Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of Self-Determination Theory

Wei Zhao
The University of Melbourne, Australia
zhao.w3@unimelb.edu.au

Ryan M. Kelly
The University of Melbourne, Australia
ryan.kelly@unimelb.edu.au

Melissa J. Rogerson
The University of Melbourne, Australia
melissa.rogerson@unimelb.edu.au

Jenny Waycott
The University of Melbourne, Australia
jwaycott@unimelb.edu.au

ABSTRACT

Restrictions during the COVID-19 pandemic significantly affected people's opportunities to engage in activities that are meaningful to their lives. In response to these constraints, many people, including older adults, turned to digital technologies as alternative ways to pursue meaningful activities. These technology-mediated activities, however, presented new challenges for older adults' everyday use of technology. In this paper, we investigate how older adults used digital technologies for meaningful activities during COVID-19 restrictions. We conducted in-depth interviews with 40 older adults and analyzed the interview data through the lens of self-determination theory (SDT). Our analysis shows that using digital technologies for meaningful activities can both *support* and *undermine* older people's three basic psychological needs for autonomy, competence, and relatedness. We argue that future technologies should be designed to empower older adults' content creation, engagement in personal interests, exploration of technology, effortful communication, and participation in beneficent activities.

CCS CONCEPTS

• **Human-centered computing**; • **Empirical studies in HCI.**;

KEYWORDS

older adult, older people, technology, meaningful activity, self-determination theory, COVID-19

1 INTRODUCTION

Engaging in meaningful activities is essential for the wellbeing of people in later life [25]. Meaningful activities are those which can bring value to people and help them achieve their goals or gain a sense of purpose. Examples include pursuing hobbies, volunteering, civic participation, and lifelong learning [30, 62, 92]. According to self-determination theory (SDT), participating in meaningful activities enables people to fulfill three basic psychological needs. These are autonomy, which is the need to self-regulate one's actions and experiences; competence, which refers to the need to feel efficacy and mastery; and relatedness, the need to feel socially connected [75]. Satisfying these basic psychological needs can motivate one's actions and promote personal development and wellness [75].

As people age, their opportunities to engage in meaningful activities may shrink due to the decline in their health and mobility [71]. Since early 2020, the COVID-19 pandemic has made it even more challenging for older people to engage in meaningful activities. In addition to the health risks posed by COVID-19 to older adults, many countries introduced social distancing policies and lockdown rules to prevent the spread of the virus, including the closure of public spaces and stay-at-home orders [6]. This means that, when lockdowns were in place, older people were unable to participate in the in-person activities they used to do. This significantly affected their ability to self-determine their engagement in activities that are meaningful to their lives.

In response to these constraints, many older adults started to adopt digital technologies in search of alternative options to pursue meaningful activities. These included contacting family and friends through video calls and messaging apps [68], participating in online social activities [80, 92], and providing care and support to others [59]. While these technology-mediated activities offered precious opportunities for older adults to maintain their social connectedness [33, 80], they also presented new challenges for their everyday use of technology, such as limited access to technical support and experiences of digital exclusion [80]. Understanding what older adults did to continue engaging in meaningful activities during the pandemic restrictions, and the opportunities and challenges involved in the process, can provide insight to inform the design of new technologies to support older adults' ongoing engagement in meaningful activities.

In this study, we aimed to examine how older adults used technology to engage in meaningful activities during the COVID-19

lockdown restrictions. This includes sustaining existing activities that older adults were engaged in prior to the pandemic, as well as pursuing new types of technology-mediated activities during the lockdowns. We further aimed to identify the opportunities and challenges involved in using technology for meaningful activities to inform future design practices. To achieve this goal, we conducted semi-structured interviews with 40 older adults to understand their experiences of using technology in their homes during COVID-19 lockdowns. We analyzed the interview data through the lens of self-determination theory, which is a fundamental theory of meaningful activity and human wellbeing [25].

This paper makes three contributions to the growing body of HCI research concerned with the design of digital technologies for older adults. First, we identified new challenges and opportunities that emerged during COVID-19. These affected older adults' use of technology to engage in meaningful activities. We found that many participants' usual activities were only run online, so participants had no choice but to use technologies to engage in those activities. They had limited access to in-person technology support and lost opportunities for social contact through volunteering. On the other hand, many participants had increased access to online programs and events. They creatively adapted their use of technology to the changing context, learned how to solve technological problems online by themselves, and formed meaningful connections with others through creating and sharing digital content.

Second, based on our findings, we argue that using digital technologies to engage in meaningful activities can both *support* and *undermine* older adults' needs for autonomy, competence, and relatedness. On the one hand, digital technologies can support these basic needs by providing a wide range of activity options that people can choose flexibly, supporting the expression of personal talents and capabilities, and fostering meaningful social interactions. On the other hand, the three needs can also be undermined by various factors, including excessive and irrelevant information online, privacy and security concerns, the lack of confidence in using technology, reliance on external help, and the lack of physical interactions with others.

Third, our analysis shows that older adults can be highly resourceful users of technology when the situation requires it - which is contrary to the common belief that they are less interested in technology or are "resistors" of new systems [4, 33]. Based on these findings, we propose five design implications for technology-mediated activities for older adults. Future technologies should be designed to 1) empower older adults in the use and production of digital content; 2) support older adults' engagement in personal interests and passions; 3) include positive feedback for technology self-exploration; 4) provide opportunities for meaningful and effortful communication; and 5) support older adults' participation in beneficent activities.

2 RELATED WORK

Our investigation builds on prior work related to self-determination theory and meaningful activity, technology-mediated activity in later life, and older adults' use of digital technology during COVID-19.

2.1 Self-Determination Theory & Meaningful Activity

Self-determination theory (SDT) is a psychological theory concerned with the nature, structure, and functioning of a person in action [75]. The term self-determination was introduced by Deci and Ryan in 1985, referring to a person's own ability to manage themselves, make confident choices, and think on their own [19]. SDT posits that in addition to physical needs such as nutrients, oxygen, and protection from physical harm, people have three basic psychological needs that must be met to achieve growth, development, and wellness [75]. These needs include self-regulating one's experiences and actions (autonomy); feeling effective in one's actions (competence); and staying socially connected with others (relatedness) [75]. They energize, motivate, and direct people's actions in the process of learning, growing and thriving [18]. Satisfying these basic needs leads to positive emotion and a sense of subjective wellbeing [75].

The term "meaningful activity" usually refers to an activity that a person finds significant or valuable [62] and which encourages the person to live a meaningful life [52] and fulfill their potential [30]. Similar concepts include valued activity [46], leisure activity [36], individualized activity [86], and purposeful activity [61]. Activities are meaningful when they are enjoyable, suited to individual preferences, and related to personally relevant goals [83]. However, the perception of 'meaningfulness' in activity can vary across age and gender groups, and there are individual differences even within small groups [37].

To better understand the concept, much of the literature on meaningful activity finds roots in self-determination theory, arguing that meaningful activities contribute to people's wellbeing through the fulfilment of basic psychological needs [25, 37]. Eakman's Meaningful Activity and Life Meaning model demonstrates the connection between meaningful activity and the satisfaction of basic psychological needs [23]. The model suggests that engaging in meaningful activity offers a means through which people can satisfy the needs for autonomy, competence, and relatedness, which then contribute to wellbeing [24].

In the field of Human-computer Interaction (HCI), self-determination theory has been used to understand people's motivations for using technology and computer systems. It is commonly used in game research to understand players' need satisfaction, intrinsic motivation, and feelings of addiction [84]. In recent years, SDT has also been applied to understand human interaction with robots [35, 39], artificial intelligence systems [15, 90], and whole-body control interfaces [28]. MacArthur et al. [53] used self-determination theory to analyze how people's diverse needs were expressed in gaming and quilting groups. They connected the pleasure and pain experienced by creators to the three basic psychological needs. Based on the findings, they discussed opportunities for the design of maker group events to fulfil each psychological need, such as by modifying existing tools to support makers' needs for competence. This exemplifies the value of SDT for understanding people's experiences in different communities and for generating design implications to support people's engagement in creative activities.

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of
Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

Other related studies have explored older adults' use of technology to fulfill one of the three basic psychological needs [58, 78]. For example, Schwaninger et al. [78] identified different forms of relatedness in people's use of telehealth technology, including interpersonal relatedness, relatedness to institutions, and relatedness to the content of technology. Nurain et al. [58] examined experiences of autonomy during COVID-19 through an interview study. They identified several factors that can limit older adults' sense of autonomy, including government guidelines, lack of control over the pandemic situation, and risk perception. Our work extends these studies by focusing on the active role of older adults when they use technologies to engage in meaningful activities.

2.2 Technology-mediated Activities in Later Life

HCI research has accrued a wealth of knowledge about the design of technology for older adults. This research has shown that stereotypes of older people as unproductive or incapable of using technology are often inaccurate, as numerous older adults have a clear motivation for learning to use technologies to satisfy their intellectual and emotional needs [48, 51]. Older people exposed to an environment of 'internalized ageism' [45] that associates older age with incompetence or technophobia may use technology less frequently and experience performance problems. Therefore, it is important for researchers and policymakers to place further emphasis on the empowerment of older adults in their engagement with technology [44, 67].

Increasingly, research shows that older adults are actively involved in technology production and design, and not just passive recipients [14, 47, 66, 67, 89]. Some researchers are exploring the involvement of older adults in the design process of new technologies and creative spaces [1, 41, 43, 47, 67, 70]. Lazar et al. [47] studied the experiences of older adults during the formation of a maker space in an independent living community. Their participants saw different benefits in forming a new maker space, including developing technical skills such as learning to code, involving more local older adults in using technology, and helping people to overcome fear and disinterest. Richards et al. [67] used participatory design techniques to explore older adults' use of maker technology in the learning and practices of crafting. Their findings show the opportunities for using technology to support older adults' connection to hobbies, and the creativity that older adults can achieve through involvement in the technology design process.

Other researchers have investigated older adults' active role in creating, producing, and sharing digital content [66, 77, 88]. Older adults can experience various social and psychological benefits from producing and sharing such content, including creating a sense of belonging in online communities [11], promoting intergenerational communication [34], expressing values and identities [88], and developing digital skills [66]. Waycott et al. [88] conducted a field study to understand older adults' use of a bespoke application to create and share photographs and messages. Their findings demonstrate opportunities for older adults to achieve social engagement and self-expression through content production. In addition, Reuter et al. [64] explored the use of community radio for older adults to express their voices and participate in civic activities. They used a tailored tool called *Radio Grabber* to support a group of older people in editing radio recordings and uploading the content online. They found that through editing and creating digital content, older people can engage in rich media experiences and pursue their interests in civic participation. Similarly, Ferreira et al. [27] explored older people's production and appropriation of digital videos. They identified different forms of creativity in participants' video editing and production, including artistic selections of video colors, fonts, music, and effects, as well as clever solutions to issues when interacting with technology. These examples suggest that digital technologies can be used actively and creatively by older adults to engage in different meaningful and enjoyable experiences. Our research explores how older adults engaged in these experiences during COVID-19 when they had to turn to technology solutions.

