Getting Closer

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Designing Personalized and Meaningful Technology with Older Adults

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PROEFSCHRIFT

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CHAPTER 1

Introduction

1.1 The Ageing Society

We are living longer than ever in many developed countries, which is a major accomplishment (Nassir, Leong, and Robertson 2015). This is happening at a large scale as stated by the World Health Organization (WHO) in 2019, there were 1 billion people aged 60 years and older. The WHO predicts that in 2030 this will increase to 1.4 billion and in 2050 to 2.1 billion (World Health Organization 2020). The rapidly increasing ratio of the number of older adults aged 65 and above to working-age citizens (Eurostat 2018) will put enormous pressure on the EU's healthcare systems, which working-age taxpayers mainly fund.

The ageing society brings more challenges worldwide. For example, the availability of professional care and social support in China is under pressure because of financial and labor market constraints (Chen et al. 2016). In Australia, the ageing society has also led to considerable policy analysis and discussion considering the economic consequences (McPake and Mahal 2017). Particularly in The Netherlands, they predict in 2050 there will be a phenomenon called double ageing. This means both the number of people of 65 years and older is increasing, which is expected to rise from 3.4 million in 2020 to 4.8 million in 2050 (NIDI and CBS 2020) and we will live longer, causing the number of people aged 80 years and older to increase due to life expectancy increasing from 800.000 in 2020 up to 2.6 million in 2050 (NIDI and CBS 2020).

This chapter provides an overview of the background of the research contexts and related earlier research. This section is structured in five subsections: 1) the ageing society, 2) the role of technology, 3) how older adults are portrayed by society, 4) from deficit-driven design towards positive ageing, and 5) approaches to designing for ageing. Subsequently, we will elaborate more about this research by introducing our research questions, sharing our approach and discussing the overview of this thesis.

> **We are living longer than ever in many developed countries, which is a major accomplishment.**
> (Nassir, Leong, and Robertson 2015)

Successful ageing has become an essential view to describe the quality of ageing, it supports addressing ageing with positivity, however, we also acknowledge the challenges of this term for lesser abled people. The definition of successful aging by Rowe and Kahn (1997) consists of three main components: low probability of disease and disease-related disability, high cognitive and physical functional capacity, and active engagement in life. In other words, successful ageing considers how to expand healthy and functional years in life expectancy (Urtamo, Jyväkorpi, and Strandberg 2019). Next to these health domains, Fernandez-Ballesteros (2019) defines successful ageing by activities of daily living (ADL), physical and cognitive functioning, social participation and engagement, and positive affect and control.

In our work, we are mainly interested in the activities of daily living (ADL) and active engagement in life. As many older adults want to live longer independently at home as they age (Ahlqvist, Nyfors, and Suhonen 2015), homes need to support the maintenance of daily independence and social contact (Barrett, Hale, and Gauld 2011). Wang et al. (2019) describe that the preference of older adults to age in place, to remain independent and live at home or within one's community (Sumner et al. 2020), is widely recognized (Matsumoto et al. 2016; Boldy et al. 2011; Eckert, Morgan, and Swamy 2004).

1.2 The Role of Technology

To address the needs of older adults, we can look at technology to provide support and enable people to live independently longer. To design technology for older adults, people's formative years should be taken into account, meaning that older adults are familiar with technology in these years and less with the current technology (Docampo Rama 2001). Currently, there are many digital developments targeted at older adults, such as technologies that promote exercise (Stuckey, Carter, and Knight 2017), prevent falls (Barros, Leitão, and Ribeiro 2014), facilitate cognitive training (Klimova and Valis 2018), foster independent living (Wang et al. 2019), stimulate on-going engagement in meaningful activity and promote community connectedness (Chamberlain, Craig, and Dulake 2019).

People aspiring to age in place can benefit from these opportunities. However, how and why people use and adopt technology varies between older adults, and in situ research about aging in place is limited (Peek et al. 2015).

Currently, society continues to enjoy many digital developments for older adults, but these often hold negative stereotypes and bias of old age.

Therefore, designers need to consider – when designing technologies to age in place well – what emotionally drives older adults in using these technologies, next to their function (Barnard et al. 2013). In addition, the value of the newly introduced technology should be clearly communicated to older adults for them to recognize the potential usefulness and benefits (Mitzner et al. 2010).

Unfortunately, though, technology for older adults often holds negative stereotypes and biases of old age (Lazar et al. 2017). Ageing has typically been framed as a problem that can be "managed" by technology (Vines et al. 2015), which neglects the growth, creativity, and development occurring in older adulthood (Brewer and Piper 2016). Alternatively, we want to view technology as a facilitator to maintain quality of life and even enrich it, taking a positive rather than a problem-related approach.

1.3 How Older Adults Are Portrayed by Society

Older adults are often seen as a homogenous user group while they, in fact, are an extremely diverse group (Lu et al. 2019; Eisma et al. 2003; Hatcher et al. 2019). Users cannot be generalized, because people have different needs, wants, and dreams (Brown and Katz 2011). Furthermore, users, and especially older adults, have knowledge that designers or other experts lack because older adults may have a very different life (van Doorn and Klapwijk 2013) and have widely varying abilities (Cabrita et al. 2015; Gregor, Newell, and Zajicek 2002; Lerouge et al. 2011). The diversity of older adults should be considered when designing technologies, products, and services, as solutions will not be suitable for an entire population.

**The individual needs
of older adults
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rather than relying on
stereotypes of elderly
as a group.**

Vines et al. (2015) describe that when analyzing 644 ACM SIGCHI papers, older adults are characterized in research as having a range of health concerns, experiencing physical and cognitive decline, performing slow with technology, and experiencing social isolation and a loss of independence. These may promote stereotyping if design researchers only focus on these, so therefore design researchers should look at people as individuals rather than representatives of a particular age group or disability (Pullin and Newell 2007), because an older adult is not just the sum of their obtained impairments (Whitney and Keith 1998). In this work, we align with the World Health Organization (2020), who express that health is a state of complete physical, mental and social well-being, and not just the absence of disease.

Maintaining selfhood while getting older is important for older adults (Cedervall, Torres, and Åberg 2015). Selfhood is defined by three parts, namely 1) the self of personal identity, 2) the self of a person's physical and mental attributes, and beliefs concerning these characteristics such as traits and skills, and 3) the self of social roles, which is developed over the lifespan in various situations (Cedervall, Torres, and Åberg 2015). It is therefore important we understand and contribute to selfhood and design for people's emotions and personalities. As such, design can promote and facilitate successful ageing, because the resulting solutions are more personal (Chapman, Hampson, and Clarkin 2014).

1.4 From Deficit-driven Design Towards Positive Ageing

With deficit-driven design, the approach targets problems, such as growing old alone and isolated, and aims to reduce such deficits (Carroll et al. 2011). As Nassir, Leong, and Robertson (2015) highlight, positive ageing acknowledges an increased likelihood of older adults experiencing functional decline but focusses on a positive approach to identify opportunities that can support independence and social agency (Robertson et al. 2012; Durick et al. 2013; Light, Leong, and Robertson 2015).

Researchers in the field of HCI are shifting the focus from challenges to interests (Lazar and Nguyen 2017). In particular, when creating technological solutions to deal with the ageing challenges such as social isolation and health issues, the focus is not just on compensating for the perceived deficits, but also about fulfilling the people's needs and interests, for example, how their personal histories impact technology use (Carroll et al. 2011; Rogers and Marsden 2013; Vines et al. 2015).

In this thesis, we include a personal perspective of the individuals to improve their quality of life through design, rather than to rely on stereotypes of older adults. We look at enriching a current individual and personal experience – so not necessarily starting from a problem but looking for opportunities.

**We focus on
opportunities
instead of
problems.**

As Righi, Sayago, and Blat (2017) also describe, the most predominant conceptualization of older adults in literature sees them as individuals in need of help, due to age-related decline in functional abilities and with limited or no experience of using technology. However, in contrast, more and more research portrays older adults now as individuals who can use technology and – despite their age - contribute to their family and society (Rogers et al. 2014; Carroll et al. 2011).

1.5 Approaches to Designing for Ageing

Addressing (social) challenges around ageing can be done through design, which helps to transform abstract ideas into prototypes (Manzini 2015). Designing artefacts provokes critical reflection on the context (Bowen and Chamberlain 2008). And an iterative design process can provide quick insights through low fidelity prototypes (Botero and Hyysalo 2013).

In design, empathy is essential to see and understand people, their full lives, social networks, and feelings (Mattelmäki and Battarbee 2002). Successfully creating meaningful concepts as designers or researchers largely depends on the level of understanding and empathy designers can gain for the target group (Smeenk et al. 2018). Designers can provide tools to assist the user in bringing forward the expertise of their own experience (Visser et al. 2005). There are several empathic methods where participants reflect on their personal experiences (Kouprie and Visser 2009), such as context mapping to understand people's interaction with products (Visser et al. 2005), generative techniques to facilitate users in making artefacts to generate a personal perspective (Stappers, Sleeswijk-Visser, and Keller 2003) and probing techniques to trigger inspirational response by maps, postcards, cameras and/or booklets to explore a design space (Gaver, Dunne, and Pacenti 1999). With probes, boundaries are offered to let the user creatively contribute to research in an open and sharing way (Wallace, Wright, et al. 2013).

With co-design, people who are not trained in design creatively work together with designers in the design process (Sanders and Stappers 2008). We will execute co-design workshops as these are a way to include older adults in developing technology, and it has shown to be effective in including people's perspectives (Hakobyan, Lumsden, and O'Sullivan 2015; Botero and Hyysalo 2013; Massimi, Baecker, and Wu 2007; Sorgalla et al. 2017; Ambe et al. 2019).

Designers can provide tools to assist the user in bringing forward the expertise of their own experience.

Design workshops can, for example, envision the future of Internet of Things technologies at home (Pradhan et al. 2020) or design mobile applications which support and promote physical activity and wellbeing (Swallow et al. 2016). Furthermore, we see how designing "visual prompts" such as scenarios make a solution more present and vivid to a user (Orso et al. 2015).

Next to these creative design methods in which making often occurs, designers apply methods from other fields as well to learn from older adults. For example, focus groups provide insights into the implementation of technology to age in place (Peek et al. 2016; Hakobyan, Lumsden, and O'Sullivan 2015). Focus groups offer qualitative data collection in an open and exploratory way (Krueger 1998). Another example is interviews to incorporate older adults' values in the design (Coleman et al. 2010) or to investigate the role of social and tangible technologies to maintain good habits when getting older (Robertson et al. 2012). An advantage of 1-on-1 interviews is that others do not influence someone's opinion, which could be the case in a group setting (Ireland 2003).

We are interested in exploring how participatory methods and tools can be used, adapted and created to suit a particular person in his or her context and background, because it is stated by Leong and Robertson (2016) that contextualizing and tweaking these is essential to achieve that these methods and tools work effectively in very specific situations. Further research is needed regarding the workshop dynamics and supporting participation (Pradhan et al. 2020).

1.6 Our Research Questions and Thesis Overview

As we illustrated by the sections above, the work presented in this thesis is characterized by three themes, which are covered in three parts: 1) in situ research on ageing in place: why older adults used smartphones and how they learned it, 2) exploring personal interests and leisure activities of older adults informing design, and 3) focusing on a positive approach identifying opportunities and creating personalized designs.

Part 1 – EXPLORE – Chapter 2

Firstly, we aimed to understand the current context of older adults who use technology, what they valued in it. More specifically, we required a better understanding of the motivators for older adults to use technology to understand how this impacts acceptance (Wildenbos, Peute, and Jaspers 2018). This was important because everyday tasks can be facilitated by technology, thereby enabling older adults to remain independent longer (Mitzner et al. 2010; Peek et al. 2015).

Furthermore, we aimed to understand the type of training that worked best in getting acquainted with new technology (Hickman, Rogers, and Fisk 2007). This resulted in research question 1 to understand people's personal motivations to use and learn mobile technology:

RQ1

How can we better understand why older adults use technology that supports successful ageing and how they learn to use it?

We conducted a field study with seven participants to gain a better understanding of what motivates older adults to use smartphones and their learning process.

In Chapter 2, we found motivating factors for using a smartphone and factors contributing to a pleasant learning environment, such as tools that grew along with older adults and 'super-users' who facilitated learning in a social setting.

Part 2 – ENGAGE – Chapter 3 and 4

Secondly, the value of older adults to participate in a co-design process is recognized, however challenges remain as Van Kleef, van Trijp, and Luning (2005) describe three reasons to consider when gathering user's input as they: 1) may not be aware of their needs, 2) may not be able to formulate their needs and 3) may not be eager to speak about their needs. Hence a strong relationship and collaboration between design researcher and older adult was needed to unfold this together.

Therefore, we wanted to engage older adults in research and design. We did that in the context of leisure time, as personal interests are an important contributor to successful ageing (Kahlbaugh and Huffman 2017). Leisure activities extend the years of independent living, decrease disability and enhance the overall quality of life (Aldrich 2004). Huang, Lee, and Chang (2007) also claim that people who participate in leisure activities feel their quality of life is higher. Lazar and Nguyen (2017) sum up a number of health benefits when engaging in certain leisure activities such as higher cognitive functioning (Litwin, Schwartz, and Damri 2017), a lower risk of dementia (Verghese 2003) and greater mental wellbeing (Lampinen et al. 2006). Collecting hobby information in a workshop setting was, therefore, the main purpose of the user research tool. Focusing on personal interests in leisure time allowed us to better understand of their past, present, and potential future lives. Thus, it was important to answer the following research question:

RQ2

How can the personal interests and leisure activities of older adults inform design for successful ageing?

We created and used a storytelling tool based on leisure time activities with six participants, to get a better understanding of the daily lives of older adults, and empower them to express themselves. Based on these findings, we co-designed with 42 participants, built, and evaluated a smartphone walking application to stimulate physical activity with 16 participants.

In Chapter 3, we found that our participants felt there was a lack of people to engage with in activities, even though they had an existing social network. Furthermore, we revealed what impactful experiences limit or promote engagement with an activity. Finally, we stated mixed opinions towards stereotypical hobbies and activities for older adults. We presented designers design opportunities to consider in a design.

In Chapter 4, we found that the community valued our walking application because it was based on their interests. The participants preferred quality rather than the quantity of physical activity. We provided designers with meaningful personal motivations to develop successful ageing interventions. Following this, we wanted to pay more attention to their individual perspective.

Part 3 – ENRICH – Chapter 5

Thirdly, personalization in design needed further investigation to consider individual experiences (Pullin and Newell 2007). Focusing on specific individual needs can also contribute to advancements in technology, and outliers, meaning extra-ordinary cases, may inspire design because of their particular behavior. For example, in the case of Stephen Hawking, where they gave him a voice using custom-made technology, but these developments also significantly contributed to text-to-speech research and software advancement (Bertelsen et al. 2019). This example showed how a personal approach can provide meaning to a broader audience.

