, Shelia R. Cotten, Vicki Winstead, and Elizabeth Yost. 2015. Getting Grandma Online: Are Tablets the Answer for Increasing Digital Inclusion for Older Adults in the U.S.? *Educational Gerontology* 41, 10 (2015), 695–709. https://doi.org/10.1080/03601277.2015.1048165 doi: 10.1080/03601277.2015.1048165.

[37] W. Tsai, W. Rogers, and C. F. Lee. 2012. Older Adults' Motivations, Patterns, and Improvised Strategies of Using Product Manuals. *International Journal of Design* 6 (2012), 55–65.

[38] Ange Wang, Lynn Redington, Valerie Steinmetz, and David Lindeman. 2011. The ADOPT Model: Accelerating Diffusion of Proven Technologies for Older Adults. *Ageing International* 36 (2011), 29–45.

[39] Yawei Wang and Yaping Chang. 2018. How Specific and General Self-Confidence Affect Assortment Decisions. *Social behavior and personality* 46, 10 (2018), 1687–1696. https://doi.org/10.2224/sbp.7063

[40] Idi Warsah and H. Fuad Nashori. 2020. Model of everyone is a teacher here: Solution to build up students' self-confidence. *Jurnal Psikologi Integratif* 8, 2 (2020), 1–17.

[41] Jenny Waycott, Sonja Pedell, Frank Vetere, Elizabeth Ozanne, Lars Kulik, Alan Gruner, and John Downs. 2012. Actively engaging older adults in the development and evaluation of tablet technology. , 643-652 pages. https://doi.org/10.1145/2414536.2414633

[42] Zachary Wilson, Helen Yin, Sayan Sarcar, Rock Leung, and Joanna McGrenere. 2018. Help Kiosk: An Augmented Display System to Assist Older Adults to Learn How to Use Smart Phones. In *Proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility* (Galway, Ireland) *(ASSETS '18)*. Association for Computing Machinery, New York, NY, USA, 441–443. https://doi.org/10.1145/3234695.3241008