2.3 Older Adults' Use of Digital Technology During COVID-19

During the COVID-19 pandemic, many older adults started to adopt digital technologies to find alternative options for connecting with others and engaging in social activities when they were unable to meet in person [33, 80, 92]. A recent study by Sevage et al. [76] shows that many older adults used social media and video communication to connect with their family and friends during COVID-19 restrictions. Technology and virtual connections also allowed some older adults to maintain social interactions by shifting their regular activities online. In our prior work [92], we found that social media and videoconferencing platforms helped older adults to participate in various group activities during COVID-19, including arts, sports, cultural, and civic events. Additionally, Richards et al. [68] examined how older adults adapted the ways they used technology for social connection, such as by blending virtual connection with in-person activities. They also identified opportunities for older adults to repurpose technologies to support creativity, playfulness, and self-expression.

However, new challenges and issues have emerged during COVID-19 in relation to older adults' everyday use of technology. For example, research has shown that while many older adults were using technology to stay connected during COVID-19, they saw it as a temporary solution and felt that it could not resolve the loss of in-person interaction and social connection [76]. Our prior work [92] revealed that many older adults preferred to participate in in-person social activities. This was because online social activities were felt to lack personal, intimate, and incidental interactions with others, and online social activities were sometimes rigid and difficult to manage. Sin et al. [80] found that while the pandemic motivated many older adults to adopt technology and become more tech-savvy, some older adults were excluded during the transition to virtual-only offerings. In addition, people had limited access to in-person technology support during the pandemic, which created a sense of helplessness when troubleshooting technical issues.

In this paper, we are interested in the ways that older adults used technology to pursue meaningful activities during COVID-19 lockdowns. We particularly focus on new opportunities for meaningful activities that emerged during the pandemic and the challenges that limited older adults' engagement in technology-mediated activities. We use SDT as a lens to understand how pursuing these activities

contributed to fulfilling older adults' basic psychological needs, and how aspects of technology use may undermine these needs more broadly.

3 METHOD

We conducted interviews with 40 older adults living independently in Victoria, Australia. We used semi-structured interviews to gain a deep understanding of participants' technology practices during the pandemic, and to enable them to bring their own experiences and challenges into the conversation [7]. Interviewing also enabled us to tailor follow-up questions based on each participant's individual experiences and situation, which would not be possible with approaches such as questionnaires and surveys [7].

The interviews were conducted between October and December 2021, when many countries and regions introduced physical distancing policies and lockdown measures to mitigate the spread of COVID-19. At our study site, strict stay-at-home orders and lockdown rules were in place when our data was collected. Our interviewees had only limited reasons to leave their homes and could not participate in in-person activities. The research received approval from the University of Melbourne human ethics team.

3.1 Participants and Recruitment

We used purposive sampling to recruit a total of 40 older adults (32 women, 8 men) aged from 65 to 84 (M = 73.9, SD = 5.8 years). Our eligibility criteria required participants to be aged 65 years or above, living independently at home, and to be socially impacted by the COVID-19 pandemic and restrictions. We focused on older adults who were living independently because we wanted to understand the experiences of those who had been active and independent prior to the pandemic. This group of older adults may have experienced a substantial loss of access to social engagement and meaningful activities during COVID-19 restrictions, and were likely (in comparison to those in other settings) to have tried using technology to continue participating in these activities. We posted recruitment information on social media (Twitter and LinkedIn) and in a university newsletter, and shared the recruitment message with different councils, activity centers, and social groups for retired people.

The sample was diverse in terms of cultural background, socioeconomic status, and experience of technology use. Ethnicities represented among participants include East Asian, South Asian, South African, Oceanian, and North-west European. 32 participants lived in metropolitan areas, and eight lived in regional and rural areas. According to the regional socio-economic index (SEIFA), the postcodes of participants show that they have varied socioeconomic backgrounds, with some coming from areas of lesser socio-economic advantage and others from areas of greater socioeconomic advantage [2]. 21 participants lived alone, 18 participants lived with a partner, and one lived with adult children. All participants had experiences of using email, texting, and phone calls to communicate with others, but had varied experiences of using social media, video calling applications, and instant messaging tools. More details about the demographics and technology use of each participant are included in Appendix A.1.

3.2 Procedure

After reading an information sheet about the project and providing informed consent, participants completed a demographic questionnaire and selected technologies they had used during COVID-19. We then conducted the interview.

Each interview was held remotely through a phone call or videoconference. We started with a broad discussion on how COVID-19 affected the interviewee's daily life. Interviewees were then asked to describe their use of digital technologies, to reflect on their positive and negative experiences of using technologies during COVID-19, and to discuss how the pandemic changed their experiences. Finally, interviewees were asked to suggest their own ideas about how future technology could be used and designed to keep older people socially engaged. They were also invited to send images over email if there were things that they wanted to show the researchers in more detail. Participants were thanked and sent a $20 gift card after completing the interview. All interviews were audio recorded and transcribed for later analysis. We removed all personally identifiable information and assigned a unique identifier for each participant to ensure anonymity.

3.3 Analysis

We conducted a thematic analysis of the interview data and interpreted the data through the lens of SDT. The first author conducted the analysis, following Braun and Clarke's six-phase approach [8]. The initial analysis began with reading through the transcripts and writing preliminary notes (phase 1). This was followed by inductive coding of data relevant to the research aims (phase 2), which were to understand older adults' uses of technology for meaningful activities during the pandemic and to identify benefits and challenges associated with these uses. Example codes include "sharing information on social media" and "privacy and security concerns". The first author clustered the codes into 12 candidate themes, drafted the themes into a report, and shared the report with the whole research team (phase 3). Through multiple rounds of discussion, reflection, and interpretation of the content in the preliminary themes, we deductively assigned the themes to the categories of autonomy, competence, and relatedness (phase 4) according to the behaviors described within each theme (e.g., we interpreted the use of technology for social activities as evidencing the pursuit of relatedness). We recursively reviewed and refined the themes and theme names, collapsing several themes and rewriting our interpretations to convey how the data segments evidenced the use of technology for meaningful activities. We finally developed nine themes under three categories (phases 5 and 6), with refinement continuing throughout the authorship of this report [82]. In the analysis process, we aimed to achieve richer interpretations of meaning rather than attempting to achieve consensus of meaning, as guided by the principles of reflexive thematic analysis [9]. The categories, themes, and example codes are presented in Figure 1.

4 FINDINGS

In this section, we present the key themes we developed from our analysis. We use the three basic psychological needs from SDT (autonomy, competence, and relatedness) to categorize findings that are relevant to each need. In terms of autonomy, we found that
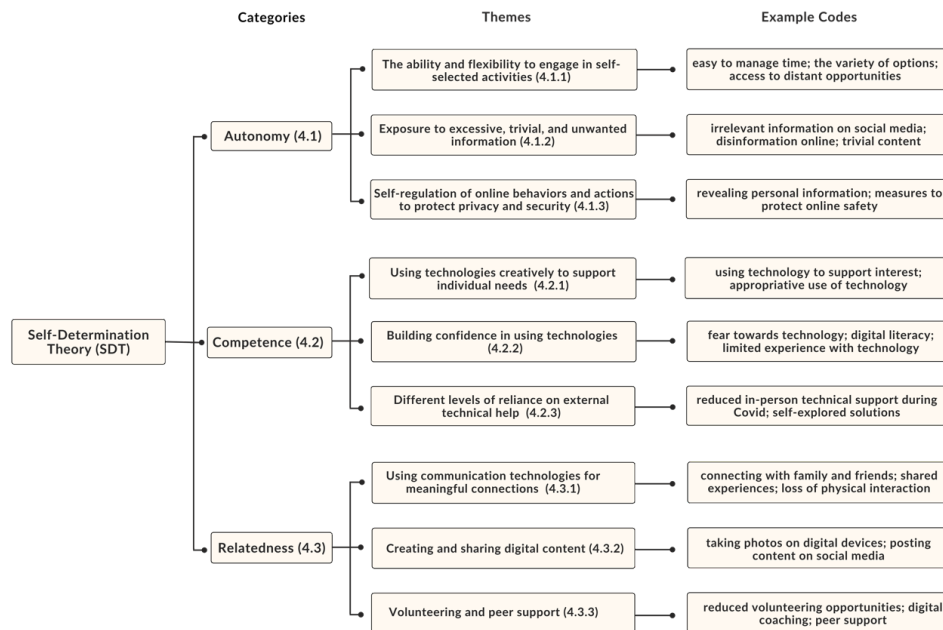
Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of
Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

Figure 1: Categories, themes, and example codes from data analysis.

participants experienced: 1) the ability and flexibility to engage in self-selected activities; 2) exposure to excessive, trivial, and unwanted information; and 3) self-regulation of online behaviors and actions to protect privacy and security. In regard to competence, we found that participants experienced: 1) using technologies creatively to support individual needs; 2) building confidence in using technologies; and 3) different levels of reliance on external technical help. For relatedness, we identified experiences of: 1) using communication technologies for meaningful connections; 2) creating and sharing digital content; and 3) volunteering and peer support. We use quotations from participants in this section to illustrate the findings.

4.1 Autonomy

Autonomy refers to people's needs to self-regulate, take control, and have ownership of their experiences and actions [75]. We found that restrictions during the COVID-19 pandemic affected many participants' ability to control their engagement in meaningful activities. While technologies provided opportunities to self-select and engage in different types of meaningful activities, some participants felt that excessive and irrelevant information on the Internet made it difficult to filter out the content they actually needed. This reduced their ability to access useful and meaningful information. In addition, some participants had concerns about privacy and security risks on the Internet, while others actively self-regulated their online behaviors and actions to protect themselves from these risks, indicating a strong sense of autonomy.

4.1.1 The ability and flexibility to engage in self-selected activities. During COVID-19 restrictions, participants could not freely engage in the activities they wanted to do, because many things were not allowed. For example, P2 commented on no longer "going to the movies, travelling, having dinner parties, and even going to the library". This loss of control made it difficult for her to make plans, which led to a negative feeling of having "nothing to look forward to" (P2).