Furthermore, Chamberlain, Craig, and Dulake (2019) developed a tangible tool facilitating older adults to reflect on platform requirements to promote healthy activities, and found the ability to personalize technology was by far the most desirable design consideration. Therefore, more research was needed to know how personalization can be expressed in design, resulting in research question three:

RQ3
How can we improve the design of technology for successful ageing through a personalized process?

Therefore, we set up personal design processes to investigate personalization in a design and a design process and the experiences of older adults and designers with this process.

In Chapter 5, we analyzed three student design projects and formulated ways to improve the designing for one approach (Wilkinson and Stones 2018) and further personalize the participation of older adults in design. Thus, we were able to reflect on how such a personalization in design and design process contributed to creating technologies for older adults.

Thesis Overview

The three parts explore, engage, and enrich, are presented in a graphic overview (see Figure 1).

As discussed in the previous section, we present four studies: a product evaluation of the GoLivePhone (Chapter 2), a storytelling tool called the Leisure Time Canvas (Chapter 3), a design case with Ommetje (Chapter 4), and a design case called Personal Design Processes (Chapter 5).

In Chapter 6, the discussion and conclusion, we will distill the previous chapters' studies. To conclude, we provide recommendations for future work, reflecting on the limitations of our work.

Part 2 Engage

Part 1 Explore

Study 2:
Leisure Time
Canvas
Tool creation

Study 1:
GoLivePhone
Product evaluation

Part 3 Enrich

Creating and using
a leisure time
storytelling tool
to understand and
empower older
adults in the design
process

Study 3:
Ommetje
Design case

Study 4:
Personal Design
Process
Design case

Understanding
personal motivations
for smartphone
technology use and
the learning process

Introduction

Co-designing and
evaluating a walking
application

Exploring
personalization
in design

Discussion and
Conclusion

Chapter 1

Chapter 2

Chapter 3
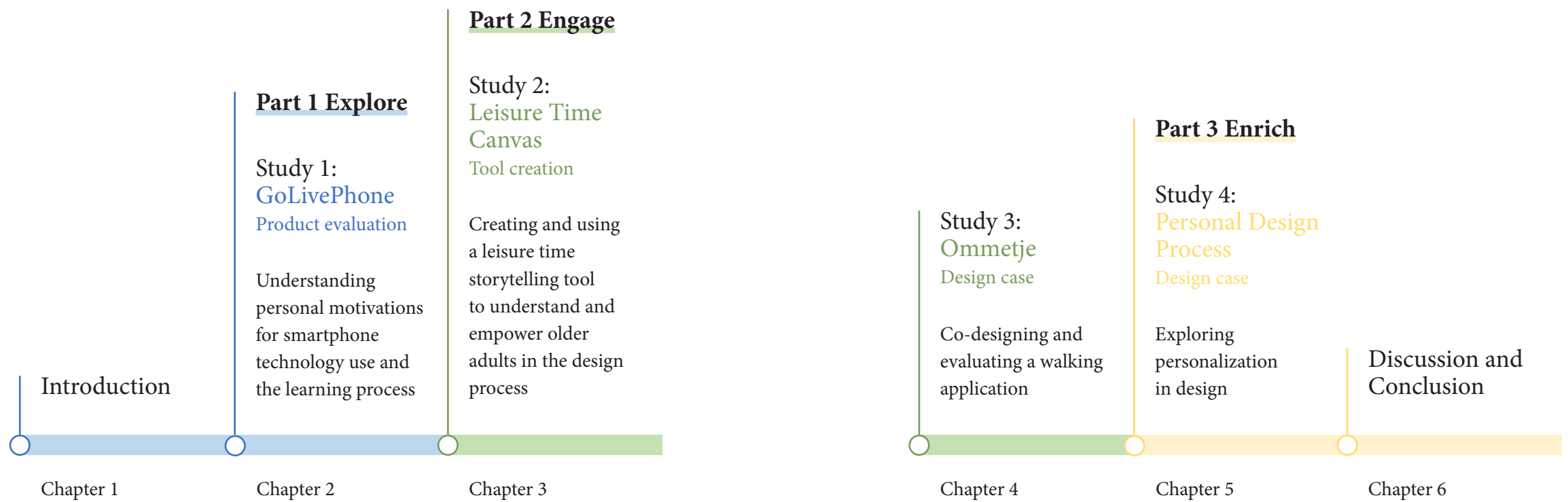
Chapter 4

Chapter 5

Chapter 6

Figure 1. The three parts explore, engage, and enrich
are presented in this thesis overview.

1.7 Research Approach

User-involvement is acknowledged to be essential in design. In research and design activities, it can mainly show positive effects on 1) quality and speed of the research and design process, 2) better match between solution and user, and 3) an increased user satisfaction (Kujala 2003). Additionally, involving users in the early stages of a project facilitates exploration and articulation of problems, opportunities, ideas, and concepts (Steen, Kuijt-Evers, and Klok 2007).

Research through design stresses design artifacts as outcomes to transform the world from a current to a preferred state (Zimmerman, Forlizzi, and Evenson 2007). This means making a product, prototype, scenario, mock-up, or detailed concept to be able to experience it (Koskinen et al. 2011). The aim is to collect (design) knowledge instead of creating a finalized design product (Zimmerman, Forlizzi, and Evenson 2007). We chose to use the research through design approach because it allows executing qualitative research in a real-life context and encourages to create prototypes through "learning by doing" (Van den Hoven et al. 2007). The strength of qualitative research is to learn about the voices of marginalized people in their everyday lives (Warren-Findlow 2013). Qualitative research can offer insights into why people engage in certain actions or behaviors (Rosenthal 2016). To evaluate whether the designs that we created actually positively impact older adults, in-context evaluation is essential to improve ecological validity (Koskinen et al. 2011). Field research is important to be able to study things in their natural setting, meaning in a place where at least a part of a design is intended to be used (Brankaert and den Ouden 2017).

The design projects in this thesis adhered to a Human-Centered Design process, meaning users are the focal point of the design and the design process (Brown and Katz 2011). This process addresses our vision to examine the needs, dreams, and behaviors of the people. It consists of the following three iterative phases:

1. Collecting stories by conducting field research (Hear)

2. Translating stories into frameworks, opportunities, solutions, and prototypes, while regularly shifting between concrete and abstract (Create)

3. Testing the design in a real-life context (Deliver)

To meet the purpose of modernizing the perception of old age, it is essential to apply an inclusive approach of human-centered design as this directly involves them in the design process and asks them to express their needs either directly or through the interpretation of designers (Pericu 2017).

We followed these three phases in this order in Chapters 4 and 5. In Chapter 2, we describe the deliver phase with testing existing technology. Chapter 3 describes phases 2 and 3 by creating and using our canvas to collect stories and define opportunities.

Experiences in Human-Centered Design

One example of a Human-Centered Design process is an easy-to-use messaging radio for people with dementia (see Figure 2), that facilitates them to stay up to date with the lives of their loved ones (Wintermans, Brankaert, and Lu 2017). In that study which was executed prior to this PhD, we used a mixed-method approach, including a group session, probes, and an in-context evaluation.

Figure 2. Executing the Human-Centered Design process resulting in an easy-to-use messaging radio for people with dementia.

This project 'Stay Tuned!' shows how to involve cognitively impaired participants in a co-design process, especially because people with dementia are often replaced in development by proxies such as a partner. We were able to develop a radio with an old familiar shape, but with modern technology inside. Loved ones could record audio messages using WhatsApp and send these messages to the radio. The two participants who used the prototype for 10 days at home, could simply rotate the knob to a family member's picture to play the audio messages. One beautiful quote that was written down in the user diary was: "I like the radio in our home. He also does. He starts to shine. The radio fits our interior, it looks cosy."

We discussed in this section how user-involvement is essential, and how through a design research approach, we execute qualitative research in context. We show that we adhere to a Human-Centered Design process and showcase this through our earlier work 'Stay Tuned!'. In this thesis, we build further to explore personal design approaches for older adults.

PART 1

EXPLORE

In the first part, explore, we aim to understand older adults in relation to technology. Looking at the current context of older adults who use and learn technology, what they value in it.
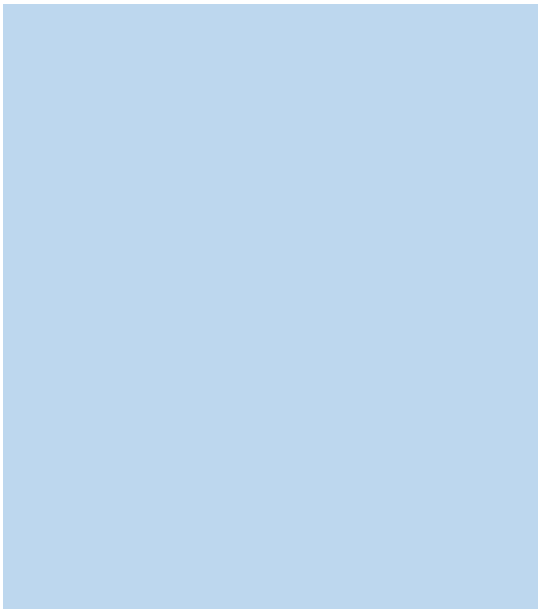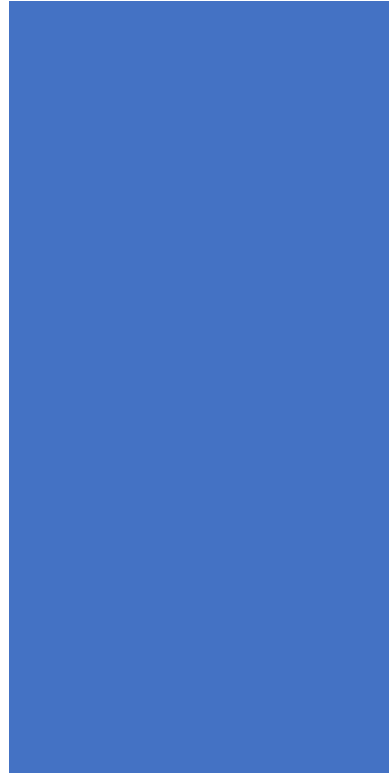
CHAPTER 2

Evaluating Smartphone Technology to Age in Place

This chapter is based upon:

den Haan, Marjolein, Rens Brankaert, Gail Kenning and Yuan Lu. 2021. "Creating a Social Learning Environment for and by Older Adults in the Use and Adoption of Smartphone Technology to Age in Place." In Frontiers Public Health – Aging and Public Health.

Smartphone technologies can support older adults in their daily lives as they age in place at home. However, they may struggle to use these technologies which impacts acceptance, adoption and sustainable use. Peer to peer community learning has the potential to support older adults to learn using (smartphone) technologies. This chapter studies such a learning community approach and how it can support older adults to learn using and adopt the smartphone application GoLivePhone.

In this chapter we answer the following research question (RQ1): How can we better understand why older adults use technology that supports successful ageing and how they learn to use it?

To answer this question, we will first elaborate on our study set-up. This chapter shows a field study with seven older adults learning and using the GoLivePhone technology through a living lab approach. These older adults participated in this research in a technology learning community that was set-up for research purposes. For this we used ordinary Samsung A3 smartphones with the simplified GoLivePhone software, particularly designed for older adults. It included health related services such as fall prevention and detection, activity tracking, and an interface that can adapt according to users' changing ability, knowledge and situation. We explored the determining factors that prompted older adults to start using a smartphone technology and facilitated continued use. We provide insights into how peer to peer community learning can contribute, and found both super-users and recall tools to be helpful to support sustainable use of smartphone technology to support older adults to age in place.

2.1 Background Information on Mobile Health Interventions and Peer Learning

Several studies have shown the challenges and opportunities of mobile health interventions. Joe and Demiris (2013) argue that older adults are more likely to have a mobile phone than a desktop or laptop. Therefore, mobile phones seem an ideal technology platform to reach many older adults.

Furthermore, Klasnja and Pratt (2012) reviewed the body of work on mobile phone health applications and concluded that there were five intervention strategies for such applications: 1) tracking health information, 2) involving the healthcare team, 3) receiving support from your social environment, 4) increasing the health information accessibility and 5) promoting entertainment. All of these could potentially support older adults to age in place.

However, there remain challenges with regard to using mobile health technology for older adults, for example, Wildenbos, Peute, and Jaspers (2018) state cognition, physical ability, perception, and motivation to negatively impact using mobile technology. Other barriers include issues with familiarity, willingness to ask for help, trusting technology, privacy, and challenges in catering for physical and cognitive changes associated with aging (Fischer et al. 2014). Additionally, another study found that tablets are currently too complex and recommend reducing available options on them (Vaportzis, Clausen, and Gow 2017). Furthermore, there is a need to ensure there is appropriate support matching the experiences of older adults with (self) supporting measures, tools and social networks (Müller et al. 2015; Vaportzis, Clausen, and Gow 2017; Fondevila Gascon et al. 2015; Seifert, Reinwand, and Schlomann 2019), that the context for use is optimized (Peek et al. 2015), and that actions are performed along with peers to positively influence learning (de Sales et al. 2009).

In this study we therefore apply a peer learning model as it provides older adults with an effective and rewarding learning environment (Clark et al. 1997). We used a specific peer learning model, called super-users, which are people with similar social-cognitive profiles to the participants, yet trained in providing expertise on the technology at hand. In our work, we study a specific mobile technology, the GoLivePhone, via a Living Lab approach.

In this we explore how new technology is used in the 'real-life' and engage with people in-context (Bergvall-Kåreborn and Ståhlbröst 2009). The Living Lab setup allows participants to become active contributors during the evaluation of technology (Brankaert and den Ouden 2017).

2.2 The study - Materials and Methods

Smartphone technologies can support older adults as they age in place in their homes. However, adoption of smartphone technology is often still challenging for older adults. This chapter engages with a community of independent older adults aged between 66 and 86 from a predominantly rural area in the Netherlands, while they learn how to use the novel smartphone technology. During this smartphone learning class we investigated the participants' motivators and barriers to start and continue learning using the smartphone technology; to observe older adults and understand how they learned, what facilitated this learning and to provide insights to the smartphone company.

We explored through the study: How can we better understand why older adults use technology that supports successful ageing and how they learn to use it?

In the following sections, we will elaborate on: 1) the use of peer-to-peer teaching and a learning class in a Living Lab approach, 2) the role of participants as users and super-users, 3) the specific smartphone technology used, and 4) how data was collected.

The Use of Peer-to-peer Teaching and a Learning Class in a Living Lab Approach

Over the course of a 13-week period, seven older adults met every Friday afternoon from 2 pm to 4 pm as part of a smartphone learning class (with four peer teachers). The atmosphere of the sessions was informal with the group sitting around a coffee table in a community center called 'The Living Room'. The community center was close-by for all older adults, being in the city center of a village, so they could easily reach it. This contributed to the sustained attendance of the group. The room was equipped with a projector and projector screen, which the lead researcher used to introduce the research study to potential participants through a presentation.

Members of the smartphone learning class were invited to take part in a series of focus groups over a period of 5 weeks (out of the 13 weeks class). The focus group methodology was used to follow users' progress as they learned how to use a smartphone (Ireland 2003). Based on existing studies using focus groups it was expected that data saturation would be reached within five weeks, and attending the full thirteen weeks would not provide additional information (Guest, Namey, and McKenna 2017). For the five weeks when the focus groups took place two researchers were present during the session, and particularly at the end of the session most of the interaction took place between researchers and participants.

A predefined set of topics was developed for discussion to capture prevailing opinions about smartphone technologies and evaluate usage and general experience. Participant responses were written down by the participants themselves, and in the final session, additionally, a transcript of an audio recording was made. All written answers and the transcript were coded by the lead researcher and analyzed by all co-authors.

This approach was selected as it could provide feedback that could contribute to innovating technology development and use through the involvement of participants in a real-life setting (Dell'Era and Landoni 2014). It could also promote group interaction and so provide better insights into the experiences and opinions of the participants (Barrett and Kirk 2000).

The Role of Participants as Users and Super-users

A call for attendees for the smartphone learning class was made by an older adult, who had previously been trained in using the technology (identified in the research as a super-user), through a local association for older adults and a local newspaper.

Attendees of the class were offered an opportunity to become acquainted with a smartphone aimed at fostering longer independent living. The class objective was to educate the local community by using volunteers and working with the local municipality and the local older adults association, to improve the environment for aging. The research study participants were the attendees of these pre-arranged learning sessions who agreed to take part in the focus groups and to be observed by researchers.

The number of participants in the learning experience and the research study was small to ensure personal feedback could be provided to everyone who participated and to be manageable for the super-users to teach effectively.

The research study was part of the European AAL project ENSAFE (Ruis 2017) which aimed to support effective prevention and self-care strategies for older adults to foster independent living. We were not required by the university to obtain formal approval through an ethics board, however general ethical procedures were followed to protect the participants. All participants in the research study signed a consent form agreeing to share their experiences which would be de-identified and analyzed anonymously. The participants were made aware of how to contact the researchers for concerns, their participation was voluntary, and they could withdraw at any point. To ensure the overall well-being of all participants, one older adult, who hosted the learning session as a so-called super-user, was in charge of communicating to the researcher any discomfort or health issues expressed by participants.

The study participant group consisted of seven older adults who wanted to learn to use the smartphone, referred to as 'users' (see Table 1). For the research study, this constituted a purposive sample providing information-rich, in context, qualitative data (Creswell and Clark 2007). This sample size is appropriate for findings that are not intended to be generalizable across populations but are transferable to context-specific populations.

P	Living situation	Frequency of using technology	Perceived technology level
1	Living independently	Daily	None
2	Living with partner	N/A	N/A
3	Living independently	Daily	Low
4	Living with partner	Daily	Low
5	Living with partner	Daily	None
6	Living independently	Daily	Low
7	Living with partner	Daily	Low

Table 1. Background information about the seven participants (P).

The hosts or facilitators of the learning sessions, were called super-users because of three main characteristics, they: 1) were experienced users of this particular smartphone, 2) have similar social-cognitive profiles to the participants, meaning a similar age range and similar ability, and 3) trained in providing expertise on the technology at hand.

These super-users, like the general attendees (users) were invited to become participants in the research study, with their presence, activities and influences observed alongside the other participants. Along with introducing and teaching the system step-by-step, these super-users simplified the text and structure of a printed manual based on what the company of the smartphone technology provided on their website, enabling the users to continue practicing at home. This reflects the position of Mitzner et al. (2010), who suggests a manual 'may not be optimal because they contain tech jargon'.

The four super-users had been in a similar program before and were informed and educated about the particular smartphone prior to the sessions and could download and install software on a Samsung Galaxy A3 (2016) using a descriptive manual provided by the company. A one-hour follow-up session of questions was organized by the company.

The Specific Smartphone Technology Used

The technology used in the learning class and research study was a smartphone Samsung A3 with a custom GoLivePhone user interface on 'top' of the usual interface, explicitly designed for independently living older adults to age in place (see Figure 3).

'Independently living older adults' refers to older adults living with or without a partner in a regular home environment. The custom interface aims to make the interaction with the technology easier for older adults by offering clear pictograms, sizable icons, and high contrast.

Figure 3. The smartphone specifically designed for and evaluated with older adults, picture by Gociety Solutions in 2017.

In addition to the common smartphone applications, this smartphone offers, amongst other things, fall prevention tips, fall detection, automatic activity tracking, and guidance to home or parking place (GocietySolutions 2020). If desired, older adults can enable the sending of a warning to their (grand) children whenever a fall is detected or when a GPS zone is crossed (digital fencing), all aimed to create a digital remote support network to allow people to age in place.

For the participants, keeping an overview on your health in this way was compared to taking your car for a regular check-up, showing how it could automatically track their activity by them simply carrying the smartphone in their pocket. Comparing their own health to car maintenance provided a metaphor to explain the concept of the technology and made users conscious about healthy aging as suggested by Mitzner et al. (2010) when trying to clarify the potential benefit that technologies can bring.

The learning class introducing the smartphone focused on introducing three functionalities in the first session, to make the learning process manageable. These include connecting to Wi-Fi, managing contacts, and reaching out to somebody (either by calling or by using messaging service WhatsApp).

In the second session, these functionalities were repeated, and three more functionalities were added, namely: using the camera, exploring photos via an album and sharing photos and videos using WhatsApp. All functionalities can be individually enabled or disabled in the main menu, in line with the older adult's interests, ability, and learning pace. An explanation of how to do this themselves was also given in the second session. To conclude, a group WhatsApp was created amongst participants for them to practice sharing photos and videos.

In the third session, they repeated taking and sharing photos and videos. In addition, a new functionality was introduced to connect family members to their accounts, so they receive a notification if a fall occurs —if the user permits. In the fourth session, particular GoLivePhone applications were introduced, and in the final fifth session, a group discussion was done which was audio-recorded and the older adults were thanked for their participation in our research and given a postcard with a small present to thank them for their contribution in the study.

How Data Was Collected

We held an open focus group after the learning class to let users reflect and voice their perspectives on the technology and learning process. This allowed older adults to actively participate and make their voices heard as equal partners in their introduction to, and assessment of the technology. The data were subject to a thematic analysis (Braun and Clarke 2006). This analysis was used to search for themes and patterns across the entire data set, rather than focusing on the responses of individual participants. By doing so, we found recurring use patterns for the whole group. The thematic analysis contained six phases, using the procedures described by Braun and Clarke (2006): 1) familiarize yourself with the data by reading and noting down initial ideas, 2) generate initial codes across the entire data set, 3) search for potential themes by gathering codes, 4) review these themes and create a 'map' of the analysis, 5) define and name each theme more to refine the specifics of each theme, and 6) produce the report on the final analysis with the selection of vivid, compelling extract examples.

2.3 Results

Background information about the seven participants (P) is shown in Table 1, based on multiple-choice questions in which the frequency of using technology and 'tech-savviness' of the participants were self-reported. For example, participants advised if they used desktop computer, phone (without internet), tablet, e-reader, smartphone, camera, smart television, technological care services or other technology. The only exclusion and inclusion criteria were that they need to be able to read the smartphone screen and be physically able to interact with it, and so in practice, this meant most of the participants had not used a smartphone before.

Through a process of familiarization with the focus group data, initial codes were generated, and searches for potential themes were carried out. The two main overarching themes were related to 'learning' and 'personal motivations', each with multiple themes and subthemes (see Table 2). 'Learning', related to how people prefer to learn, which tools contribute to learning, and who facilitates learning. 'Personal motivations', related to information about why people started using the phone and what keeps them motivated to continue doing so. We will provide more details on these themes and illustrate the content by including quotes from participants. As the researcher joined five of the sessions, we will phrase the specific quotes of participants (P) and super-users (SU) in time as Q1, Q2, Q3, Q4, and Q5, respectively.

Learning

Learning consisted of four themes: 1) step-by-step, 2) repetition, 3) tools, and 4) learning facilitators.

How People Prefer to Learn (step by step and repetition)

The general view on the technology was clear: "It [GoLivePhone] is easy to use." (P7, Q1), and "It [interface] has big tiles, and the overview is not cluttered." (P4, Q2). We found step-by-step introductions, in both the course material and the number of technological functionalities offered at once, were key factors to facilitating learning: "Take it easy, step by step!" (P5, Q3).

	Theme	Subthemes
Learning	Step by step	In class guidance Introduction of technology options
	Repetition	
	Tools	Manual Quick reference guide
	Who facilitates the learning	
Personal motivations	Why start	Preparation for the future Move with the times
	Social	
	Product-related values	Feeling of safety Accessibility

Table 2. Our thematic analysis with the two overarching themes 'learning' and 'personal motivations' including their themes and subthemes.

Also, frequent repetition is essential: "I see the GoLivePhone as a tool to become more knowledgeable." (P3, Q4) but, he added, "People have to explain it to me 2-3 times." (P3, Q5).

Which Tools Contribute to Learning

The smartphone community relied on one particular learning tool, which is a manual containing all course material: "If you practice using the GoLivePhone for a week and then do not use it for a month, you lose how to work with it. I am not sure I can remember everything, so that is why I need a step-by-step manual to help me out." (P4, Q5). However, at the final evaluation, super-users initiated the request for a quick reference guide as well, of which all participants agreed: "It is difficult for people to start using the GoLivePhone. It would be handy to have a short recap for every application for daily use, to be able to look something up quickly." (all SU, Q5).

Who Facilitates the Learning

Learning to use smartphone technology in a group setting was experienced as positive and motivating: "I think it is very motivating to participate with multiple people. You can exchange experiences, and you do not feel so alone." (P4, Q5) and "I think it is a nice club. It is a little difficult though." (P1, Q3). Furthermore, both the super-users and peers were appreciated as the relationship continued to be built: "I think it is very nice they [super-users] organized this course because I can practice the manual, challenge my difficulties and try to make it a nice thing [smartphone] for myself!" (P3, Q5) and "We get to know each other better." (P4, Q3).

A conversation between two participants in the final evaluation, shows their concerns about the appropriateness of using a phone in the presence of others. They felt technological interactions were taking over regular day-to-day interactions. P4, Q5: "I think it is necessary and valuable that super-users can give extra explanation personally in-between if you cannot keep up with the speed of the group lesson." P3, Q5: "But people also explain things to each other on a birthday. She goes on to explain her concern of how this is interfering. "Then there is this couple explaining things to each other, while they should celebrate a birthday! Then I think, what are you doing?"

Personal Motivations

Personal motivations for smartphone use focusses on three different themes: motivation to use the smartphone, social motivators, and product-related values.

Motivations to Use the Smartphone

Within this theme, there were two prominent subthemes. Firstly, the need to prepare for the future and, for example, for health-related purposes: "I think an advantage is the tips we get from the medical applications for elderly people." (P6, Q1). They expected that getting used to new technology might become more difficult as they aged: "Start using the GoLivePhone now, before you cannot learn it anymore." (P7, Q3).

Secondly, there was a perceived need to "Move with the times." (P5, Q1) as to be valued as part of ongoing society: "Everything I learn helps to keep up with the modern times." (P3, Q4) and "I think it is convenient to use a timer on the GoLivePhone because my granddaughter said an egg timer is old-fashioned." (SU3, Q5). However, some participants explained they had limited time to practice the GoLivePhone: "There are functionalities which I cannot manage, and that is because I am swamped and have limited time to sit down and work on it." (P4, Q5) and "I do not have time to use it, and I find it difficult, I am 86 years young." (P1, Q3).

While the participants were motivated to respond to the calls put out by the hosts to come and learn how to use these phones, it is possible they would have responded to the call for the use of any phone, but because this had an interface designed for older adults it may have been more encouraging because they knew the technology was aimed at people like them.

Social Motivators

Participants are very enthusiastic because it offers connectivity to their families: "I use WhatsApp [a simple messaging service] to communicate with my grandchildren!" (P5, Q1) and "When I try to call my children, then they might not be home or do not pick up the phone. However, with WhatsApp, you are in contact immediately. I like it because I am sure I get a response, and I think they like the fact that I am not bothering them for half an hour during a phone call." (P4, Q5).

Similarly, P2 appreciates that she can keep in contact with her children: "I can see how my kids are doing, without even picking up the phone!" (P2, Q1) But she does not want the phone to replace all communication: "I use WhatsApp a lot, but I hardly make a phone call. I think WhatsApp replaces calling. However, I do not want to give a lot of personal details; I do not like that. I also do not like meeting people who are walking in the park, only looking at their phones." (P2, Q5). Careful attention should be paid to the latter statement as a smartphone, according to her, has both positive and negative connotations.

Product-related Values

Within this theme, participants gave a few examples of product-related values, as the smartphone is most commonly used for communication: "An advantage is to be able to have contact with my girlfriend. It generates more contact with people." (P3, Q2). It is also interesting to note attitude towards the perceived usefulness of the technology towards the end of the study: "Calling and WhatsApp are the biggest advantages to me." (P6, Q4), "There are a lot of nice things in the GoLivePhone." (P1, Q4), "I use WhatsApp, calling, and internet the most." (P5, Q3) and "The smartphone is indispensable for me now." (P5, Q3). In addition, the technology gave people a feeling of safety: "It is handy to have such a phone with you." (P1, Q2) and "I think sending messages, calling, taking pictures and having a backup in case of an emergency, are the advantages to me." (P4, Q1).

It is interesting to note the different perceptions of the warning feature to informal caregivers. One participant stated, "I am healthy, so I do not need this feature yet." (P4, Q5) and someone else mentioned, "They do not always need to know where I am, I think it should be possible to disable this functionality." As the alarm functionality also shared the location, it would be interesting to see when older adults make the change from wanting to maintain their privacy to wanting to benefit by sharing information about their health with caregivers. Interestingly, a super-user's mother is using the GoLivePhone, and the super-user mentioned this location information gave a feeling of security from the caregiver perspective: "When they are away together, they are actually not alone [because she knows where her parents are in case of an emergency]." (SU1, Q5).