To cope with this disruption in their lives, many participants turned to technologies and online platforms to stay engaged in meaningful activities. P32 felt that technologies like podcasts made her life "very manageable", as she could listen to them whenever she wanted while doing other things at the same time. P26 used her digital devices more frequently during COVID-19. She used YouTube for yoga, dancing, and other exercises, which enabled her to manage her leisure time more freely than before. P3 found that she was able to engage more deeply with a neighborhood she used to live in through a virtual Zoom tour:

> When it was virtual, she [the tour guide] was at her computer on a Zoom call, and then she brought up photos and maps and historical photos of what she was talking about. We moved virtually around the [suburb] looking at the sites that she was describing. . . It's much better actually in some ways because she has access to a lot more photographs. And we could go much further around the suburb because we didn't physically have to walk.

The increase in online activities offered during COVID-19 helped participants to engage in new, enriching, and meaningful experiences. P9 noted that since the lockdown, she could access more courses and programs online, which was "an asset" to her and provided her with opportunities that she had not been aware of before. For example, she participated in an online program organized by a university located in a different city, as she felt this would keep her brain active and prevent dementia. P3 told us that she was interested in film and arts, and was able to access many international activities and events when they were moved to online platforms. Instead of being limited to local events, she could browse the program of a prestigious international film festival, and even participate in a virtual visit to the Louvre Museum in Paris. P13, meanwhile, found online resources to be useful for enriching her life. She said:

> If you don't feel like getting out or can't get out, it's actually quite a resource of free things that you can do online in the comfort and privacy of your own home. Online lessons, I think that's a really convenient, private, personal way of doing things, using all of those resources to enrich your life and help you live your life.

However, some participants experienced inconvenience when they were forced to choose digital options. For example, P20 complained that, during the pandemic, many restaurants required customers to scan QR codes to access digital menus when ordering food. As she had reduced vision, P20 found it difficult to see the menu on a small phone screen. This affected her autonomy in choosing how to engage in daily activities and whether to use technology.

4.1.2 Exposure to excessive, trivial, and unwanted information. We found that the volume of information on the Internet exposed some participants to irrelevant and meaningless content, and sometimes even misinformation. This had a negative impact on participants' ability to filter out useful information and manage the adoption of technology, leading to a reduced sense of autonomy.

Some participants were annoyed by trivial information shared by their contacts on social media and messaging apps. P9 was a member of a walking group that used the WhatsApp application for group communication. She did not enjoy the experience of using the platform because there was too much irrelevant information:

> I find WhatsApp, sometimes a lot of nonsense goes on. A lot of discussion about silly things that I'm not particularly interested in. I don't want to express this with the people who are contributing these things, but for me, it's a facility to get information out and in, that's useful. But I'm not interested in this idle commentary. There needs to be a specific purpose for me to use it.

P9 felt even more annoyed when she received ping notifications every time a person in the group left a new message. The feeling of being exposed to trivial, unwanted, and sometimes intrusive information affected participants' willingness to continue using the technology. P21 felt that some of the content people shared on Facebook, such as what they were eating, were "trivial" and "menial". This made her feel annoyed and sometimes even stopped her from using the application. Information shared on social media

was also considered to be intrusive sometimes, such as aggressive discussions about political issues. P9 stopped using Twitter because of the attacks on people:

> I didn't participate in Twitter, but I used to enjoy reading some of the political satire. But it's become so toxic that I find... It's stressful to even look at the stuff that's on there. It's the attacks on people or commentators or politicians. You have a view of the world and others don't agree with, it just becomes really nasty stuff, and dragging people down.

The Internet could also be misused by malicious third parties, which led to concerns about misinformation:

> Nowadays, especially through Google, you can find a lot of information, but you have to be intelligent enough to utilize that information in a proper fashion, and separate the misinformation part from the good information part. But digital technologies are definitely very useful in terms of giving you lots of information with very little effort. (P28)

These examples show that many participants chose to stop using the technology when they felt annoyed or frustrated by content that was not relevant and meaningful to them. For example, P9 sometimes disengaged from using WhatsApp, and her reluctance to check Twitter caused her to miss tweets she enjoyed after being discouraged by aggressive discussions. This limited her opportunities to access important and relevant information, leading to a reduced sense of autonomy.

4.1.3 Self-regulation of online behaviors and actions to protect privacy and security. Many participants expressed their concerns about privacy and security risks when using digital technologies. P19 recounted receiving new friend requests from 10 people every week on Facebook, but he had no idea whether these people were real or not. P37 was not comfortable when the content she shared on social media was passed on to strangers, because she only wanted to share it with people she knew. P26 decided to stop using Facebook because she objected to the collection of personal data to generate targeted advertising. She said:

> They kind of follow you. I notice that if you search for something, usually maybe a product, they track you down and they try to advertise. At first, I didn't realize how come all these advertisements came up when I'm reading about my friends and looking at their photos. . . That's something I'm really against.

In response to these concerns, many participants developed their own strategies and learned new skills for protecting their privacy and security, thereby exercising autonomy. For example, P9 wanted to minimize her exposure to data harvesting in the digital world, so she learned how to protect her identity by subscribing to the DuckDuckGo newsletter. P24 used a Virtual Private Network (VPN) to protect his online safety and security.

Some participants protected their online security by controlling the type of information they would share on public platforms. For example, P23 chose not to provide personal information such as her date of birth or home address on social media. P6 preferred to

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

use emails to share things with others because she felt that it was easier to control who had access to the content.

Others chose to use only products and devices they trusted. For example, P35 felt more comfortable when doing banking on her desktop computer than her tablet, because she thought operating systems of computers were more secure as they were longer established. P24 was very cautious of his online actions, and would only use digital products provided by companies he trusted, such as those from Apple. He also developed a list of "suspect apps" that he would avoid using.

These examples reveal that many participants were aware of the potential risks of using technology for meaningful activities. Some participants adopted different approaches to self-regulate their online behaviors to protect their privacy and security, indicating their exercise of control and autonomy. While older adults are frequently considered to be vulnerable to fraud and scams [32, 63], our results show how older people acquired more skills to fight against the misuse of their information when pursuing meaningful activities online.

4.2 Competence

Competence refers to people's need to operate effectively and apply their abilities to solve moderately difficult tasks to gain a sense of achievement [75]. Our analysis suggests that competence was important for driving participants to discover new projects through technology and find new meaningful tasks on the Internet. However, there were some factors that limited participants' sense of competence, including their confidence in using technologies and their reliance on external technical help.

4.2.1 Using technologies creatively to support individual needs. We found that many participants gained a sense of achievement through completing online tasks, especially during COVID-19 lockdowns when people had more time to stay at home. For example, P27 used YouTube to discover new things to do:

> I've got into quilting. It's time-consuming, but I've made lots of items that I've given as gifts. It just keeps me so busy and motivated to try new things. And I access tutorials through YouTube, that's how I've learned sourdough bread making and the quilting. . . I just do searches for new projects on YouTube that I think I'd like to do.

P27 added that learning new things through the Internet helped her to challenge herself. Both P3 and P7 used a mobile application, Duolingo, to learn new languages during lockdowns. P3 started to learn Spanish after being inspired by her sister who was learning Italian. She felt that the increased spare time during lockdowns motivated her to learn new things. P26 used a mobile application called *Pleco* to help her learn Mandarin. She said:

> With that app, it helped me to pronounce, and sometimes I've forgotten how to write certain characters. You know how I kind of know the form but don't know the exact strokes? That helped me. It makes sentences as well. It puts words in context and tells you the meaning, and it gives you sentences.

Additionally, many participants used technologies to support their interests and gain entertainment. P21 used her smartphone and tablet during the lockdown to play games, such as *Bridge* and *Rummikub* (a tile-based game). P26 used mobile applications to support her interest in gardening by taking photos of plants and checking their species.

Some participants adapted their use of technologies to the changing context of the pandemic, demonstrating competence and resourcefulness. Previously, P39 had volunteered at a radio station for people with low vision. During the lockdowns, he created a home studio to continue broadcasting (see Figure 2). He used old towels and pillows to build a 'sound buffer', and combined an ironing board with a child's chair and a stack of books to hold a 'teleprompter'. After recording his broadcast, he sent it to a producer located in a different area of the city. This shows his creativity in adapting the physical environment to support digital creation, which is close to the concept of 'bricolage' described by Gibson et al. [29] as creating and constructing new artefacts from a diverse range of available things.

Similar creativity was found in participants' use of devices and software to engage in tasks that were unfamiliar to them, and which required them to learn new things to pursue meaningful activities. For example, P27 connected her mobile phone to a set of speakers, which she then connected to her laptop and monitor to create a better music listening experience. P8 recounted her experience of "hooking my phone up to my television", which gave her a great sense of accomplishment. P5 described how she and other older adults made business cards and added creative decorations to the cards using design software on computers:

> I make my own business cards. I put them on an A4 sheet, and I laminate them all so that I have something to give people if they ask me for my address. I taught the oldies how to make their cards. They love making the business cards. Someone will put a dog on, and someone will put flowers on. I do the same. I usually put a flower or some descriptions on them.

These examples show that older adults managed their use of technology, adapted their use to individual goals, and gained a sense of competence through the achievement of these goals.

4.2.2 Building confidence in using technologies. We found that participants' confidence in using technology affected their pursuit of meaningful activities and their ability to gain a sense of competence. The interface design and logical operation of a system could affect its ease of use and thus people's confidence in using it, leading to negative experiences. P19 told us that he had to use a very old computer at home because the "too advanced one" kept updating automatically. These updates changed the interface of the system and made P19 feel confused and frustrated, because he lost the sense of competence previously acquired with the original interface. P32 also described the issue of inconsistent interfaces following automatic updates:

> I just noticed the other day when I shut down, they've upgraded, and you open up the computer and suddenly it's different. That's the frustration I find, is that everything changes so much. I got used to how

Figure 2: Demonstration of a home recording studio set up by P39.

it works, then I opened it up, and I couldn't even find where it said. . . The shutdown used to be over there, now it's moved to a window.

While many technology companies kept introducing new features to their products, some participants felt that these new updates were "trying to be too clever" and considered them to be "retrograde steps" (P7). The frequent updates to digital systems made it difficult for participants to keep up, leading to reduced motivation to learn new technologies. P4 believed the biggest challenge for older people was that things were changing too quickly:

I think a lot of us are not really that clear on how to do it. And we're probably a bit scared as well. I could ask someone to teach me, and they'd show me and then I'll forget, or something's changed. . . Things change so quickly. I can't keep up. I pressed the green button last week, and now it's an orange button or something.

As can be seen in P4's quote, the feeling of confusion and frustration could sometimes turn into fear. P19 said "nowadays because they make a lot of things too complicated, we lost the skills to use it, then we were afraid to use it". Fear also arose when people were concerned about using technology in the wrong way. For example, P13 said:

I've been using computers for 30, 35 years probably. Before then, I was really frightened. I guess people need to get over the fear that they will do something wrong, and it will hurt either the machine or your phone or something like that. Confidence is probably the biggest thing that people need, and not to worry if you press the wrong button, or you feel silly or dumb or something.

The fear of 'hurting' or 'breaking' digital devices could be partially attributed to the earlier days when computers were more expensive. P26 said that "we never grew up with computers", and when she first learned to use technology, she was too fearful to touch any buttons in case she lost hours of work by clicking on the wrong thing. When learning to use new technologies now, she had similar worries:

I said, 'Well, how come you know all these things and you are so quick? You have to slow down and teach me.' And my daughter said, 'Don't worry, Mum. Just touch any button. It won't break.' I said, 'My things will be gone.' I think a lot of older people feel like that.

These examples show that negative feelings or fear can affect older adults' confidence in using technologies, limiting their ability to engage in meaningful tasks and achieve competence needs.

4.2.3 Different levels of reliance on external technical help. We found that participants relied on different levels of external technical help. Some could only use technologies when they were already set up and ready to be used. For example, P4 found it enjoyable and useful to show her family what was going on through video calls, though she could only use them when someone had set up the meetings.

However, external help was not always available to all participants. P15 noted that many older people "don't have people around who are able to show them how to manage the technology", as their families might live in a different city. Without ample support, many participants experienced negative emotions when technologies did not work as expected. P31 said that she would "throw the tablet away for a while" when it did not work properly. P25 felt that his brain was "going to melt down" when things went out of control on his digital devices. P38 felt it was "stressful" and "daunting" when setting up a new laptop, because she did not know how to answer the questions she encountered when going through the set-up steps.

Participants described two types of technical help that they had previously received. Some had been given instructions on how to complete a task or solve a problem, whereas others had family or friends who had directly fixed the problem without explaining the steps involved. For the person providing support, the latter option may be more efficient, but for those receiving support, the former option would be more beneficial as they could learn and build up new skills, thus developing their competence. During the restrictions, however, people's access to in-person technical support was more limited, as they were not allowed to have visitors to their homes. P36 described her frustration and feeling of insecurity when she could not access technology support:

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

> There was another time when I was having a lot of problems with my printer... It was just the panic of my printer not working, not being able to work things out during the hard lockdown, not being able to get like a friend or neighbor to drop in and help me with it.

On the other hand, the lack of in-person support meant that people had to find other ways to seek help, which encouraged some participants to learn how to solve problems by themselves. For example, P26 described how she felt empowered by being able to troubleshoot a problem by herself:

> It's a benefit from being locked up by COVID, I learned a lot of things online. Whatever I cannot do or understand or whenever I have a question, I can just type it in. I can Google or YouTube. I learned a lot of gardening tips from YouTube. I learned more about my new watch online... It's a skill that I learned from COVID, because when I first acquired my laptop, I used to go to the Apple store to have classes, or I ring up the call center to help. But now I find a lot of support online.

P25 also shared how he found solutions to technical problems on his own through internet searches:

> I have never had to pay anybody to help me. I think that's terrific. I've worked out how to reprogram my car key. You hop in your car and you go, 'Oh, it's not working anymore. Something's gone wrong.' Very unlikely, but that happened to my spare key. I just looked it up on YouTube, and YouTube had the answer. I followed their instructions, and that's kind of how I go now.

These examples show that the COVID-19 pandemic revealed opportunities for older people to solve problems on their own through internet searches, which could help them build digital skills, become less dependent on external help, and form a sense of competence.

4.3 Relatedness

The third and final basic psychological need is relatedness, which refers to the feelings of being socially connected and being a significant member of a group [18]. The need for relatedness is usually satisfied when people feel able to help and be supported by others [18]. During COVID-19 lockdowns, many participants turned to communication technologies to maintain connections with loved ones. Some participants created and shared digital content as a way of sharing their skills and helping others, while volunteering and peer support played a vital role in some participants' meaningful social engagement, forming a sense of relatedness through benefiting others.

4.3.1 Using communication technologies for meaningful connections. One of the biggest impacts of COVID-19 restrictions on participants' lives was a change in the way they communicated with other people. As face-to-face communication was greatly impacted by restrictions, many participants used different communication technologies and online platforms to stay connected. P1 used Facebook to obtain news and information about the local community:

> I probably use Facebook more than I ever did, especially with connecting with the local community, like the road's flooded, or the local supermarket's closed for cleaning, people giving away produce, a police presence somewhere, or lost and found. Just general information, which I didn't need before COVID. But I find it quite interesting to know what's going on.

Interviewees noted that spending time with their grandchildren provided significant meaning in their lives, but their ability to maintain relationships was impacted during the lockdowns. Therefore, some older people turned to technology to sustain the activities they previously did in person:

> I have friends who constantly are involved with their families, and it's great, because they can talk to their grandchildren every night. They can even read them stories. They can hear what they've been doing. They can't touch them, but they're part of their lives. It's so valuable, both to the child and to the older person, to have these little people in their lives. (P15)

P35 used the instant messaging application *Signal* to connect with family members. This enabled her to see photos and video clips of her grandchildren, such as "the granddaughter just had a two-minute part in the school Christmas performance". In these cases, the need for relatedness was fulfilled by being involved in the lives of significant others. It went beyond regular chats and functioned in a way that was as intimate as what would happen if they were physically together, such as by reading stories to grandchildren at nighttime. Communication technologies were sometimes used in unexpected ways, as shown in P6's example of how her mother-in-law received emails from them:

> She's in her 90s, she's 98. She lives alone. And she is not, apart from her television, she doesn't know the technical skills. What we do is we write an email to her, but because she can't receive the email, we send it to a friend who lives nearby. The friend photocopies it and gives it to her. We don't go through the post.

Additionally, many participants used communication technologies to participate in shared recreational experiences with family and friends. For example, P16 had friends who were living in a different city, and they would usually drive back and forth to meet regularly. In between, they used FaceTime to talk and challenge each other by working on quizzes published in the local newspaper. P15 played a word game called *Words with Friends* on her mobile phone with friends and relatives. She could play the game by simply pressing a button and sending a sentence to people anywhere, which was "a great social thing for her". These shared experiences created a sense of co-presence in people's engagement in recreational activities.

Some participants discussed collaborative activities organized through social media platforms. P38 enjoyed patchwork quilting, and she joined a hobby group that shared a new pattern on Facebook each month. Members then worked on the pattern for the month, and shared it on the social media page. P7 described a similar experience of completing daily tasks and sharing them with members of a social group:

I belong to a walking group, which of course isn't walking together anymore. During September, the head person of that group decided to suggest every day a photo that people could make of various things. We could all go and look for garden gnomes one day, and the next day we're looking for a flag, and the next day we're looking for a different kind of flower, and another day we were looking for ducks. Then we post it on Facebook. It's just a little activity which has been good for the group.

While communication technologies created many new opportunities for people to connect with others, some participants felt that the level of direct and physical interactions with people had declined:

If you catch a bus and get on the train, nobody will speak to you. They just bring out their phone, put their earphones in, put their head down. No one will do eye contact with you. That gets me upset. It makes people almost zombies. They can't reach out and touch someone's hand and say, 'Hey, mate, I need help.'. . . Humans are meant to communicate face-to-face. We're meant to shake hands. We're meant to hug. We're a tribe, and the glue that keeps us together is the physical interaction. (P12)

While P21 felt it was more convenient to exchange messages through emails with friends, she also described it as "a loss of gift" for direct conversations with people. These examples show that while communication technologies offered valuable opportunities for people to build meaningful connections, the feeling of relatedness could also be undermined when people had fewer in-person, physical interactions with others.

4.3.2 Creating and sharing digital content. Sharing meaningful moments with others is an important source of enrichment in life and can build a sense of connectedness [85]. We found that many participants gained a sense of relatedness through the creation and sharing of digital content, including photos, videos, and recordings.

Some participants shared interesting things they found online with their family and friends. P34 talked about using email to share interesting YouTube videos with her friends, such as videos of "magicians and dogs". Others shared content they created themselves, such as photos and videos they took on their phones. For example, P33 enjoyed taking photos while walking in nature. She took pictures of wattle trees and sent the photographs to friends and family, or sometimes posted them on Facebook.

Content creation and sharing contributed to participants' fulfilment of relatedness by enabling conversations and facilitating the sharing of skills to benefit others. Like P39, P24 was a member of the local community radio station. During COVID-19, he kept broadcasting a one-hour music program every week, which included a specific segment about music from the 1940s. As the radio station went online, he was excited to "send a little greeting across the world on the radio" to his friends living in Portugal.

P28's wife was fond of cooking, and she was especially good at making Indian food. During lockdowns, with the help of her grandson, she created many cooking videos and shared them with her extended family members and friends through YouTube. When asked about what motivated this, P28 said:

Those videos were seriously listened to and applied by our friends for their cooking arrangements. And today, some of those friends when they meet us, they remember that we have tried your recipes, and they appreciate my wife for doing that job. . . We did it mostly to help our colleagues and people known to us, to be able to produce good food in the house. As the [restaurants] were all closed during the COVID period, the family were mostly indoors, and they had to cook their own food. These videos did come in handy to them.

4.3.3 Volunteering and peer support. The feeling of being helpful to others is a key aspect of satisfying people's relatedness needs [75]. For older people, this is often achieved through engagement in volunteering activities and peer support [31]. The COVID-19 restrictions greatly impacted people's opportunities to do volunteering activities, as described by P28: "I wanted to give back to the society at my age. . . and that opportunity of giving back was denied during the COVID period."

The loss of opportunities led to reduced social connections, as volunteering was a major component of many participants' social networks. P14 had been living alone for 11 years after her husband passed away, and she did not have any siblings or neighbors. She had been doing volunteer work for many years, and this was her main source of social contact. She had to give up these volunteering activities during lockdowns, which significantly reduced her opportunities to have meaningful social interactions with people.