2.4 Discussion

In this research, we found strategies to facilitate smartphone learning and identify the daily motivations of using this technology for aging in place. This study findings are potentially transferable to a similar context such as a small group of older adults learning new technology in a social setting and might inspire other smartphone technology research projects. The study also contributes to our general understanding of learning and using smartphone technology.

How People Prefer to Learn

People made use of the two learning styles we offered: 1) practicing at home using the manual, and 2) coming to class and learning with and from peers.

Manual and Quick Reference Guide

Both the manual and quick reference guide were perceived as a comforting backup reference, both for learning the complete functionalities in detail (manual) and for looking things up quickly (quick reference guide). The manual used needs to match the level of expertise of the participants. Research suggests sharing notes is an ICT learning strategy when people translate the formally written manual to a more understandable and personalized style (Sayago, Forbes, and Blat 2013). Here the super-users were able to do this translation. This addresses the need that was recommended by Fondevila Gascon et al. (2015) to provide clearer manuals. This highlights how the communication style most fitting this group was the translation from a company manual to an improved version, through the eyes of an older adult. So, rather than peers sharing their personalized notes, the super-user can adapt the manual before handing it out in class.

Furthermore, we found it was valuable for people to be able to dedicate time for specific prioritization of different functionalities. This reflects the position of Müller et al. (2015) by creating anchor points to connect technology with people's daily lives. The super-users can then suggest specific pathways for learning using the manual, but the older adult can decide which track is most meaningful for them. This promotes autonomy for the older adults, to consider their learning styles, interests and expectations (Martínez-Alcalá et al. 2018).

The course material consisted of an extensive text-driven binder explaining all functionalities and steps in detail. These step by step instructions are known to enable participants to learn faster and more accurately (Hickman, Rogers, and Fisk 2007).

In addition, the participants also requested a quick reference guide as a tool for small reminders. We created this guide focusing on specific interactions, resulting in a low-text A4 page. This addresses the needs of people who have a basic understanding already and know most steps to be executed. The quick reference guide provides security rather than being needed all the time. This guide also allows for a quick lookup of functions related to the most frequently used daily tasks. By facilitating this, we enable them to take control of their learning (Mitzner et al. 2008).

Also, the older adults in this community associated the course material and quick reference guide as 'trustworthy' and 'comforting'. We observed that it is comforting for people not to have to remember everything at once in class and to have the opportunity to extend and practice to learning at home. We recommend including these tools in the learning process so that it becomes an integral part of the technology proposition itself.

Physical Classroom

We found needs regarding the learning process on several levels: 1) the individual (older adult), 2) the super-user (older adult, facilitator), and 3) the group (all older adults together in class). The super-users who facilitate the course need to be as motivated as others (de Sales et al. 2009). Our results show general guidelines that can be followed, such as having one-on-one interaction with super-users to discuss what the focus of the next meeting should be. We also learned from our participants that the regular face to face sessions with peers made them confident learners. Seeing that others can use the technology, made participants feel they could do it as well, and so it became a joint effort in the use of new technology (Barnard et al. 2013).

Who Facilitates the Learning

In being part of a community, people are motivated to address and work on their difficulties together. Sayago, Forbes, and Blat (2013) addressed this as collaborative and informal learning. Collaborative learning proves to be more effective for older adults than competitive or individual learning (Sayago, Forbes, and Blat 2013). In this work, we proposed two separate levels of collaborative learning: peers and super-users.

Peers

With peer learning, we saw the informal in-between class learning in their natural social environment (de Sales et al. 2009), where people help each other, so everybody learned at the same pace. They all have the same goal to get acquainted with technology, as the technology has been unfamiliar from the start for all of them, together they make faster progress in learning.

Super-users

In addition to peers, super-users were the people who hosted the session, who took the lead in facilitating which steps to practice next and joined in executing tasks together. Master-apprentice roles is an acknowledged way of learning (Calvert 2014), that transfers to this context, to make this work trust in each other is essential. The availability of support, in this case through super-users, influences how older adults experience certain challenges (Barnard et al. 2013). And sometimes super-users changed roles between facilitating and being a peer learner, as they relearn and repeat steps with their peers one on one.

Sustainable Learning Process

The compelling aspect of this collaborative learning community is that peers can grow towards becoming super-users, which turns this approach into a sustainable learning process in the community. We have seen one year after this project, there have been four different groups practicing the smartphone, and from this study, everyone became a super-user later. Not only users become super-users but they continue to enjoy this role as super-user. Although this is outside the scope of our research, we have seen new users continue to learn in this group and super-users continue to teach. Potentially this is because of the living lab set-up, as this is an organized learning club and people value to teach and learn in this setting. This makes it more than a one-time interaction as part of a project, but shows a long-term collaboration.

It is a low-cost way to facilitate teaching, and the social value of getting together to learn with peers is an essential motivator. We believe this role of super-user stimulates continued learning, as people seem to value being recognized as a super-user (Morrison and McCutheon 2019). This credit gives an extra stimulus for participants to become super-users.

Acknowledgement and Support from the Municipality

We have seen this growing group of older adults to come together and learn has caught attention from the municipality as they benefit from a healthier and happier community. Therefore, the municipality subsequently subsidizes the ongoing service costs of the smartphone for all participants who accomplished the first class. This need for organizational collaboration is expressed by policy advisors in order to enable successful implementations of technology for aging in place (Peek et al. 2016). Furthermore, participants of the smartphone classes gained recognition as they were acknowledged in a local news article and received a certificate of their successful participation (see Figure 4).

Informal Atmosphere

We saw a social atmosphere where people shared personal learning stories. Work from Sayago, Forbes, and Blat (2013) shows such learning does not depend on knowing more or less as your peers, but the social and informal atmosphere itself is motivating.

We saw through this informal atmosphere, that accepting new functionalities was easier, as users saw their peers using this. However, there is a limit to this informal setting, for two participants a birthday gathering was not appropriate for example. This shows, on the one hand, the integration of the device in people's daily life but, on the other hand, some non-acceptance (yet) of others. We believe the learning atmosphere should be informal, but the importance of attending classes and of making use of fixed timeslots to learn together needs to be emphasized.

We have seen our participants had a busy lifestyle, we observed people needed frequent repetition. By having a dedicated timeslot to learn, they could keep up with the pace.

Personal Motivations

Within the category of personal motivations concerning smartphone use, we will elaborate on three different themes: motivations to use the smartphone, social motivations, and product-related values.

Figure 4. The 'graduates' of several smartphone classes together getting their certificates, picture derived from public database Punt24 with their permission (2017).

Motivations to Use the Smartphone

Preparing for the Future and Not for Me (yet)

Participants indicated one reason for joining the class is preparing for the future, when they might be more dependent. This illustrated how the participants were engaged in future thinking (Light, Leong, and Robertson 2015). This need is prevention-driven, to prepare for the changes which might follow in later life when more support is needed. Most participants saw the smartphone as a system, which could help them to achieve that and provide a feeling of being prepared. Not only did they think about the use of a specific application for today or tomorrow, but the motivation for some of our participants was also to get acquainted with the smartphone before they could not learn it because, for example, the onset of dementia. They saw the smartphone as a means of giving them a secure, safe, and in control perspective on the future. In addition to keeping up with modern times, as reflected in the findings of Rosales et al. (2017).

We found our participants were still healthy and not in need of the health support functions of the smartphone technology yet. Literature shows that older adults perceive certain stigmas with technology designed for them, such as is discussed in the work of Neven (2010) where participants imagined potential users of a health robot as a lonely person who is in need of care and company.

However, our participants mentioned that it motivated them to start using the smartphone, and getting acquainted with the novel technology now, and be able to start integrating the device into their daily lives. This makes sense for older adults who want a device that addresses their current needs and to use a technology shaped in dialogue with their everyday practice now (Righi, Sayago, and Blat 2017), with options to support them in a different way later with regard to their personal health. As was shown by their wanting to move with the times, and not be left out (Vaportzis, Clausen, and Gow 2017), our participants happily agreed to learn a smartphone now 'with some additional care functions for later'.

Fun and Social Functionalities

Often technology focusses on what is no longer possible, trying to 'solve aging problems' (Lazar et al. 2017). However, we saw that the value technology brings is much more than that. It creates opportunities to enrich people's daily life. For example, it is an easy way to stay in contact when living far away from each other.

Therefore, we have to recognize and emphasize the need for fun and social smartphone functionalities (such as WhatsApp) in addition to care functionalities (such as fall prevention). These do not have to be contradictory or independent from each other (Mitzner et al. 2010). People might not feel like they need care services but instead want to interact and share meaningful things with their surrounding network (Rogers et al. 2014). These motivators can be used to fuel learning and link a technology to different essential real-life needs (Sayago, Forbes, and Blat 2013), which can be complementary to daily life now as well as in the future.

Social Motivators

Emotional Response to Technology

Sayago et al. (2013) suggest learning is driven by real-life situations, such as a son who keeps telling his parents to learn to use email for communication. Children could for example lay a major role in motivating technology addition as suggested by Fausset et al. (2013). And even if the older adults themselves do not believe it is important, if family members think it is important, they may still comply with them (Venkatesh and Davis 2000). Our study showed, in the communication and use of WhatsApp, that the smartphone technology facilitated participants to stay in touch with social networks. These findings expand on existing literature showing that in addition to showing a willingness to use technology, it is crucial to building the experience towards not only a functional response but an emotional one such as facilitated by social contact (Barnard et al. 2013).

Immediate and Flexible Contact

As people value the smartphone as an enabler to have contact with their loved ones (Vroman, Arthanat, and Lysack 2015), they also specifically point out the value of immediate and flexible contact. Our participants compare sending a message versus a phone call and prefer the message so that their busier family members can respond any time rather, and they do not feel like they are bothering them with a long call. This extends the findings of Lindley, Harper, and Sellen (2009), saying that older adults do not want to become burdensome or intrusive when staying in contact.

Product-related Values

Security and Privacy

While we see, in general, a positive view of people expressing why they value the smartphone, the security and privacy topic still evoked mixed responses among the participants. On the one hand, our participants suggested they feel safer because in our system they could chose an informal caregiver to reach out to them and monitoring their location, whenever in need of help. On the other hand, participants mentioned they value their privacy and do not want to be tracked by anyone else (Niemeijer et al. 2015). This is a personal preference, and in some cases, it is the older adult and, in some cases, it is the (informal) caregiver who might feel safer due to the technology. With our smartphone, older adults can decide with whom they share information, which is important for data privacy (Mittelstadt et al. 2011). There we propose that the freedom of choice should always be facilitated by technology, also in the case of people in need.

2.5 Concluding this Chapter

The research described in this chapter was executed to answer the following question:

How can we better understand why older adults use technology that supports successful ageing and how they learn to use it?

First, why older adults use technology that supports successful ageing. Müller et al. (2015) states the importance to create anchor points to connect technology with people's daily lives. We found such anchor points by not only preparing for the future, as technology often focusses on solving aging problems (Lazar et al. 2017), but we recognized and emphasized the need for fun and social functionalities – reflecting to let technology not only provide a functional but also an emotional response (Barnard et al. 2013).

Second, how older adults learn technology. Research in ICT learning strategies shows that product manuals need to be clearer (Fondevila Gascon et al. 2015). The translation of manuals can be done e.g. by sharing notes between participants (Sayago et al. 2013). Our research shows that super-users can already provide the participants with a translated manual.

Furthermore, step by step instructions are known to enable participants to learn faster and more accurately (Hickman et al. 2007). We've added the quick reference guide next to the manual, which accompanies the learning curve of users from novice to more advanced.

PART 2

ENGAGE

In the second part, engage, we will work with older adults to design new technology that is based on their personal interests. We want to understand better how people spend their leisure time and investigate how to design for this. This part consists of two chapters: in Chapter 3 we elaborate on the storytelling tool we created called the Leisure Time Canvas, and in Chapter 4 we share the development process and evaluation of our walking application Ommetje.
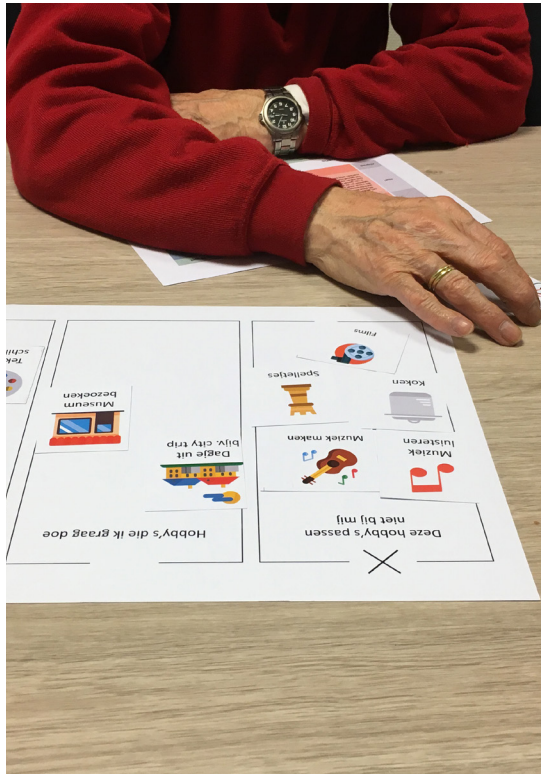
Creating and Using a Storytelling Tool
about Leisure Time

This chapter is based upon:

In Chapter 2, we evaluated the GoLivePhone and found changing personal motivations to use technology for successful ageing. Leisure time activities contribute to successful ageing and can provide input to develop better fitting and fun technology. This can, in turn, lead to better adoption of technology. However, the challenge is that users may find it complicated to express themselves and designers may have difficulties taking their perspective and emphasizing them. Therefore, this brings us to the current chapter, where we answer the following research question:

How can the personal interests and leisure activities of older adults inform design for successful ageing?

To answer this question, we created and used a storytelling tool called the Leisure Time Canvas. First, we will provide background information on leisure time and define three challenges when gathering user input. Then, we elaborate on the creation of the canvas: why we created it, how to use the canvas, and where it is based upon. Furthermore, we will report on using the canvas with six participants and discuss the related findings. Lastly, we will conclude this chapter with our main insights on creating and using the Leisure Time Canvas.

3.1 Background Information on Leisure Time and Challenges when Gathering User Input

To understand people's different needs, wants, and dreams, we are interested in the leisure time context – to understand people's individual preferences. People's hobbies and leisure time activities present an opportunity to contribute to successful ageing (Kahlbaugh and Huffman 2017) and connect to older adults on a personal level. As we shared in the introduction, it is important to maintain selfhood, and this is shaped through hobbies and leisure time because they are often expressed throughout a lifetime (Cohen-Mansfield, Parpura-Gill, and Golander 2006). In this thesis, leisure activities are seen as 'preferred and enjoyable activities participated in during one's free time' (Chang, Wray, and Lin 2014). Leisure activities extend the years of independent living, decrease disability, and enhance the overall quality of life (Aldrich 2004). Huang, Lee, and Chang (2007) also claim that people who participate in leisure activities feel their quality of life is higher.