While some volunteering activities, such as fundraising meetings, could be sustained through Zoom, the type of work people could do on Zoom was very limited, and could not meet everyone's expectations:

For the fundraising activities, even if you can have a meeting through Zoom, you can't have a street stall, people can't sell their badges. We have a lot of volunteers here and a lot of groups in the area, they haven't been able to raise money because you couldn't have all the functions that you did before. . . In a community like ours, you've got the arthritis group, the cancer group, the motor neuron group. It would amount to billions of dollars not raised through events and functions. (P15)

Another type of volunteering mentioned in the interviews was providing peer support to older adults with less experience in using technologies. For example, P9 described participating in a digital coaching program:

For the last two years I've been a volunteer, and one of my activities as a volunteer, last year specifically, was helping people get online after the digital program, helping people set up with Zoom. I'm not an expert, but as an older adult, having to seek help with IT, it's always a traumatic experience. You get a young, 20 something year old who assumes you have considerable IT knowledge, and it's very stressful.

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of
Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

In this example, P9 provided support for older people with similar frustrations with technology. Their similarity in technical backgrounds and empathy for each other gave people like P9 an advantage over those who are younger as digital coaches. However, the COVID-19 situation made it difficult for people to volunteer as digital coaches. When P9 helped other older adults to get online through phone calls, she felt "sometimes it was difficult trying to explain things". It was particularly challenging when there were multiple people in the room:

> The dialogue became difficult, working with two people. Somebody who I couldn't see was trying to help, and I couldn't understand what they were saying. It slowed the process down. . . It was a light bulb moment for the person I was working with, and myself, to be able to see each other face to face. And a sense of achievement for that person on the other end of the line, to be able to think, 'Ah, I've done it!' So that's very satisfying. And it's satisfying for me to think that 'Wow, we've been able to do it.'

As can be seen from the example above, providing peer support over distance was difficult. And when support is provided over the phone, participants could gain less fulfilment from providing support as they could not see each other face to face, which limited their sense of relatedness gained through benefiting others.

5 DISCUSSION

This study aimed to understand how older adults used digital technologies to engage in meaningful activities during COVID-19 lockdowns. We interpreted data from 40 interviews using the lens of self-determination theory (SDT), which enabled us to examine how using technology for meaningful activities can affect older adults' fulfilment of basic psychological needs. These needs are thought to be crucial for personal wellbeing, and for giving people a sense of purpose in life [75], but were threatened by lockdowns associated with the pandemic.

Based on the interview findings, we argue that using technology to engage in meaningful activities can both *support* and *undermine* older people's sense of autonomy, competence, and relatedness. Below, we discuss the challenges and opportunities that participants encountered during the pandemic lockdowns. We then describe how using technologies for meaningful activities both supported and undermined older adults' basic psychological needs. Based on these insights, we propose five implications for designing technology-mediated activities for older adults.

5.1 Challenges and Opportunities Presented During the COVID-19 Pandemic

Our findings shed light on new challenges and opportunities encountered during the COVID-19 pandemic that affected older adults' use of technology for engaging in meaningful activities. In terms of challenges, we saw that participants were sometimes forced to use technology due to the prevalence of virtual-only offerings. Early in the pandemic, many venues started to offer digital-only options to avoid physical contact, including banking, restaurants, concerts, and sports events. Previous research found that when technology became the only option, the issue of digital exclusion became more

serious, leaving some older adults feeling frustrated and alienated [80]. Our findings resonate with this and indicate that online-only programs can negatively affect some older adults' sense of autonomy and competence. Second, older adults' access to in-person technical support was greatly limited by COVID-19 restrictions. This affected some participants' sense of competence when using technologies, especially those who relied heavily on external support. Third, during the COVID-19 restrictions, participants had limited opportunities to engage in volunteering activities, which were a major source of social contact for many of them. While some participants were able to provide and receive remote technology support through video calls, the experience was not satisfactory. This was described as "technical support paradox" in previous work [80]: it is impossible to teach technology through technology to people who do not know how to use it. We suggest that the lost opportunities to benefit others and contribute to society limited participants' satisfaction of relatedness needs.

On the other hand, the pandemic situation introduced new opportunities for engaging in meaningful activities. Many participants gained increased access to online programs and events during the pandemic, because more opportunities became available online and hence supported their need for autonomy. Participants enjoyed being able to attend international exhibitions from home, and they expressed regret if these events were no longer available after the end of the pandemic restrictions. In addition, many older adults adapted their use of technology creatively to the COVID-19 situation, such as in P39's building of a home recording environment, which demonstrated imagination and creativity in the use of technology to meet his needs. Sin et al. [80] suggest that many older adults crossed the digital divide during the pandemic and became savvy technology users. Our findings are consistent with this and further reveal that limited access to in-person technology support pushed many older adults to learn how to solve problems for themselves. This in turn helped them to build independence in their use of technology, and appeared to enhance their sense of competence. The COVID-19 pandemic also encouraged many older adults to adopt new communication technologies to stay connected to loved ones and to share their skills with others, such as P28's story of sharing cooking videos, which contributed to the satisfaction of relatedness needs. These opportunities show that technology was an important outlet for enabling older adults to continue pursuing meaningful activities during the lockdowns. Digital platforms enabled older adults to continue pursuing personally meaningful hobbies and interests, try new things, exercise autonomy in choosing what to do, and develop competence with technology by engaging in these pursuits. This is significant, as without these digital outlets, their personal wellbeing might have been greatly affected.

5.2 How Technologies Support and Undermine Older Adults' Basic Psychological Needs

Our analysis suggests that engaging in meaningful activities through digital technologies can both *support* and *undermine* older adults' needs for autonomy, competence, and relatedness. We discuss each of these in turn.

5.2.1 Autonomy. Our findings emphasize that technologies provide opportunities for older people to access a wide range of activity options to choose from and relate to. Examples from our findings include listening to podcasts, taking virtual tours, visiting virtual exhibitions, attending online courses, doing exercise, playing games, broadcasting, and volunteering. Dendle et al. [20] found that older people had concerns about losing autonomy due to anticipated constraints as they aged, typically from health challenges, economic constraints, or social norms. The virtual nature of digital environments has the potential to remove some real-world constraints and opens up choices that are often unavailable in everyday circumstances [75]. People can easily pursue these activities from home, and it is easy for them to manage their time as many activities do not have a fixed schedule. The need for autonomy is supported through provisions of choice and the encouragement of self-regulation of daily activities. This is especially useful for older people who are not able to participate in in-person activities due to illness, mobility constraints, or geographic isolation. Dowds et al. described digital technology as "a window to the outside world" for older adults who are housebound or socially isolated [22]. Access to virtual worlds also provides *opportunities for action* as people can move through an open environment and participate in day-to-day activities regardless of their physical limitations [81], supporting their need for autonomy.

On the other hand, older adults can be exposed to excessive, irrelevant, and unwanted information when using the Internet. Previous research has shown that the rise of technologies such as smartphones and social media has greatly increased the amount of information people encounter on an average day [21]. The overwhelming stream of information and the constant online interaction with other people can lead to the issue of *information overload*, which negatively affects human behavior and directs users from other important activities in their daily lives [26]. This may lead to a restricted sense of autonomy, due to an ongoing need to filter information and avoid unwanted content. Furthermore, people can be exposed to misleading news and disinformation [79]. While these issues may not be limited to older adults, our findings show that the frustration caused by unwanted information, and concerns about being targeted by miscreants, can discourage older people from using technologies. This can limit their willingness and ability to explore and utilize the full range of functions that technologies provide, undermining their autonomy needs.

5.2.2 Competence. Digital technologies provide opportunities for older people to discover and learn new things, apply skills and effort to different tasks, and gain a sense of achievement. Participants used online platforms such as YouTube and Facebook to learn new hobbies such as crafts, languages, and recipes. Some participants used technologies to support their interests in hiking and gardening. In these cases, the need for competence was supported through the exercise, expansion, and expression of one's talents and capabilities [16]. Similarly, Dendle et al. [20] found that older people value developing new competencies, taking classes, and exploring new hobbies. Extending their findings, we identified examples of older adults gaining competence from creative appropriations of technologies to support individual needs and goals.

According to Orlikowski [60], technology appropriation refers to the various unintended and unexpected ways that technology is used. This could include "*ignoring certain properties of the technology, working around them, or inventing new ones that may go beyond or even contradict designers' expectations*" [60]. In our findings, technologies were sometimes used in ways that were less common or not intended by the designers. P6 shared an example of her 98-year-old mother-in-law receiving emails with the help of her friends who printed the emails out and left them at her mailbox. The use of emails was appropriated to suit the need of the older person, resulting in a blended use of digital and material objects. Richards et al. [68] found that mixing digital with physical artifacts, such as using game pieces to play board games with others over Zoom, can formulate multimodal connectedness for older adults. We argue that these practices of adaptation and appropriation can support older people's application of skills to achieve their goals, contributing to the satisfaction of their needs for competence.

Gaining a sense of competence usually involves the achievement of one's tasks and goals. For older adults, the need for competence can be undermined in three main ways: through age-related loss of functionality [56]; when the tasks and goals are too difficult; or negative feedback is prevalent [75]. Some constraints were caused by the design of the technology, such as frequent system updates and the lack of consistency between versions. These constraints could affect older adults' confidence in using technologies, especially when they received negative feedback from the interface. Previous research has shown that self-learning by trial-and-error is a useful method for developing digital skills [54]. Our findings show that many older adults were hesitant to explore or experiment with their devices because they were afraid of 'breaking' or 'hurting' them. This fear becomes an obstacle to older adults' engagement with technology to pursue meaningful activities and tasks, limiting their sense of competence.

In addition, our findings show that the availability of and reliance on external technical help can affect older adults' satisfaction of competence needs. For older people who rely heavily on external help, inadequate technical support can limit their abilities to use technologies to engage in meaningful activities. For those who are willing to learn how to use technologies, the lack of patience and clear instruction from support providers can reduce their confidence in learning new skills. We conclude that the impact of external technical help on older people's satisfaction of competence needs is conditional, depending on the user's technology experience and willingness to learn digital skills.

5.2.3 Relatedness. Communication technologies can help older people to maintain existing relationships and build new connections, leading to increased social interactions and connectedness [3]. Our findings show that many older people used social media platforms and video conferencing tools to connect to their family and friends, to the local community, and to different social groups. The sense of relatedness can be supported by technologies not only through conversations, but also through being involved in the lives of others, which can foster a sense of intimacy and closeness, as revealed in P15's example of reading bedtime stories to grandchildren. In addition, many participants used technology to engage in shared recreational experiences, such as playing the same word

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of
Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

puzzle games with others. Through collaboration on the same task, people can gain a sense of co-presence and build social bonds with others [10]. The need for relatedness can also be supported through expressions of benevolence to others [75]. Participants used their digital skills and talents for the common good, such as through the creation and sharing of cooking videos (P28) and volunteering as digital coaches (P9). Dendle et al. [20] found that beneficent behaviors were closely aligned with older adults' interpersonal relatedness. Our findings support this argument and suggest that older people's need for relatedness can be supported when using technologies to engage in beneficent activities, such as volunteering and peer support.

On the other hand, some participants complained about the lack of physical interaction with others and reduced verbal communication skills if they relied too much on digital communication platforms. Lindley et al. [50] pointed out that new technologies often entail a shift to 'lightweight' messaging. Examples include texting, sending a picture message, or making a social media post, all of which are performed in discrete but short bursts of time. They found that older adults expressed a preference for 'heavyweight' communications with others, which involve personalized and focused interaction with people and require a commitment of time [49]. This has been described as *effortful communication* in other studies [42]. Some participants in our study mentioned their feelings of frustration when being notified of trivial or irrelevant messages, and they wanted more informative content on social media. Hope et al. [38] found that older adults tend to limit weak ties on social media and focus on the strong ties within their networks. We suggest that older adults' needs for relatedness can be satisfied when communication tools are supplemented by opportunities for deep and effortful communication.

5.3 Designing for Technology-mediated Meaningful Activities for Older Adults

Based on our interview findings, we developed the following implications for the future design of technologies for supporting older adults' engagement in meaningful activities through technology. We particularly point towards how we can design and use technology to maximize the support of basic psychological needs and minimize factors that can undermine people's basic needs.

5.3.1 Empower older adults in the use and production of digital content. Our findings show that older adults can be highly active and resourceful users of technology when the situation requires it, and they can be both consumers and creators of digital content. This aligns with previous research that encouraging older adults to create and share digital content on social media can deconstruct stereotypical discourses about the image of older people [55] and promote citizen dialogue in later life [65]. We suggest that future researchers and practitioners explore new technologies to support older adults' active roles in creating and producing digital content for creative expressions through different platforms, such as Instagram [55] and TikTok [57]. However, generating digital content requires experience and skills in using digital platforms. To accommodate the needs of those older adults who are less confident

with technology, we suggest that intuitive platforms with easy-to-use interfaces should be designed to reduce barriers to creative productions.

5.3.2 Support older adults' engagement in personal interests and passions. Our findings show that older adults used digital technologies to participate in a wide range of activities, which were closely related to their personal interests and goals. Previous research has shown that interest can motivate people's exploration, learning, and engagement in the environment [40]. Intrinsically motivated behaviors are those which people pursue out of interest when they are free from external pressure and demands [17]. In our research, we found that when people tried to use technology to sustain their pursuits in interests, they relied on limited types of existing systems, rather than using platforms that were specifically designed for the activity. A growing body of research is exploring older adults' participation in communities, such as the University of the Third Age, to engage in a wide range of activities for social or recreational purposes [5, 69]. Future research should further explore how interest-led technologies can be designed and implemented in different settings to support older adults' engagement in meaningful activities and fulfil their needs for competence.

5.3.3 Include positive feedback to support technology self-exploration. Our findings suggest that many older adults are afraid of performing incorrect actions when using technology, for fear of breaking the device or making a mistake that is difficult to resolve. Self-learning by trial-and-error is an important way to develop digital skills and confidence and to learn to solve technical problems independently [54], but this can be impeded by feelings of fear and hesitation experienced by some older people. From this struggle, we see an opportunity to design positive feedback on digital systems that can support older adults' independent exploration of technologies. Existing web and mobile interface design guidelines for older adults argued that informative feedback and simple error handling should be included in the system [74]. We argue that *positive feedback* should be added to these guidelines, which means digital interfaces should avoid negative messages and use a more affirmative tone. Future work could develop a more comprehensive guideline for positive interfaces to alleviate older people's fears and support them in their free exploration of the digital world, scaffolding their needs for competence and autonomy.

5.3.4 Provide opportunities for meaningful and effortful communication. Our analysis shows that during the COVID-19 pandemic, many older adults missed physical and in-person interactions with other people. While communication technologies can only supplement, rather than replace, in-person interaction, we believe that there is an opportunity to design technologies that support older adults' needs for meaningful, authentic, personalized, and effortful communication [42]. As suggested by prior work [91], creating meaning in communications can be achieved by providing channels for personalization, bridging physicality, and explicitly revealing the effort involved in creating and sending messages. In our research, we found that the sense of relatedness was supported by technology through shared recreational experiences, which provided a sense of intimacy and closeness. Future researchers and practitioners should further explore ways that can increase older

people's perceptions of the meaning and effort in communication, and design bespoke communication systems that can meet their needs for relatedness.

5.3.5 Support older adults' participation in beneficent activities. Our findings show that engaging in beneficent behaviors can promote older adults' feeling of being an important member of communities and society, which can contribute to the satisfaction of relatedness needs. Engaging in volunteering and making contributions to society is also an essential component of older adults' social connectedness [87]. Previous research has examined the role of older adults as *organizational firekeepers* in passing on organizational practices, maintaining community memory, and ensuring social continuity [13]. The authors designed a project that involved a collaboration between older residents and middle school students, during which the younger members were able to help the older partners learn and apply programming interactions, and the older partners were able to provide knowledge about community issues and interactions [72, 73]. We see an opportunity for future researchers and practitioners to consider ways in which older adults' skills and knowledge can be used to benefit communities, for example through peer support, sharing life experiences with younger generations, helping immigrants integrate into new communities, and teaching languages or musical instruments.

6 CONCLUSIONS

Meaningful activities are crucial for older adults to have a sense of purpose in later life [24]. In this paper, we have investigated older adults' use of digital technologies for meaningful activities during COVID-19 restrictions. We found that the pandemic presented new challenges and opportunities for older adults to engage in technology-mediated activities and fulfill their basic psychological needs. Drawing on Ryan and Deci's [75] self-determination theory, we suggest that older adults' needs for autonomy, competence, and relatedness can be supported by technologies in different ways. These include the ability to engage in self-selected activities, appropriation of technology, content creation and sharing, being involved in others' lives, and benefiting others. However, these needs can also be undermined by factors such as exposure to unwanted information, privacy and security concerns, lack of confidence in using technologies, reliance on external technical help, and lack of deep communication. These insights contribute to a better understanding of the ways that older adults use technology to engage in meaningful activities, and can inform the design and use of future digital systems intended for supporting older adults' basic psychological needs. Based on these results, future work should involve prototyping and evaluating a series of technology-mediated activities for older adults and investigating how these activities are perceived to be *meaningful* for them. This will endeavor to involve older adults' voices in the design of new technology and support older adults' wellbeing through positive computing [12].

ACKNOWLEDGMENTS

REFERENCES

[1] 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. 1-15.

[2] Australian Bureau of Statistics. 2018. Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia. Retrieved from https://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001.

[3] Steven Baker, Jeni Warburton, Jenny Waycott, Frances Batchelor, Thuong Hoang, Briony Dow, Elizabeth Ozanne and Frank Vetere. 2018. Combatting social isolation and increasing social participation of older adults through the use of technology: A systematic review of existing evidence. Australasian journal on ageing 37, 3, 184-193.

[4] Belén Barros Pena, Rachel E. Clarke, Lars Erik Holmquist and John Vines. 2021. Circumspect Users: Older Adults as Critical Adopters and Resistors of Technology. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. 1-14. http://dx.doi.org/10.1145/3411764.3445128

[5] Jeanie Beh, Sonja Pedell and Wendy Doubé. 2016. Evaluation of interest-bridge model: older adults mediated learning of mobile technology. In Proceedings of the 28th Australian Conference on Computer-Human Interaction. 293-301. http://dx.doi.org/10.1145/3010915.3010943

[6] Tony Blakely, Jason Thompson, Laxman Bablani, Patrick Andersen, Driss Ait Ouakrim, Natalie Carvalho, Patrick Abraham, Marie-Anne Boujaoude, Ameera Katar, Edifofon Akpan, Nick Wilson and Mark Stevenson. 2021. Association of Simulated COVID-19 Policy Responses for Social Restrictions and Lockdowns With Health-Adjusted Life-Years and Costs in Victoria, Australia. JAMA Health Forum 2, 7, e211749-e211749. http://dx.doi.org/10.1001/jamahealthforum.2021.1749

[7] Ann Blandford, Dominic Furniss and Stephann Makri. 2016. Qualitative HCI research: Going behind the scenes. Synthesis lectures on human-centered informatics 9, 1, 1-115.

[8] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. Qualitative research in psychology 3, 2, 77-101.

[9] Virginia Braun and Victoria Clarke. 2021. Thematic analysis. Analysing qualitative data in psychology. London: Sage Publications Ltd, 128-147.

[10] Jed R. Brubaker, Gina Venolia and John C. Tang. 2012. Focusing on shared experiences: moving beyond the camera in video communication. In Proceedings of the Designing Interactive Systems Conference. Association for Computing Machinery, Newcastle Upon Tyne, United Kingdom, 96–105. http://dx.doi.org/10.1145/2317956.2317973

[11] Oliver Kisalay Burmeister. 2012. What seniors value about online community. Journal of community informatics 8, 1, 1-12.

[12] Rafael A Calvo and Dorian Peters. 2014. Positive computing: technology for wellbeing and human potential. MIT press,

[13] John M. Carroll, Gregorio Convertino, Umer Farooq and Mary Beth Rosson. 2012. The firekeepers: aging considered as a resource. Univers. Access Inf. Soc. 11, 1, 7–15. http://dx.doi.org/10.1007/s10209-011-0229-9

[14] Montserrat Celdrán, Rodrigo Serrat and Feliciano Villar. 2019. Older adults as internet content producers: Motivations for blogging in later life. In Perspectives on human-computer interaction research with older people, Springer, 169-182.

[15] Triparna De Vreede, Mukhunth Raghavan and Gert-Jan De Vreede. 2021. Design Foundations for AI Assisted Decision Making: A Self Determination Theory Approach.

[16] Edward L Deci and AC Möller. 2005. The Concept of Competence: A Starting Place for Understanding Intrinsic Motivation and Self-Determined Extrinsic Motivation. In Handbook of competence and motivation: Theory and application. , New York: The Guilford Press.

[17] Edward L Deci and Richard M Ryan. 1994. Promoting self-determined education. Scandinavian journal of educational research 38, 1, 3-14.

[18] Edward L Deci and Maarten Vansteenkiste. 2003. Self-determination theory and basic need satisfaction: Understanding human development in positive psychology.

[19] Edward L. Deci and Richard M. Ryan. 1985. Self-determination and intrinsic motivation in human behavior. EL Deci, RM Ryan.−1985.