User involvement is acknowledged to be essential in design. In research and design activities, it can mainly show positive effects on 1) quality and speed of the research and design process, 2) better match between solution and user, and 3) an increased user satisfaction (Kujala 2003). Van Kleef, van Trijp, and Luning (2005) describe three reasons to consider when gathering user's input as they: 1) may not be aware of their needs, 2) may not be able to formulate their needs, and 3) may not be eager to speak about their needs. Hence users need adequate facilitation when involved in the design process. It is essential to overcome these challenges because users, especially older adults, have knowledge that designers or other experts lack (van Doorn and Klapwijk 2013). Designers and researchers can provide tools to assist the user in becoming an 'expert of their own experience' (Sanders and Stappers 2008). However, there are no concrete tools to facilitate this, particularly targeting hobbies and leisure time activities. Therefore, we developed the Leisure Time Canvas.

3.2 Creating a Storytelling Tool about Leisure Time

In this section, firstly, we will discuss why we created the Leisure Time Canvas. Secondly, we will explain how to use the canvas in detail. Thirdly, we will discuss where the canvas is based upon.

Why the Leisure Time Canvas

There are two main reasons why we created this storytelling tool. Firstly, to capture user insights of older adults, we need to take a more active approach in empathizing with them.

Secondly, the literature suggests that focusing on hobbies and leisure time activities would help designers gain a better insight into older adults and eventually contribute to successful ageing.

User Research Methods with Older Adults

Understanding your user's daily life and interests is essential in providing insights that can be leveraged to define new design opportunities. Understanding your user is important in general, but even more so because of the diversity in needs of older adults (Cabrita et al. 2015; Gregor, Newell, and Zajicek 2002; Lerouge et al. 2011). Furthermore, designers may have difficulties understanding their perspectives and empathize with them. Different user research methods gather user insights, such as interviews, observations, workshops and multiple empathic methods.

Multiple empathic methods can be used to let users reflect on their personal experiences (Kouprie and Visser 2009). These include context mapping, to learn the users' product interaction (Visser et al. 2005), generative techniques to support users in creating artifacts (Stappers, Sleeswijk-Visser, and Keller 2003), and probing techniques to get inspiration via maps, postcards, cameras, and/or booklets (Gaver, Dunne, and Pacenti 1999). They often require great participation efforts and cognitive capability from older adults. The required data analysis is also much more complex.

Hobbies Contribute to Quality of Life

As mentioned before, older adults define keeping busy and enjoying hobbies as a valuable contributor to successful ageing (Knight and Ricciardelli 2003). Leisure activities extend the years of independent living, decrease disability, and enhance the overall quality of life (Aldrich 2004). Huang, Lee, and Chang (2007) also claim that people who participate in leisure activities feel their quality of life is higher. Lazar and Nguyen (2017) sum up several health benefits when engaging in certain leisure activities such as higher cognitive functioning (Litwin, Schwartz, and Damri 2017), a lower risk of dementia (Verghese 2003), and greater mental wellbeing (Lampinen et al. 2006). Therefore, collecting hobby information in a workshop setting is the main purpose of the user research tool. We will investigate a very particular scope around leisure time.

How to Use the Canvas

This section describes the tool we created and used to understand people's hobbies and activities. The Leisure Time Canvas (LTC) is a storytelling tool designed to facilitate older users to share stories about their hobbies and activities, elicit their perspectives, desires and needs, thereby inspiring the design process.

The LTC is used in the interaction between the designer and the user to stimulate sense-making and facilitate a meaningful conversation. The canvas consists of three columns on a printed A4 to sort hobbies and other leisure activities on, the columns state from left to right: 'Hobbies which do not suit me', 'Hobbies I like doing' and 'Hobbies I would like to do more often' (see Figure 5).

The participants are given a pile of cards with common activities and hobbies for older adults, displayed by an icon and corresponding name of the activity. During a session between the design researcher and the older adult, the older adult sorts the activity cards according to his or her preference onto the canvas.

Figure 5. The Leisure Time Canvas facilitates the user to tell stories about hobbies and activities, and leads quickly to more personal stories.

The Leisure Time Canvas can be downloaded via this link: http://bit.ly/LeisureTimeCanvas.

The purpose of dividing the cards into three different places allows participants to become aware of their perspective on these activities, and reflect on how they engage with them in the past, nowadays, and possibly in the future. This also gives us insights on the reasons why some activities are currently not performed, finding the reason which hinders them from doing that particular activity. Besides the pre-made cards, several blank cards enable the participant to write down missing hobbies or activities that they might engage in. While placing the cards, the user may provide a small explanation, but the follow-up and deeper questions can be asked after all the cards are used to enable the user to reflect on the entire canvas.

Then, the researcher discusses the resulting 'palette' with the participants - meaning the filled-in canvas - with a primary focus on the barriers they experience with the category 'Hobbies I would like to do more often'. This conversation results in rich contextual stories about people's personal motivations, barriers, and routines regarding their hobbies, and personal lives and interests.

Where the Canvas is Based Upon

Hendriks, Slegers, and Duysburgh (2015) pointed out that it is necessary to provide the rationale behind a tool for purposeful implementation, thus enabling other researchers and designers to adapt and expand this tool. With the Leisure Time Canvas, we want to provide older adults a playful tool to discuss their activities.

The hobby and leisure activity cards (see Figure 5) were chosen based on the Pleasant Activity List (Roozen et al. 2008), including social activities, domestic activities, culture/science/travelling, intimacy/personal attention, and diverse activities resulting in the following eleven cards: reading, walking, visiting a museum, playing games, cooking, listening to music, drawing/painting, cycling, gardening, meeting with family/friends, making a city trip.

Corresponding icons were chosen to make it playful and provide concrete visual examples, inspired by the enthusiastically received probe packages created by Gaver et al. (1999) and (Suijkerbuijk et al. 2015), which also targeted older adults. Our tool was discussed with other researchers both with icons and photographs on the cards. However, it was decided to use icons to, on the one hand, remove the focus on details of a specific brand, and, on the other hand, remove the context details so it would be more applicable to a larger group.

The card sorting interaction was chosen based on the redesigned semantic differential (Branco, Quental, and Ribeiro 2017). People with dementia used cards with positive and negative adjectives that should be placed on a scale of intensity, to evaluate how they characterize their experience while playing a game. As it was proven as an understandable task for older adults with dementia, we used a similar card sorting interaction for the Leisure Time Canvas but instead used it to facilitate a conversation rather than evaluation.

3.3 Using the Leisure Time Canvas

With the canvas, we gained an understanding of hobbies older adults used to enjoy doing, currently do, and would like to do more often. We will collect stories through interviews, and this exploration will result in potential new design directions which are meaningful for them. We will elaborate now on the initial evaluation of the canvas with six participants, the data collection and analysis, and the findings.

Participants

We recruited participants of a smartphone learning class and shared within that group a call for participation. Our main contact was one of the three facilitators of this class, and he arranged the meetings between us design researchers and the participants.

This smartphone learning class had a similar set-up and product use as described in Chapter 2, although this was in a different region with different users. Inclusion criteria were flexible and covered that people should be considered older adults, interested in learning new technology, and willing to participate in the research. The facilitator shared an open call to participate in a short exercise with a researcher about their hobbies, gain insight into their personal interests, and create a better fitting design for them.

The tool was used together with six (one male, five female) independently living older adults, aged 61-78 years (Pauline did not provide her age), in a session between the user and the design researcher (see Table 3). All participants signed a consent form after understanding the session through a briefing.

Participant	Gender	Age	Living situation
Amy	Female	61	Living together with partner
Dorothy	Female	73	Living alone
Ella	Female	71	Living alone
Frederick	Male	76	Living together with partner (Tess)
Pauline	Female	-	Living together with partner
Tess	Female	78	Living together with partner (Frederick)

Table 3. Demographics of our six participants who used the Leisure Time Canvas.

They gave permission to make audio recordings and take pictures where they were unrecognizable. Furthermore, they understood they could withdraw from the research at any point.

Data Collection and Analysis

All participant sessions were held in April 2017,in a community building and lasted between 20 and 30 minutes. The sessions were audio-recorded, and a thematic analysis was done following the steps defined by Braun and Clarke (2006). We transcribed the interviews to familiarize ourselves with the data. Then we generated initial codes across the six interviews, which resulted in 38 codes. Some examples include busy, choir, and husband. From these, 11 were selected to be most present with all participants, such as independence, insecurity, and routines. We browsed through the data with a different lens again, so instead of finding commonalities, we structured quotes (including the positive and negative labels) in a table per participant in past, present and future. Then this table was colour coded by the initial codes. Three themes became apparent: the lack of people to engage with in activities, impactful experiences limiting or promoting engagement with an activity, and stereotypical hobbies and activities for older adults. These three themes came forward because of the extensiveness of a story (including who, what, where, how often) and emotional attachment to a story (impacting life, life changer). We will elaborate on the findings in the next section.

Findings

The findings of using the canvas are described below in several sections. First, we will provide a visual overview of the cards that the participants used. Second, we describe three common themes which we identified from the stories. However, we were mainly interested in the individual aspects within these themes, so thirdly, we describe the diversity within our findings.
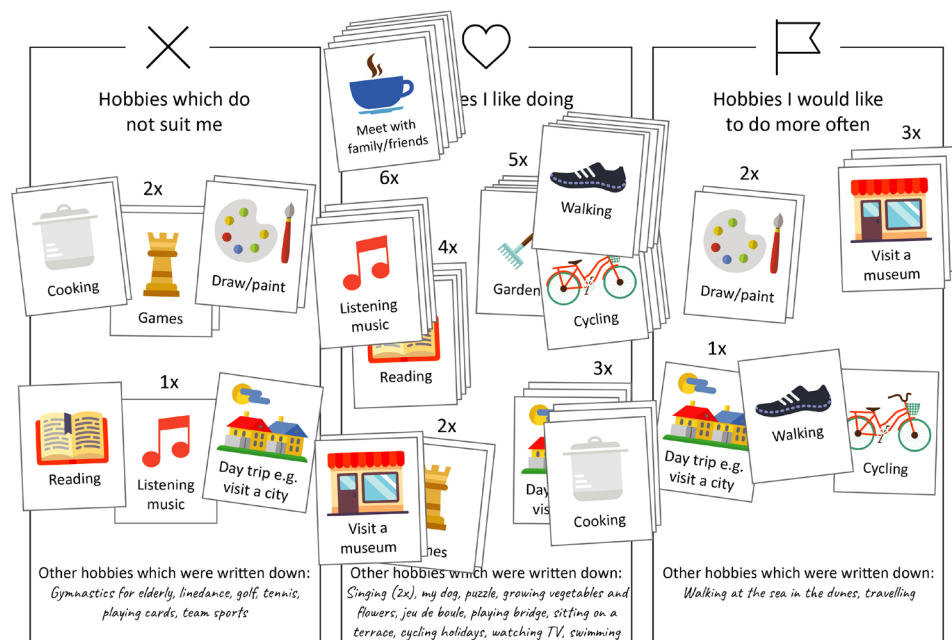
Figure 6. The results of six sessions of card sorting on the Leisure Time Canvas.

Overview of the Used Cards

In this section, we provide an overview of the most popular hobby cards of our participants. In Figure 6, the following information can be found representing our six users: 1) placement of hobby cards, 2) frequency of hobby cards in a specific column, and 3) additional hobby cards written down separately by the participants.

This figure shows some common trends within the small user group about the activities they already engage in. In the left column of Figure 6, 'Hobbies which do not suit me', mostly indoor activities were mentioned such as cooking, playing games, and drawing/painting. In the middle column 'Hobbies I like doing', we see that all six participants picked meeting with friends, as social network, of course, is a strong motivator. Then next to this, walking, gardening and cycling were most often picked, all outdoor activities.

In the right column, 'Hobbies I would like to do more often', we see that the cards point to a need to go out more: 1) three participants picked visiting a museum and 2) day trip, walking and cycling were mentioned once.

Although we have two drawing/painting cards here, we decided not to continue with this because two participants clearly stated this as a hobby that didn't suit them. The rest of the cards were all outdoors and showed potential as inspiration for a design concept.

Common themes

Lack of People to Engage with in Activities while Having an Existing Social Network

Amy, Ella, and Dorothy expressed they each had individual hobby ambitions but did not feel like going alone. For example, Amy desires to go to a museum more often: 'I once said I would love to have a museum card, but my husband is not that interested in it. And to do it by yourself… you don't do it that often. At least, not me. But it would be very nice!'. This is an interesting perspective on the situation as they feel like because they currently do not have somebody to share this hobby ambition with, they do not perform the hobby, while they do have the desire for it. Furthermore, for example, Amy is part of the gymnastics club, a choir, a woman association, and an elderly association, but does not want to go by herself to a museum. Ella is a board member of the choir she is part of and would like to walk at sea more often but she does not feel confident to go alone. Dorothy goes cycling every two weeks with an elderly association, but she feels insecure about attending activities alone, such as walking through the forest. So, interestingly, while some of our participants do have people in their existing social network, they may not be the ones to execute a hobby with. As the example with Tess shows about her desire to travel: 'Because my husband does not like travelling, I visited my oldest sister in Brazil together with my daughter three years ago. Lots of fun! My daughter arranges the travel herself.' and 'To be able to make such travels [Brazil] you have to be healthy and have somebody who joins and that's not the case anymore. So, we'll go on a weekend trip to The Netherlands…'.

Impactful Experiences Limiting or Promoting Engagement with an Activity

What impressed us is the dedication with which some participants execute a hobby or certain activity for several decades already, as Pauline said: 'I go swimming for 35 years already every Monday afternoon, I really enjoy this!'. Furthermore, Pauline has a strong drive to be busy and active: 'The recovery [knee surgery] went really well because I thought what if I cannot go cycling and walking anymore! Home all day! What would I have to do then?'. Furthermore, she cycles on many occasions: 'I enjoy cycling as well. Once a year we go cycling for 50 km with the whole family. We have been doing that for 25 years already. Together with the elderly association once every two weeks. And once a month 40-50 km with my sisters (during winter walking – a local event), we have already been doing that for 15-16 years. Every time a different route, time flies! People are impressed we still keep up. And on Sundays whenever it's good weather, with my husband. I love it!'.

And if an older adult builds up a routine over a long time, he or she may not be very likely to change this unless certain factors cause this change. Serious life events might influence one's engagement in hobbies and activities. One example is Dorothy, who felt insecure about going somewhere alone since her husband died, and this decreases the number of places where she still goes: 'I really do not drive to the big city, it is because since the moment I was alone, I became much more insecure'. Another example is that Frederick's wife recommended him to start playing bridge after he could not play soccer and tennis anymore due to his knee surgery: 'I learned to play bridge when I came out of the hospital [knee surgery]. At the start, really limiting… damn, I could not do anything anymore. But my wife motivated me to do so'. Pauline had a strong drive to stay active despite her surgery: 'The recovery [knee surgery] went really well, because I thought what if I cannot go cycling and walking anymore! Home all day! What would I have to do then?'. Another example is that Dorothy got lost once while walking, increasing this insecurity: 'I chose for a less busy road but then went this way and that way… and I completely got lost… no one came by… I did not know where I was. After a while, luckily, a mountain biker came by and showed me how to get back. Since that moment, I do not walk in the forest alone anymore'. And Ella feels a similar restriction to go by herself: '1 ½ years ago I had a severe nose bleed, and it took so long to get back to the car… like… really long. And I am a bit stressed out, scared. I even did not dare to get out of the house for a while, so to speak.

I used to go into the forest with my dog, walking or cycling, but my psychologist said better not to do it by yourself, so I only choose routes where many people are.'. So, this means serious life events can both facilitate and set a barrier to engaging with hobbies. Because reduced time invested in hobbies can result in less social contact as well, it is important to find meaningful alternatives.

Stereotypical Hobbies and Activities for Older Adults

We have found an interesting contradiction in perspective on 'elderly hobbies': Frederick said 'I have old people's hobbies' while Ella mentioned that she moves away from these hobbies: 'I don't feel at home with gymnastics especially for the elderly. So, I went to gymnastics before, but it was not for the elderly. Golf is also a bit for elderly, I think, for people who are retired. The gray-headed.'. These quotes show there is a particular perspective of one's hobbies and hobbies that are common in the community. It is an interesting contrast that Frederick accepts the change of hobbies to things that better suit his needs, while Ella desires not to change her hobbies and does not want to be associated with these. Potentially people need support in making these decisions to start with a new hobby, or can benefit from inspiration for what is on offer in a community. For example, in the case of Ella, her opinion may change when trying out a certain hobby or knowing who else is participating.

Diversity within Findings

Within these common themes, there certainly are different specific and individual reasons and situations that colour a certain theme for a participant (see Table 4). Here we describe per participant in the second column a similar theme such as 'alone', while in the third column, we show the individual and personal component of that theme. For example, in terms of not wanting to walk alone. For Amy, the reason is that her husband is not interested in visiting a museum, while Dorothy and Ella do not want to go to the forest or sea because they are anxious about going alone. These different reasons show very individual needs and perspectives, and these need to be respected as such when we design for this target group.

	Common theme	Diverse reasons and examples
Amy	Cycling, knee injury	Cycling instead of walking, because of her knee injury.
	Alone	Her husband is not that interested in a museum card and she does not want to go by herself.
Dorothy	Cycling	Cycling every two weeks (routine).
	Alone	Because she got lost in a forest once, she does not dare to walk there alone anymore.
Ella	Cycling	Cycling with good weather.
	Alone	Because of a severe nose bleed, she got anxious and won't go by herself anymore into the forest.
Frederick	Cycling	Cycling instead of soccer and tennis.
	Knee surgery, playing bridge	Dropped previous hobbies and his wife motivated him to start playing bridge after he came out of the hospital.
Pauline	Cycling	Cycling yearly with family, monthly with sisters and ever 2 weeks with elderly association, on Sundays with her husband. Strong drive to stay active.
	Knee surgery	The recovery went really well and her drive to stay active was high.
Tess	Cycling	Cycling as summer activity.
	Alone, health	She does not feel able to travel anymore such as her trip to Brazil, due to health reasons and needing a travel buddy.

Table 4. Although common themes are found between participants,
the examples may be very different.

Another interesting point we have noticed regarding our canvas is how the first column, 'Hobbies which do not suit me' is interpreted in two ways. On the one hand, Ella clearly states she stays away from the 'gray-headed'-hobbies, since she does not want to associate herself with these hobbies. On the other hand, we have heard multiple times that a certain hobby was an activity that they used to do but could not anymore due to various reasons. This is, for example, the case with Frederick, who started cycling instead of soccer and tennis.

3.4 Discussion

Through our findings, we have partly answered our research question: How can the personal interests and leisure activities of older adults inform design for successful ageing?

We can create meaningful designs for successful ageing: 1) when we support older adults to express themselves through the Leisure Time Canvas, 2) when we are aware of the influence of existing communities, and 3) when we are conscious about individuals being diverse. This means we did not answer yet what kind of design for successful ageing we should build, but we do elaborate on how to gain a strong basis in the context of leisure time to build a design upon. Additionally, it revealed with whom, when, and how often they executed certain activities, giving the designer an empathic view of the context of their participants. Finally, we discuss and reflect on the use of the tool as a design researcher.

Supporting Older Adults to Express Themselves through the LTC

Before we dive into discussing our findings, we want to generally reflect on the extent to which it facilitated our participants in sharing their stories. The problem identified by van Kleef, van Trijp, and Luning (2005) was three-fold, namely the user: 1) may not be aware of their needs, 2) may not be able to formulate their needs, and 3) may not be eager to speak about their needs.

Firstly, Amy and Ella explicitly mentioned a concrete need, vocalized through their hobbies and interests, and for the remaining participants, we interpret this from their stories. By describing their activities and events in their daily life, we were able to extract personal motivations.

For future research, it is important when using this tool to focus on the personal motivations for a hobby next to the specific activity. This uncovers why someone is intrinsically motivated, and that can contribute to designing a suitable design.

Secondly, we found that the user is facilitated through the LTC to formulate their perspectives and needs easily. This is indicated by our participants being open about their activities in their daily life in a brief session. Dorothy and Ella, for example, feel the need whenever they want to go for a walk; they want company as they do not dare to go alone. Tess has a similar feeling but then in the context of traveling. Pauline expresses a strong desire to keep her independence. Frederick currently does not seem to show a need for change, as he feels like he can do whatever he wants and feels free (this may be his need). Amy expresses the need to have someone to go to a museum with together.

Thirdly, we saw in our study that participants, with the help of our canvas, were eager to share their needs, even including unrequested and personal topics such as surgery, anxiety, and people who deceased. These were somewhat surprising findings to us as we do not explicitly ask to discuss these topics. We see, however, in a similar study based on personal stories that participants do point out big events during their lives (Orth, Thurgood, and van den Hoven 2018). Our participants also felt these were related topics for them and felt the need to bring these up.

As the older adult steers the conversation, they may feel more at ease to highlight the things they feel comfortable sharing. This is relevant for design because, as much as identifying the personal motivations also the barriers are meaningful to be aware of to get a complete understanding of a user.

The Influence of Existing Communities on Hobbies

To discuss the common themes we found, we elaborate on the relationship between hobby routines and community. Of course, not having people to do activities with limits acting on hobbies, and similarly having people with similar interests promotes engaging with hobbies on a regular basis. Yet, we were surprised to learn that some participants, although they are all part of several social communities, may not perceive the people in their communities to execute a new hobby together.

Righi, Sayago, and Blat (2017) describe a similar example, mentioning that older adults associated themselves more with a learning community than representatives of a social category 'older adults'. This influences the focus of a design from just the people towards the people in their communities. Thus, where meaning is provided to the design through the communities.

We build on this by saying we should be aware of a potential barrier to change the core hobby the user executes within that community to a new hobby. Thus, designs could incorporate this barrier by, for example, creating a new community to connect with on a new hobby or sharing your new hobby easily within your existing community. We seem to have learned from our evaluation that people are very dedicated to sticking with a certain hobby for a long time, yet we observe changing a hobby is mostly associated with an impactful event like, for example, surgery – meaning that people had to change their hobby. By knowing individual characteristics, we can create tailored designs while balancing barriers and motivators. Lastly, when introducing a certain hobby, it is important to recognize the 'status of the hobby', meaning that some participants rejected hobbies for the 'gray-headed'. Thus, we should take this into account when introducing a new design.

Diversity within Findings

While having commonalities such as cycling, the personal motivation to execute a hobby routinely can be diverse. For example, from Amy's and Frederick's perspective, cycling is a replacement activity for a previous hobby, while Pauline had many cycling occasions together with others and the strong desire to remain doing this: 'What if I cannot go cycling and walking anymore! Home all day! What would I have to do then?'. Therefore, we have to reflect on people's hobbies in the past, present, and future, and on a personal level to understand to what extent certain activities are more meaningful than others. Perhaps we can as designers, learn which elements of a previously enjoyed hobby we can use in a new design. This illustrates that we cannot design for all older adults in general terms but that we can distil trends from specific users to design personalized interventions and services.

Reflection on the Use of the Tool as Design Researcher

Overcoming 'Sameness' in Design

One identified challenge is that users reflect on familiar products, resulting in more 'sameness' in design (van der Panne, van Beers, and Kleinknecht 2003). This can be addressed by reflecting on leisure time activities as this has an open mindset and focuses on doing the activity rather than using a product. This early user involvement is important as the user can frame the problem (Keitsch 2014). Also, by segmenting the stories into past, present, and future, gaps can be identified: what did a person do? What does a person currently enjoys doing or has been doing for many years? What does a person wish to do in the future but feels a barrier limits him/her? It is important to not just learn from an existing interest only but also to provide space to develop new interests in the future (O'Keefe, Dweck, and Walton 2018). By putting these next to each other, experiences with different hobbies and activities can be compared and more accurately valued by the designer.

The User Filling in the Canvas Prior to the Meeting with the Design Researcher

We were surprised that four participants already prepared for the meeting by writing down their hobbies, even though we did not ask them to do so and wrote down on the canvas we would bring cards for this session. Yet because they already filled it in, this enabled us to reflect on which hobbies were missing on the cards because we could compare the hobbies they wrote down prior to the session to the hobby cards we brought in the session. Such an approach may be relevant to include when using this canvas, as is shown in the work of Leong and Robertson (2016), where they intentionally encourage older adults to begin reflecting on their values prior to their workshop attendance resulting in a focus on what is important to them. In our case though, this unintentionally happened because they already had the notebook with the Leisure Time Canvas in their possession (though without the cards) due to their participation in a different study. For example, for Ella, we found that about half of her written answers were similar to the hobby cards, and the other half gave some new suggestions (see Figure 7). Thus, the hobby cards trigger new conversations which have not been thought of by themselves.
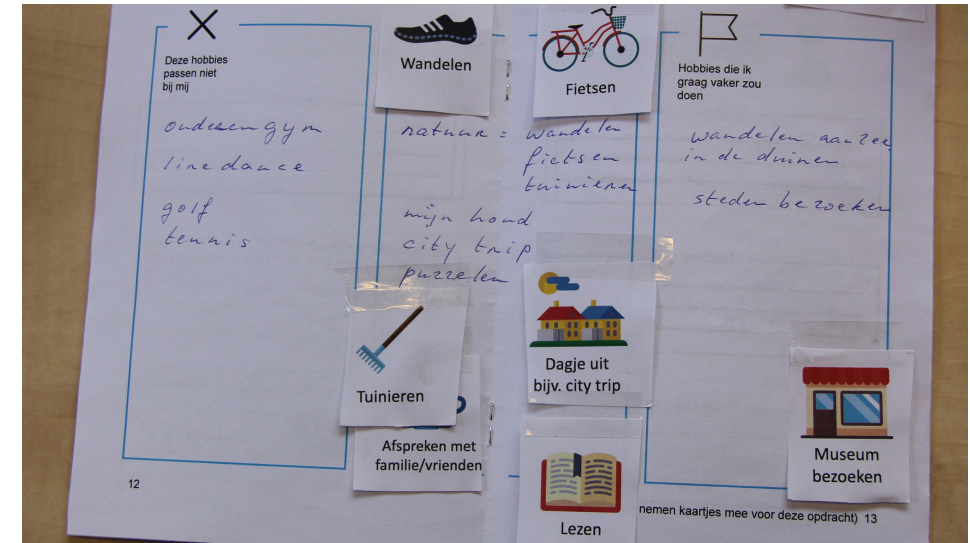

Figure 7. Our participant Ella wrote down some hobbies prior to the meeting, yet during the session added more hobby cards.

Figure 8. In the left column, the 'games card' with the chess piece icon is used. This can be interpreted in two ways, it may indicate physical games, while others may include digital games as well.

General Icons Providing Meaning to the Hobby Cards

One participant wrote down singing separately on a new card as she felt like creating music is different from listening to music. We learned from this that general cards can cover broad interests and can thus be used by more people. However, it can also be interpreted differently: for example, we wrote down 'games' but put a chess piece on the card together with it (see Figure 8). This led to a person asking if it is about board games in particular, or it could also be playing a game on the iPad. On the one hand, because this canvas is used between researcher and older adult, there is the opportunity to discuss this. It is important to provide time and space to learn about the participants' views, even if the discussion goes 'off topic' (Kenning 2020). On the other hand, if a person does not dare to ask or does not associate the chess piece with him/her playing a computer game, the card may not be appropriately included in the canvas, and this will give misleading information. More research on the number of cards may be needed to understand the ideal number of cards because more cards may provide clearer topics and decrease the ease of use as the pile of cards gets bigger and more decisions need to be made by the participant.

Ways to Stimulate Reflection for the User

One woman specifically added hobbies for the gray-headed, as she called them, such as exercise classes and golf. It may be interesting to purposefully add hobbies of other target groups/age categories which we expect will be outliers. This may stimulate to reflect on the development of new future hobbies (O'Keefe, Dweck, and Walton 2018). Moreover, we can identify if certain hobbies they see people do in their environment may be of interest for them in the future. So next to naming hobbies that are in line with the general interest of a specific age group, to purposefully add outliers as hobbies as well. This provocative act of adding 'strange' hobbies may lead to unexpected answers of people explaining why they would or wouldn't include particular hobbies, to elicit dreams or out-of-the-box activities that they may not actively do or think of currently (van der Panne, van Beers, and Kleinknecht 2003). This is also executed in the work of John Vines et al. (2012) to show provocative things that encourage criticism and debate.

3.5 Concluding this Chapter

The research described in this chapter was executed to answer the following question:

How can the personal interests and leisure activities of older adults inform design for successful ageing?

We contributed a storytelling tool in the leisure time context that deeply engages people to design something meaningful.

This tool provides a solution to the challenge defined by Van Kleef, van Trijp, and Luning (2005) that users may not be aware of their needs, may not be able to formulate their needs, and may not be eager to speak about their needs.