[20] Kelli Dendle, Laurie Buys, Desley Vine and Tracy Washington. 2022. Fears and freedoms: A qualitative analysis of older adults' basic psychological needs for autonomy, competence, relatedness and beneficence. Australasian journal on ageing 41, 2, 229-236.

[21] Tao Deng, Shaheen Kanthawala, Jingbo Meng, Wei Peng, Anastasia Kononova, Qi Hao, Qinhao Zhang and Prabu David. 2019. Measuring smartphone usage and task switching with log tracking and self-reports. Mobile Media & Communication 7, 1, 3-23.

[22] Gillian Dowds, Margaret Currie, Lorna Philip and Judith Masthoff. 2018. A window to the outside world. Digital technology to stimulate imaginative mobility

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of
Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

for housebound older adults in rural areas. In Geographies of transport and ageing, Springer, 101-130.

[23] Aaron M Eakman. 2013. Relationships between meaningful activity, basic psychological needs, and meaning in life: Test of the meaningful activity and life meaning model. OTJR: Occupation, Participation and Health 33, 2, 100-109.

[24] Aaron M Eakman. 2014. A prospective longitudinal study testing relationships between meaningful activities, basic psychological needs fulfillment, and meaning in life. OTJR: occupation, participation and health 34, 2, 93-105.

[25] Aaron M. Eakman, Mike E. Carlson and Florence A. Clark. 2010. The Meaningful Activity Participation Assessment: A Measure of Engagement in Personally Valued Activities. The International Journal of Aging and Human Development 70, 4, 299-317. http://dx.doi.org/10.2190/AG.70.4.b

[26] Martin J Eppler and Jeanne Mengis. 2008. The concept of information overload-a review of literature from organization science, accounting, marketing, mis, and related disciplines (2004). Kommunikationsmanagement im Wandel, 271-305.

[27] Susan M Ferreira, Sergio Sayago and Josep Blat. 2017. Older people's production and appropriation of digital videos: an ethnographic study. Behaviour & Information Technology 36, 6, 557-574.

[28] Matthew Ford, Peta Wyeth and Daniel Johnson. 2012. Self-determination theory as applied to the design of a software learning system using whole-body controls. In Proceedings of the 24th Australian Computer-Human Interaction Conference. Association for Computing Machinery, Melbourne, Australia, 146–149. http://dx.doi.org/10.1145/2414536.2414562

[29] Grant Gibson, Claire Dickinson, Katie Brittain and Louise Robinson. 2019. Personalisation, customisation and bricolage: how people with dementia and their families make assistive technology work for them. Ageing & Society 39, 11, 2502-2519.

[30] Bluma Goldberg, E Sharon Brintnell and Jack Goldberg. 2002. The relationship between engagement in meaningful activities and quality of life in persons disabled by mental illness. Occupational Therapy in Mental Health 18, 2, 17-44.

[31] Emily A Greenfield and Nadine F Marks. 2004. Formal volunteering as a protective factor for older adults' psychological well-being. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences 59, 5, S258-S264.

[32] Babita Gupta and Anitha Chennamaneni. 2018. Understanding Online Privacy Protection Behavior of the Older Adults: An Empirical Investigation. J. Inf. Technol. Manag. 29, 3, 1-13.

[33] Kristen R Haase, Theodore Cosco, Lucy Kervin, Indira Riadi and Megan E O'Connell. 2021. Older Adults' Experiences With Using Technology for Socialization During the COVID-19 Pandemic: Cross-sectional Survey Study. JMIR aging 4, 2, e28010.

[34] Dave Harley and Geraldine Fitzpatrick. 2009. YouTube and intergenerational communication: the case of Geriatric1927. Universal access in the information society 8, 1, 5-20.

[35] Olivier A Blanson Henkemans, Bert PB Bierman, Joris Janssen, Rosemarijn Looije, Mark A Neerincx, Marierose MM van Dooren, Jitske LE de Vries, Gert Jan van der Burg and Sasja D Huisman. 2017. Design and evaluation of a personal robot playing a self-management education game with children with diabetes type 1. International Journal of Human-Computer Studies 106, 63-76.

[36] RSM Heung and Jean Tak Alice Loke Yuen. 2012. Leisure and older people: a concept analysis, and implications for nursing. The International journal of aging in society: an interdisciplinary journal 1, 2, 55-68.

[37] Stephanie A Hooker, Kevin S Masters, Kaitlyn M Vagnini and Christina L Rush. 2020. Engaging in personally meaningful activities is associated with meaning salience and psychological well-being. The Journal of Positive Psychology 15, 6, 821-831.

[38] Alexis Hope, Ted Schwaba and Anne Marie Piper. 2014. Understanding digital and material social communications for older adults. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. 3903-3912.

[39] Lixiao Huang. 2017. Qualitative Analysis of the Application of Self-Determination Theory in Robotics Tournaments. In Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction. Association for Computing Machinery, Vienna, Austria, 135–136. http://dx.doi.org/10.1145/3029798.3038342

[40] Carroll E Izard and Brian P Ackerman. 2000. Motivational, organizational, and regulatory functions of discrete emotions. Handbook of emotions 2, 253-264.

[41] Ben Jelen, Anne Freeman, Mina Narayanan, Kate M Sanders, James Clawson and Katie A Siek. 2019. Craftec: Engaging older adults in making through a craft-based toolkit system. In Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction. 577-587.

[42] Ryan Kelly, Daniel Gooch, Bhagyashree Patil and Leon Watts. 2017. Demanding by design: Supporting effortful communication practices in close personal relationships. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing. 70-83.

[43] Wiesław Kopeć, Bartłomiej Balcerzak, Radoslaw Nielek, Grzegorz Kowalik, Adam Wierzbicki and Fabio Casati. 2018. Older adults and hackathons: a qualitative study. In Proceedings of the 40th International Conference on Software Engineering. Association for Computing Machinery, Gothenburg, Sweden, 702–703. http://dx.doi.org/10.1145/3180155.3182547

[44] Hanna Köttl, Ella Cohn-Schwartz and Liat Ayalon. 2021. Self-perceptions of aging and everyday ICT engagement: A test of reciprocal associations. The Journals of Gerontology: Series B 76, 9, 1913-1922.

[45] Hanna Köttl, Vera Gallistl, Rebekka Rohner and Liat Ayalon. 2021. "But at the age of 85? Forget it!": Internalized ageism, a barrier to technology use. Journal of Aging Studies 59, 100971.

[46] Shalini Lal, Michael Ungar, Carl Leggo, Ashok Malla, James Frankish and Melinda J Suto. 2013. Well-being and engagement in valued activities: experiences of young people with psychosis. OTJR: occupation, participation and health 33, 4, 190-197.

[47] A. Lazar, A. Pradhan, B. Jelen, K. A. Siek and A. Leitch. 2021. Studying the Formation of an Older Adult-Led Makerspace. Proc SIGCHI Conf Hum Factor Comput Syst 593, 1-11. http://dx.doi.org/10.1145/3411764.3445146

[48] 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.

[49] Siân E Lindley, Richard Harper and Abigail Sellen. 2009. Desiring to be in touch in a changing communications landscape: attitudes of older adults. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. 1693-1702.

[50] Siân E. Lindley. 2012. Shades of lightweight: supporting cross-generational communication through home messaging. Univers. Access Inf. Soc. 11, 1, 31–43. http://dx.doi.org/10.1007/s10209-011-0231-2

[51] Stephen Lindsay, Daniel Jackson, Guy Schofield and Patrick Olivier. 2012. Engaging older people using participatory design. In Proceedings of the SIGCHI conference on human factors in computing systems. 1199-1208.

[52] Jason B. Luoma, Steven C. Hayes and Robyn D. Walser. 2007. Learning ACT: An acceptance and commitment therapy skills-training manual for therapists. New Harbinger Publications, Oakland, CA, US.

[53] Cayley MacArthur, Caroline Wong and Mark Hancock. 2019. Makers and quilters: Investigating opportunities for improving gender-imbalanced maker groups. Proceedings of the ACM on Human-Computer Interaction 3, CSCW, 1-24.

[54] Uwe Matzat and Bert Sadowski. 2012. Does the "do-it-yourself approach" reduce digital inequality? Evidence of self-learning of digital skills. The Information Society 28, 1, 1-12.

[55] Sandra Miranda, Ana Cristina Antunes and Ana Gama. 2022. A different type of influencer? Examining senior Instagram influencers communication. In Proceedings of the 9th European Conference on Social Media. Academic Conferences International, 130-136.

[56] A. B. Neubauer, O. K. Schilling and H. W. Wahl. 2017. What Do We Need at the End of Life? Competence, but not Autonomy, Predicts Intraindividual Fluctuations in Subjective Well-Being in Very Old Age. J Gerontol B Psychol Sci Soc Sci 72, 3, 425-435. http://dx.doi.org/10.1093/geronb/gbv052

[57] Reuben Ng and Nicole Indran. 2022. Not Too Old for TikTok: How Older Adults are Reframing Aging. The Gerontologist.

[58] Novia Nurain, Clara Caldeira and Kay Connelly. 2021. Older Adults' Experiences of Autonomy During COVID-19 Pandemic. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems. 1-6. http://dx.doi.org/10.1145/3411763.3451674

[59] Novia Nurain, Chia-Fang Chung, Clara Caldeira and Kay Connelly. 2021. Hugging with a Shower Curtain: Older Adults' Social Support Realities During the COVID-19 Pandemic. Proc. ACM Hum.-Comput. Interact. 5, CSCW2, Article 463. http://dx.doi.org/10.1145/3479607

[60] Wanda J Orlikowski. 2000. Using technology and constituting structures: A practice lens for studying technology in organizations. Organization science 11, 4, 404-428.

[61] Rebecca Owen, Katherine Berry and Laura JE Brown. 2021. Enhancing older adults' well-being and quality of life through purposeful activity: A systematic review of intervention studies. The Gerontologist.

[62] Alison Phinney, Habib Chaudhury and Deborah L O'connor. 2007. Doing as much as I can do: The meaning of activity for people with dementia. Aging and Mental Health 11, 4, 384-393.

[63] Ivana Piterová. 2020. Older Adults Vulnerability to Fraud: Narrative Review Study. Work and Organizational Psychology, 49.

[64] Arlind Reuter, Tom Bartindale, Kellie Morrissey, Thomas Scharf and Jennifer Liddle. 2019. Older Voices: Supporting Community Radio Production for Civic Participation in Later Life. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, Glasgow, Scotland Uk, Paper 434. http://dx.doi.org/10.1145/3290605.3300664

[65] Arlind Reuter and Jennifer Liddle. 2020. The Later Life Audio and Radio Cooperative: considering radio as a technology to promote citizen dialogue in later life. In 9th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion. 153-157.