Furthermore, our canvas supports to gain empathy for your user older adults have knowledge that designers or other experts lack (van Doorn and Klapwijk 2013).

Certainly, there are tools to assist the user in becoming an 'expert of their own experience' (Sanders and Stappers 2008). However, we target the context of hobbies and leisure time activities in particular.

Therefore, inspired by the work on probes for older adults of Gaver, Dunne, and Pacenti (1999) and Suijkerbuijk et al. (2015), we created the LTC in the landscape of probes on how to leverage personal interests to design interventions for successful ageing. We have shown how participants were encouraged and empowered to provide rich contextual individual stories through their leisure activities in an effective way. With this, the designer can frame a new design space based on the personal contexts of the users' hobbies and leisure time activities. In the next chapter, we will address how these insights inform technology design.

CHAPTER 4

Co-designing and Evaluating a Walking Application

This chapter is based upon:

• den Haan, Marjolein, Rens Brankaert and Yuan Lu. 2020a. "Applying Design Methods to Promote Older Adults' Walking Activities Based on Their Hobbies and Personal Interests." In Design of Assistive Technology for Ageing Populations, edited by L.C. Woodcock, A. Moody, L. McDonagh, D. Jain, A. Jain. Springer.

• den Haan, Marjolein, Rens Brankaert and Yuan Lu. 2018. "What moves you? Designing a walking app for and with older adults." In Christer, Kirsty, Claire Craig and Dan Wolstenholme, eds. 2018. Proceedings of the 5th European Conference on Design4Health, Sheffield, UK, 4th – 6th September 2018. Sheffield: Sheffield Hallam University.

As discussed in Chapter 3, we created and used the Leisure Time Canvas to identify older adults' previous, current and potential future hobbies. In this chapter, we will continue to answer the following research question:

How can the personal interests and leisure activities of older adults inform design for successful ageing?

To answer this question, we would like to create a design case based on the LTC results in Chapter 3 to encourage healthy behavior. We learned that walking was a popular hobby for our participants. The personal motivations for walking included other people's recommendations (social) and popular places to go to, such as nature routes or day trips to museums. In addition, an increasing number of older adults use internet outdoors on their smartphones and messaging services like WhatsApp (CBS 2017). We, therefore, saw the potential to integrate several of the users' outdoor interests as motivators for the design of a walking application.

This chapter is organized in the following way. First, we will describe the final design and functionalities of the walking application Ommetje. Subsequently, we will report on the concept discussion sessions with 42 older adults. Further, we will report on the field evaluation of this walking application with 16 older adults for four months will be presented. Finally, we will discuss our findings and conclude this chapter with our main insights on designing and evaluating Ommetje.

4.1 Background Information on Physical Activity

For older adults, there are continued health benefits of regular physical activity (PA). This is influenced by multiple factors such as self-efficacy, daily life integration, social support, financial resources, and awareness of PA programs (Ory et al. 2018). Smartphones can influence people's physical activity, but recommendations should be contextualized and personalized (Stuckey, Carter, and Knight 2017). In the Netherlands, as of December 31, 2017, the national statistics agency listed on its website that in 2017 an increasing number of older adults are using internet outdoors: 61% of 65-75-year-old internet users and 33% of the 75+-year-old internet users, while five years ago this was 16% and 4% respectively (CBS 2017). As these numbers were increasing around the development period of our concept, we see the potential to empower older adults through internet-connected applications.

4.2 Concept Description of Walking Application Ommetje

Ommetje is a walking application in which people can record their walking activities and share these in a walking community. The meaning of 'Ommetje' in Dutch is 'short walk' as the intention of the application was to record everyday walks, even to the supermarket, for example. We aimed at stimulating physical activity through social triggers, by friends or other people from the community, to go for a walk. While designing the application, a low threshold to initiate use was important, and therefore the application was free, and making an account was not necessary. If desired, only a user name could be made, and their location was automatically found by GPS.

Figure 9. Ommetje's main menu.

Figure 10. The Twitter-like wall with routes of others.

The main menu consists of four functionalities (see Figure 9):

1) Recording routes to track your walks ('Wandeling opnemen').

2) Reviewing your personal walking history with the distance and timestamp of the walk ('Mijn gelopen wandelingen'). The users can send their walk to another user and receive walks from others.

3) Getting inspiration from other users by seeing the routes which are shared via a Twitter-like wall by peers from the community (see Figure 10). We aimed at providing opportunities to explore new places ('Routes van anderen'). Users could decide to turn the sharing feature on or off per walk. When not shared, the walk would only be visible in their personal walking history. This is because we learned through a user session that there were concerns about privacy, particularly who could see their walk.

4) Creating a 'list of routes' you plan to walk, to downscale the list of walks into the most interesting ones ('Nog te lopen wandelingen').

The two remaining tiles are for settings and closing the application.

4.3 Co-creating Ommetje

Designing a Walking Application

From the previous chapter, we found three points that we need to consider when designing our walking application:

1) to create a design that is conscious about the community it 'lives' in and serves as a motivator (see the section the influence of existing communities on hobbies in the previous chapter).

2) to create a meaningful design that is properly introduced to the user while being aware of potential resistance towards 'products for the elderly' (see the section on stereotypical hobbies and activities in the previous chapter).

3) to create a flexible design that tailors to individual needs, interests, and circumstances (see Table 2, in the previous chapter).

At first, we were considering making a route generator application. This app would generate a walk starting from the GPS location of the users, based on the preferred distance and potential filters such as visiting a park or supermarket. This concept is aimed at motivating people to make short walks as part of their daily routine and give them the confidence to explore new routes in the neighborhood as well. However, in this case, the user would not have the control, while in our research, the user's influence and active participation is essential.

This is where we switched the perspective from generating a route automatically towards recording a route by the user him or herself. The aim was to inspire the users to go for a short walk in the neighborhood and let the social environment serve as a trigger and motivation to actually go out and walk these. In Figure 11, some of the initial sketches and wireframes can be seen (in the back) while also showing the final logo of our app (in the front).

The scenario of use could be the following: You start recording your route when you leave your house to go for a walk with the dog. You often take the route through the park, because the dog is allowed to run around. When you are at home, you check your route on your smartphone and think about your friend living a few streets further. She also has a dog and might be interested in your route. You send your walk to your friend, and she plans to try it at the weekend.

Concept Discussion Sessions

We did three concept discussion sessions with 42 users in total, from May 2017 till August 2017, to co-create Ommetje. Most participants of these concept discussion sessions already participated in our research with the GoLivePhone presented in Chapter 2, the learning class continued, and we joined them after completing our previous study. However, we asked them to sign a new consent form for this study, again asking for permission to make audio recordings and take pictures.
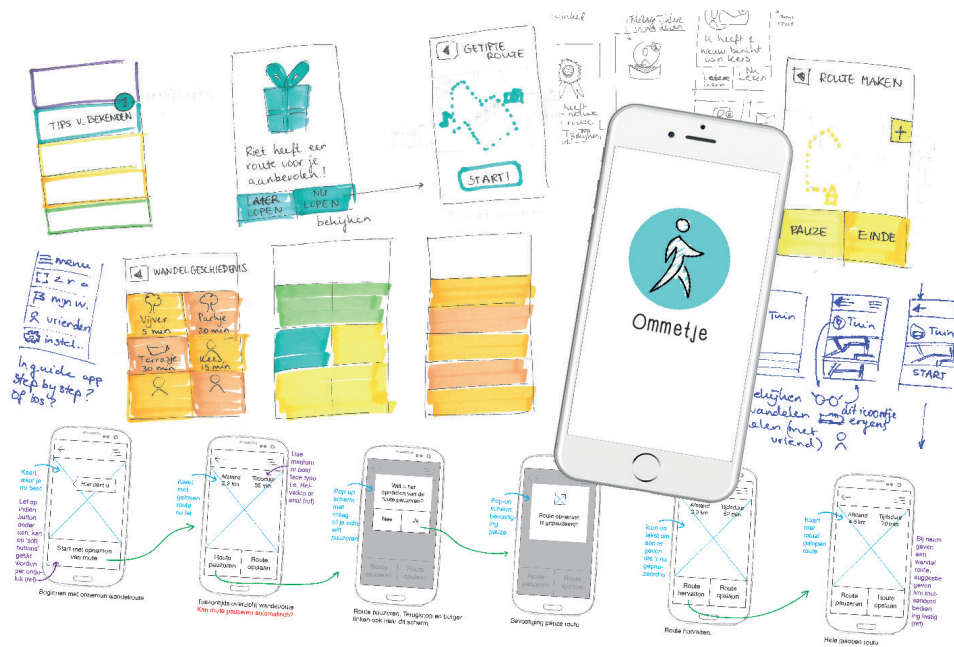
During these pre-arranged learning sessions for the GoLivePhone, we asked the attendees whether they wanted to provide input on our walking app idea in that particular session. For the third session, participants were invited individually, as the pre-arranged learning sessions were paused due to the summer holidays.

In the following sections, we will describe how we set up these concept discussion sessions and discuss our findings.

Session 1:

During the first concept discussion session, we presented the idea to understand people's willingness to use it (N=20). We wanted to find out whether people saw potential in the idea and if they could imagine using it. In this session, the screens of the application were presented (see Figure 12) and a related context picture to enable people to familiarize themselves easier as users of the application (see Figure 13).

Figure 11. Some of the initial sketches of the walking application.

Figure 12. Early design of our application.

Figure 13. Contextual picture used in the presentation to explain the concept to a group of users.

Three main functions were presented: recording a route, seeing personal walking history, and sharing routes with friends. Then people were asked for remarks and feedback. Later on in the session, two more advanced functions were presented: uploading a picture on a route and seeing highlights on a map when visiting a city. Again, these functions were discussed in a group setting.

Results:

Our participants saw potential in sharing their walks with others, yet were concerned about privacy: 'who can see my walks and can I share anonymously?'. Furthermore, people wanted the application to show deviation from the original route and wanted to use it for other purposes as well, such as cycling tours. It was interesting for us to see that people defined new use cases, brainstorming already in this early stage on future use.

Session 2:

In the second session of the concept discussion, we created eight like/dislike cards with concept statements such as: 'I definitely do not think my walking information is interesting (e.g., walking speed, distance, and calories)' (see Figure 14). The participants (N=10, see Figure 15) individually selected which cards to answer to give more detailed feedback on specific functionalities. Drawing on the postcard design probe by Burrows, Mitchell, and Nicolle (2015), these cards were created to support participants' in providing concrete remarks. After writing down their reflection on the cards, everyone commented about one card with the other participants.

Results:

We got enthusiastic responses that people were interested in the application providing information on important places to visit in an unknown city. People particularly find it valuable to rely on other people's knowledge and experience with routes and are open to trying new things. One barrier a full-time caregiver experienced is that she had limited spare time and preferred to have walks in the neighborhood.
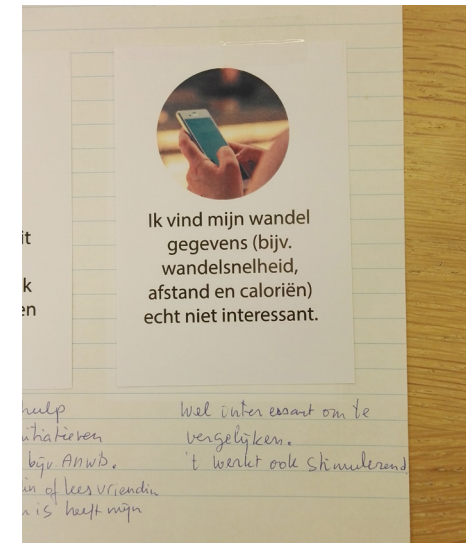

Figure 14. The participants wrote down their answers below the card.

Figure 15. The participants using the eight like/dislike cards to determine functionality preferences.

Some improvements suggested for the walking application were to 1) show what surfaces you come across (sandy, branches, etc.) 2) extend the application towards cycling, and 3) provide information on the width of the path (e.g. when using a wheelchair). These showed that our participants could indeed brainstorm on additions to the current design.

Session 3:

In the third concept discussion, a contextual inquiry (Dell'Era and Landoni 2014) with an early prototype was executed (N=12, see Figure 16). This prototype was based on the input from sessions 1 and 2, and this session was used to observe people's behavior and discuss with them if the interface made sense. The participant took the researcher along on his/her walk in the neighborhood. The researcher had a passive role in providing hints to the participant if they were confused, so instead, questions were asked to stimulate the older adults to find out themselves. Furthermore, troublesome interactions and steps were noted down by the researcher. This preliminary testing was valuable to learn about interaction difficulties as we could improve these before the start of the pilot.

Figure 16. A contextual inquiry with an early prototype was executed.

Results:

We observed one participant that used a small pencil to interact with her phone, which made us aware of properly spacing all elements on the screen. Furthermore, some technical issues with GPS were encountered. For example an error occurred with the GPS location shifting 84 kilometers to a completely different village than the city we were testing.

Finally, some changes needed to be made on the User Interface, specifically on the looks, recognizability, and affordance of the icons:

1) We had a dark orange button to record a walk. This was perceived as scary and for emergencies only (see Figure 17),

2) Some icons were different than expected e.g., 1) users were used to a calendar icon instead of a heart icon for saving a route, and 2) users were used to an envelope icon instead of the WhatsApp icon for sharing a route (see Figure 18), and

3) it was unclear how to get to the keyboard to type a name, so people immediately wanted to press the start button (see Figure 19).

Also, when starting a route from someone else in a different city than your current location, it was not easy to see because the application only shows your current location. We implemented the feedback and altered our design for a final pilot evaluation to conclude the three concept development sessions.

These include, for example, a new sharing option where people could select to share the walks with their community, with one person, or do not share at all. Furthermore, extra information concerning a walk could now be added to a route. In addition to this, the overall technical performance of the system was improved, the routes were recorded better, and the distance measurement became more accurate.

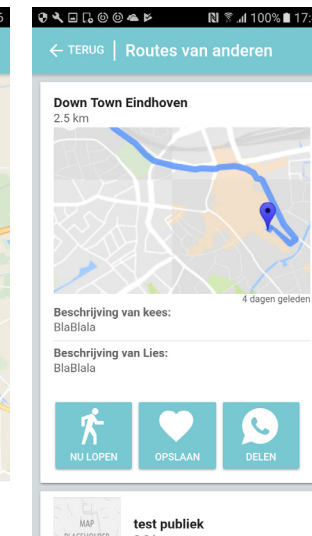
Figure 17. The dark orange circle was perceived as scary.