[66] Arlind Reuter, Thomas Scharf and Jan Smeddinck. 2021. Content Creation in Later Life: Reconsidering Older Adults' Digital Participation and Inclusion. Proceedings of the ACM on Human-Computer Interaction 4, CSCW3, 1-23.

[67] Olivia K. Richards. 2017. Exploring the Empowerment of Older Adult Creative Groups Using Maker Technology. In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems. Association for Computing Machinery, Denver, Colorado, USA, 166–171. http://dx.doi.org/10.

1145/3027063.3048425

[68] Olivia K. Richards, Gabriela Marcu and Robin N. Brewer. 2021. Hugs, Bible Study, and Speakeasies: Designing for Older Adults' Multimodal Connectedness. In Designing Interactive Systems Conference 2021, Association for Computing Machinery, 815–831. http://dx.doi.org/10.1145/3461778.3462075

[69] Valeria Righi, Sergio Sayago and Josep Blat. 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, 15-31.

[70] 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. 3913-3922.

[71] Andrea L Rosso, Jennifer A Taylor, Loni Philip Tabb and Yvonne L Michael. 2013. Mobility, disability, and social engagement in older adults. Journal of aging and health 25, 4, 617-637.

[72] Mary Beth Rosson and John M Carroll. 2003. Learning and collaboration across generations in a community. In Communities and technologies. Springer, 205-225.

[73] Mary Beth Rosson, John M Carroll, Cheryl D Seals and Tracy L Lewis. 2002. Community design of community simulations. In Proceedings of the 4th conference on Designing interactive systems: processes, practices, methods, and techniques. 75-83.

[74] Ljilja Ruzic, Seunghyun Tina Lee, Yilin Elaine Liu and Jon A Sanford. 2016. Development of universal design mobile interface guidelines (UDMIG) for aging population. In International Conference on Universal Access in Human-Computer Interaction. Springer, 98-108.

[75] Richard M Ryan and Edward L Deci. 2017. Self-determination theory: Basic psychological needs in motivation, development, and wellness. Guilford Publications,

[76] Rachel D Savage, Sophia Di Nicolo, Wei Wu, Joyce Li, Andrea Lawson, Jim Grieve, Vivek Goel and Paula A Rochon. 2022. The Factors Associated With Nonuse of Social Media or Video Communications to Connect With Friends and Family During the COVID-19 Pandemic in Older Adults: Web-Based Survey Study. JMIR aging 5, 2, e34793.

[77] Sergio Sayago, Paula Forbes and Josep Blat. 2012. Older people's social sharing practices in YouTube through an ethnographical lens. In The 26th BCS Conference on Human Computer Interaction 26. 185-194.

[78] Isabel Schwaninger, Christopher Frauenberger and Geraldine Fitzpatrick. 2020. Unpacking Forms of Relatedness around Older People and Telecare. In Companion Publication of the 2020 ACM Designing Interactive Systems Conference. Association for Computing Machinery, Eindhoven, Netherlands, 163–169. http://dx.doi.org/10.1145/3393914.3395867

[79] Kai Shu, Amrita Bhattacharjee, Faisal Alatawi, Tahora H Nazer, Kaize Ding, Mansooreh Karami and Huan Liu. 2020. Combating disinformation in a social media age. Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery 10, 6, e1385.

[80] Frances Sin, Sophie Berger, Ig-Jae Kim and Dongwook Yoon. 2021. Digital Social Interaction in Older Adults During the COVID-19 Pandemic. Proc. ACM Hum.-Comput. Interact. 5, CSCW2, Article 380. http://dx.doi.org/10.1145/3479524

[81] Stephanie Stewart, Terri S Hansen and Timothy A Carey. 2010. Opportunities for people with disabilities in the virtual world of Second Life. Rehabilitation Nursing 35, 6, 254-259.

[82] Gareth Terry and Nikki Hayfield. 2020. Reflexive thematic analysis. In Handbook of qualitative research in education, Edward Elgar Publishing.

[83] Laura Tierney and Elizabeth Beattie. 2020. Enjoyable, engaging and individualised: A concept analysis of meaningful activity for older adults with dementia. International journal of older people nursing 15, 2, e12306.

[84] April Tyack and Elisa D. Mekler. 2020. Self-Determination Theory in HCI Games Research: Current Uses and Open Questions. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, Association for Computing Machinery, 1–22. http://dx.doi.org/10.1145/3313831.3376723

[85] Marie Jacqueline van de Goor. 2021. Wonderful life: The power of sharing and reflecting on meaningful moments. thesis. Univesity of Twente,

[86] Kimberly S Van Haitsma, Kimberly Curyto, Katherine M Abbott, Gail L Towsley, Abby Spector and Morton Kleban. 2015. A randomized controlled trial for an individualized positive psychosocial intervention for the affective and behavioral symptoms of dementia in nursing home residents. Journals of Gerontology Series B: Psychological Sciences and Social Sciences 70, 1, 35-45.

[87] Jenny Waycott, Frank Vetere and Elizabeth Ozanne. 2019. Building social connections: a framework for enriching older adults' social connectedness through information and communication technologies. In Ageing and Digital Technology, Springer, 65-82.

[88] 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.

[89] Jenny Waycott, Frank Vetere, Sonja Pedell, Amee Morgans, Elizabeth Ozanne and Lars Kulik. 2016. Not For Me: Older Adults Choosing Not to Participate in a Social Isolation Intervention. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, San Jose, California, USA, 745–757. http://dx.doi.org/10.1145/2858036.2858458

[90] Xi Yang and Marco Aurisicchio. 2021. Designing Conversational Agents: A Self-Determination Theory Approach. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, Yokohama, Japan, Article 256. http://dx.doi.org/10.1145/3411764.3445445

[91] Lei Zhang, Tianying Chen, Olivia Seow, Tim Chong, Sven Kratz, Yu Jiang Tham, Andrés Monroy-Hernández, Rajan Vaish and Fannie Liu. 2022. Auggie: Encouraging Effortful Communication through Handcrafted Digital Experiences. arXiv preprint arXiv:2207.07771.

[92] Wei Zhao, Ryan Kelly, Melissa Rogerson and Jenny Waycott. 2022. Understanding Older Adults' Participation in Online Social Activities: Lessons from the COVID-19 Pandemic. Proc. ACM Hum. -Comput. Interact 6, CSCW2, Article 470. http://dx.doi.org/10.1145/3555571

Older Adults Using Technology for Meaningful Activities During COVID-19: An Analysis Through the Lens of
Self-Determination Theory

CHI '23, April 23–28, 2023, Hamburg, Germany

A A APPENDICES

A.1 Participants Demographics

ID	Age	Gender	Metropolitan or Regional	Living Status	Communication technologies used during the pandemic
P1	84	F	Metro	With partner	Zoom, Facetime, Facebook, email, texting, phone call
P2	66	F	Metro	With partner	Zoom, Facebook, WhatsApp, email, texting, phone call
P3	68	F	Metro	Alone	Zoom, Facebook, WhatsApp, email, texting, phone call
P4	68	F	Metro	With partner	Zoom, Facebook, email, texting, phone call
P5	84	F	Metro	With children	Zoom, Facetime, Facebook, email, texting, phone call
P6	74	F	Metro	With partner	Skype, Facebook, WhatsApp, email, texting, phone call
P7	71	F	Metro	Alone	Zoom, Skype, Facebook, WhatsApp, email, texting, phone call
P8	75	F	Metro	With partner	Zoom, Facebook, Messenger, email, texting, phone call
P9	71	F	Metro	Alone	Zoom, Skype, WhatsApp, Facebook, Twitter, email, texting, phone call
P10	78	F	Metro	Alone	Zoom, Facebook, Twitter, Messenger, email, texting, phone call
P11	82	F	Metro	Alone	Facebook, Messenger, email, texting, phone call
P12	81	F	Regional	Alone	Zoom, WhatsApp, email, texting, phone call
P13	68	F	Regional	With partner	Zoom, Facebook, WhatsApp, email, texting, phone call
P14	79	F	Metro	Alone	Zoom, email, texting, phone call
P15	73	F	Regional	With partner	Zoom, Facebook, Messenger, email, texting, phone call
P16	81	M	Regional	With partner	Zoom, Facetime, WhatsApp, email, texting, phone call
P17	80	F	Metro	Alone	Zoom, email, texting, phone call
P18	73	F	Regional	With partner	Zoom, Facebook, email, texting, phone call
P19	69	M	Metro	With partner	Zoom, Facetime, Facebook, WhatsApp, WeChat, email, texting, phone call
P20	69	F	Regional	With partner	Zoom, Facebook, Messenger, email, texting, phone call
P21	73	F	Metro	Alone	Zoom, Facetime, Facebook, Messenger, email, texting, phone call
P22	69	M	Regional	Alone	Zoom (once), email, texting, phone call
P23	66	F	Metro	With partner	Zoom, Facetime, Facebook, WhatsApp, WeChat, email, texting, phone call
P24	75	M	Metro	Alone	Facetime, Facebook, Instagram, email, texting, phone call
P25	75	M	Metro	Alone	Zoom, email, texting, phone call
P26	71	F	Metro	With partner	Zoom, Facetime, Facebook, WhatsApp, email, texting, phone call
P27	65	F	Metro	Alone	Zoom, Microsoft Teams, WhatsApp, email, texting, phone call
P28	76	M	Metro	With partner	Zoom, WhatsApp, email, texting, phone call
P29	73	M	Metro	With partner	Zoom, Facetime, WhatsApp, Messenger, email, texting, phone call
P30	83	F	Metro	Alone	Zoom, WhatsApp, email, texting, phone call
P31	75	F	Metro	Alone	Zoom, Facebook, Messenger, email, texting, phone call
P32	70	F	Regional	With partner	Zoom, WhatsApp, Messenger, Facetime, email, texting, phone call
P33	84	F	Metro	Alone	Zoom, Facebook, Messenger, email, texting, phone call
P34	77	F	Metro	Alone	Zoom, Facetime, Facebook, Messenger, email, texting, phone call
P35	67	F	Metro	With partner	Zoom (once), WhatsApp, Signal, email, texting, phone call
P36	66	F	Metro	Alone	Zoom, email, texting, phone call
P37	75	F	Metro	Alone	Facebook, email, texting, phone call
P38	70	F	Metro	Alone	Zoom, Skype, Messenger, Viber, email, texting, phone call
P39	70	M	Metro	With partner	Zoom, Houseparty, email, texting, phone call
P40	83	F	Metro	Alone	Zoom, Facebook, email, texting, phone call