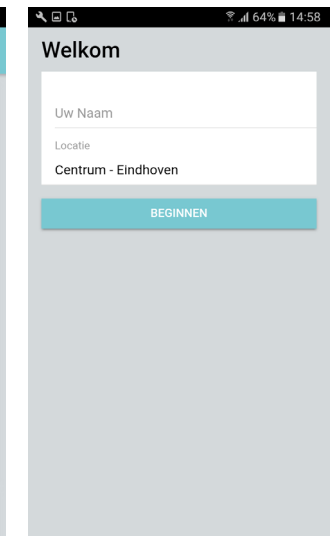Figure 18. Some icons were different than our participants were used to.

Figure 19. It was unclear how to access the keyboard.

4.4 Evaluating Ommetje

After the design process, we conducted a field study with sixteen participants to evaluate the Ommetje walking application prototype.

A call to participate in an evaluation of Ommetje was made in the same group as the study we presented in Chapter 3. Our contact person arranged meetings between us design researchers and participants. After the smartphone learning class, people were invited to join in a group walk to practice the walking app together.

The main inclusion criteria for this study was that the people were older adults, did not experience any difficulties or challenges with walking, they were willing to participate in our research and that they should own a smartphone including internet services outdoor. This was needed for the walking app to function. Since some of them participated in the Leisure Time Canvas study (see Chapter 3) and/or in the early testing (see concept discussions of this chapter), this might have influenced the results of this evaluation. However, this study is explorative to understand the potential impact and fit with the user, for which the pre-experience actually benefitted the research. Additionally, we assume some may have been more willing to participate because of their awareness of it, and the design was based on their input.

Our participants, aged 63 to 83 (average 72), used the walking application for four months from November 2017 till February 2018. Of the sixteen participants, three dropped out due to health issues. A larger middle group used the application only sporadically, with an average of two walks per person. Three users were very active as they recorded 8, 14, and 16 walks in total and continuing to use the application after the research. Overall the recorded number of walks was lower than expected, though, the participants could see the potential of the application as they were actively contributing ideas on future use.

In the next section, we will elaborate upon our results. As mentioned before, the intention of Ommetje was to facilitate users to share their routes and thereby motivating them to walk (more). By making it easy to share a route and see these of others, we expected to lower the barrier to interact and support them in doing their hobbies.

Figure 20. An older adult recording her walk just outside the village with Ommetje.

However, we have learned from our users that they did not record their regular walks inside the village because: 'Everyone knows these routes.'. This shows our users were very aware of who else was using the application, which even influenced their use.

And we also learned that the trigger is already earlier in the customer journey, by the consideration to even start recording a walk. So, regarding social connectedness, it is not simply the direct contact between people, but also the indirect feeling of belonging to a particular community. It would be an interesting next step to see what happens if users do not know other community members (yet) and whether or not they do have the feeling of belonging to a community of strangers.

Instead of recording the village routes, they wanted to record special routes outside the village only (see Figure 20), which did not occur often as people saw these routes as special occasion weekend trips for example. However, this did provide insights on a particular wish or need from some older adults to record special walks.

Another assumption we had was that their personal history would motivate them by seeing the walking distance and frequency. Some participants were indeed quantitively driven to record their walks and see their walking history. One woman mentioned this as: 'keeping track of all her walks really motivated her'. However, most participants were qualitatively driven by more unique walks outside the village (see Figure 20). Combined with the fact that routes outside the village were more appealing to people than regular inside the village walks, we can conclude the quality of the walks is more meaningful to people than its quantity.

Furthermore, we found that for the 'ease of use' people were comparing their previous smartphone experience with the application, for example, 1) the awareness of a limited phone memory so similar to a photo gallery they wanted to remove unnecessary routes from others, 2) the affordance of a map being an interaction possibility and 3) the critical mindset of more purposeful icons they are familiar with. Leonardi et al. (2008) mention that the technology used to be unfamiliar to older adults, as it was from outside of their culture. However, we see this trend has changed, and older adults start reflecting on the User Interface themselves. Actually, in this particular case with our participants, they may not have been novice users wishing to have a simple interface but were able to reflect on previous technology experience.

4.5 Discussion

This chapter so far showed how we translated our findings from the Leisure Time Canvas to Ommetje. We wanted to find out how we could use personal interests and leisure activities of older adults to inform design for successful ageing. Our design case shows that in our walking application, several hobbies and personal interests can be connected because it is not just about walking, but about getting inspiration on where to go, by people in the community themselves who share walks, or by the places they visit. To summarize, we found the importance of being aware of which group of people is part of the testing environment, influencing what people wanted to record. Furthermore, we have learned that the quality of the route should have more priority than the quantity, meaning that the focus should shift towards, for example, what is interesting to see there rather than the number of times a walk is made. Therefore, it is important as designers to always challenge assumptions during the design process.

To reflect on the community in which we evaluated our app, we realized both learning and sharing were promoted with people from one village. We see the trigger to go for a walk is already earlier in the customer journey, by the consideration to even start recording a walk. As Righi, Sayago, and Blat (2017) suggest, we should design for people and their community, as 'the meaning of technology is shaped in dialogue with everyday practices'. So, this influences the use of the application a lot. We could hypothesize that if we enlarge the community of the walking application, people would be more willing to contribute nice routes in their surroundings for people outside their social network.

A design implication for our findings that we presented earlier could be to shift the focus from quantity to quality. To be specific, to decrease the focus on frequency, duration, and date of the walk, towards, for example, perceived quality and level of enjoyment. This change was based on users saying they rather see new nature routes outside the village than tracking an ordinary walk to the supermarket that everyone is already familiar with.

Potentially the application could develop towards a more picture-heavy interface with highlights which characterize the walk to put the emphasis more on the quality than on the number of walks. This could even extend towards having a limited number of walks you can store to decide which one was most meaningful to you.

To define the quality of the walk on a personal level, we should be aware of people's interests and hobbies on top of walking. Different users will have different preferences, and, therefore, personalized walking suggestions should be given. For example, one user prefers to walk through natural landscapes mainly, and another user would select a cultural route with several highlights of a city. However, we have to consider how much input people want to give to let the app respond to a personal profile. Perhaps because of privacy reasons, users may be more willing to receive recommendations from friends and family mostly, but this needs further investigation.

In hindsight, our findings are in line with Kahlbaugh and Huffman (2017), who suggest that quality is more important for older adults than the quantity – in our case, the perceived quality of the walk versus the number and frequency of the walks. In the end, we have shown that we already made a step in the good direction by approaching the user to increase their physical activity. We already added the possibility to write a description about the walk, next to seeing the number of walks and distance. This is in line with Rousseau and Vallerand (2008) indicating to go beyond the 'more-is-better' approach and to identify elements that will boost the possibility for older adults to benefit from having an active lifestyle. By discussing the future opportunities and worries of Ommetje, participation is supported throughout the process (Pradhan et al. 2020).

4.6 Concluding this Chapter

The research described in this chapter was executed to answer the following question:

How can the personal interests and leisure activities of older adults inform design for successful ageing?

This question is partly answered in Chapter 3 by using the LTC with older adults. In this chapter, we continued to answer this question by creating a design and reflecting on it through evaluating Ommetje with our participants.

Our starting point was leisure time and our canvas to understand users but also enable them to share stories and add other activities. We used this information to decide which insights would have a high potential to be translated into a design proposal and illustrated how this could be done in the design case Ommetje. Next to the main focus on walking, we used other personal interests such as visiting museums to build a design that has anchor points in people's lives. Furthermore, we let the user co-create a prototype because users value self-designed products (Franke & Schreier, 2010). We evaluated to what extend our generated concept was considered meaningful to our users. The design indeed showed a strong match with commitment from the users to participate and explore the application.

We also found that we have to emphasize quality in experience to motivate older adults rather than focus on measuring the quantity of their physical activity.

PART 3

ENRICH

In the third part, enrich, we aim at investigating how to personalize designs to address people's individual needs and wishes. Furthermore, we want to reflect on Wilkinson's and Stones' (2018) *designing for one* approach based on the experiences of older adults and designers with this process.

CHAPTER 5

Personalizing Design with Older Adults

This chapter is based upon:

• den Haan, Marjolein, Rens Brankaert and Yuan Lu. 2020. "Design for One: Personalisation and Experiences of Design Researchers and Participants." In The Sixth International Conference on Design Creativity (ICDC2020), 1–8.

• den Haan, Marjolein, Nicole van Essen, Rens Brankaert and Yuan Lu. 2021. "Your Moments: Co-designing a Personalized Audio Player." In: R. Brankaert, C. Raber, M. Houben, P. Malcolm, J. Hannan (eds) Dementia Lab 2021: Supporting Ability Through Design. D-Lab 2021. Design For Inclusion, vol 2. Springer, Cham.

In Chapter 4, where we developed and evaluated Ommetje, we used walking, a common hobby of older adults in our participant group, as a starting point to connect design to people's personal interests. However, we learned that we still unintendedly projected what we believed was good for them in the design rather than letting them decide this. We focused on displaying the number of walks made by older adults while they were motivated mostly by the beautiful environment.

That is why in this chapter, we want to change our design strategy and move even more towards what our participants value and choose. We want to learn from older adults what according to them enriches their daily lives, and empower them to live as they prefer. To do so, we were inspired by the designing for one approach from Wilkinson and Stones (2018) to create personal designs based on individual needs and experiences. We analyzed three design cases in which design researchers co-created personal designs with older adults, through which we aim at answering the following research question:

How can we improve the design of technology for successful ageing through personalized design?

We answer this question by focusing on two aspects:

1) capturing the experiences of the design researchers and older adults.
2) reflecting on how personalization could be expressed in the resulting design and the process.

5.1 Background Information on the Designing for One Approach

Designing for one is a term used by Wilkinson and Stones (2018) describing the work of their students where each design project is driven to suit the individual and their preferences, abilities, and context. They suggest a very open project brief, to design for a single person "to make this person's life more pleasant". By executing a designing for one approach they aim to acknowledge the value of involving the marginalized and underprivileged, such as people with dementia, and, empower them to share their individual opinions and needs. This also implies the shift in focusing on the dementia condition itself to how the condition may impact a person and his or her needs, abilities, and context of use.

Both their and our work are based upon co-design principles, although in contrast with most co-design processes, the entire design process is built from beginning to end around one individual. This means the design researcher has several sessions with one participant to get to know them and consequently generates design ideas based on the collected personal participant information.

To better evaluate what contexts and disciplines benefit from the designing for one approach, Wilkinson et al. (2018) suggest more research is needed around the designers' experiences executing these projects. This is what we want to investigate. Additionally, we want to incorporate the older adults' experience. By being aware of both these experiences and reflecting upon what works and doesn't work, we aim to improve the process (e.g., workload, challenges, and benefits) leading to better design. To stimulate this reflection, we proposed to our design researchers to execute two personal design processes in parallel, which is different from Wilkinson et al. (2018). Ultimately, we assume that individually focused ideas might lead to more specific solutions, and we intend to learn from this project as well as whether these can be generalized.

5.2 Related Work

We want to elaborate on relevant work when creating personal designs. Although these examples do not explicitly focus on designing for one, we do see the overlap with our work as they deeply engage with a particular user.

For example, the work of Orth and van den Hoven (2016) shows the potential to use people's unique identities and life narratives to create meaningful user-object relationships. This is relevant to make designs that are personal and purposeful to the user. This paper investigates the emotional attachment towards and the identity-relevance of possessions that are cherished and newly introduced. They thereby discuss how designs can stimulate emotional attachment by having multiple emotionally significant meanings to users.

Furthermore, Wallace, McCarthy, et al. (2013) use their design probes to deeply engage with an older couple to design interventions to support their sense of self and relationships with others. This again shows the importance of someone's identity being represented by design. Although making is a core element in both our work, in our case, the tangible part comes later with creating experiential prototypes to reflect on with the user.

Branco, Quental, and Ribeiro (2017) also focus on the individual by attending to the uniqueness and personhood of people, which together shape their definition of personalisation. In their work, they aim to give people with dementia the control and choice to select relevant content and codesign towards a meaningful artefact. The researchers urge to think carefully about making participation respectful, ethical and empathic, and suggest making the process open enough for participants to personalise their participation. This is something we are going to build upon further.

Ambe et al. (2019) created the IoT Un-Kit Experience, where older adults could explore, design and generate personally meaningful IoT applications. The Un-Kit contains a set of decontextualized sensors, actuators, and media elements that seem to be incomplete. By this approach, the participants are stimulated to lead the making process and imagine new designs that have personally legible interactions and desirable aesthetic qualities.

In addition, the work with Stephen Hawking showcases how design for the very particular, tailored to one person, can be meaningful to a broader audience in terms of technical development. Researchers gave Hawking a voice by custom-made technology. These developments significantly contributed to text-to-speech software (Bertelsen et al. 2019). So, this example shows the potential scale and impact designing for one can have.

5.3 Study Set-up

We want to investigate how to improve the design of technology for successful ageing through personalized design. We focus on two aspects, namely 1) to capture the experiences of the design researchers and older adults, and 2) to reflect on how personalization could be expressed in the resulting design and the process. We will describe how we set up the design process, the participants, and the data collection and analysis.

The Design Process

We asked three design researcher students to conduct a design process with two older adults in parallel to create a personal design. This process was inspired by the designing for one approach of Wilkinson et al. (2018), yet instead of collaborating with one individual, our students conducted two design processes in parallel to stimulate reflection on two different unique participant characteristics, with the goal to transfer these into the personalized design outcome.

Academic design research supervision was involved in bi-weekly coaching of the design researchers.

The project brief for the design researchers was to co-design "something" personal (e.g., product, service, or system) with the participants to enrich their lives. Such an open brief is considered essential in the Industrial Design department to stimulate your own design identity and feel motivated for a project. We suggested having four sessions.

Session 1 – Getting to Know Each Other

First, an introductory session was held where the design researcher introduced herself, the project, and the projects' timeline. Here the session focused on gathering information with regard to who the user is as a person, their history, their favourite aspects in life, whom they are closely related to, and what matters to them most. This introductory session was done to get to know each other and also to start collecting user information to design for.

Session 2 – Discussing Activities Using the Leisure Time Canvas

Second, we used the Leisure Time Canvas (Chapter 3) to gain insights about the preferred activities of the participants. In Figure 21, participant Anna is placing the hobby cards onto the canvas. The collected information was summarized in a portrait of the participant.

Session 3 – Discussing Ideas

Third, the design researchers discussed ideas with their participants by proposing sketched design concepts. The preference for certain ideas or elements of ideas became clear, and inspiration was gathered to continue the co-design process.

Session 4 – Evaluating the Prototype

Fourth, the insights of the previous session were translated into experiential prototypes by the designer. First, the prototype was used in a session where the design researcher was present to facilitate. In this way, a low-fidelity prototype could be experienced by the user. Later, the prototype was placed in context so the participant could use it by themselves. This was to learn about its use when the designer is not present.
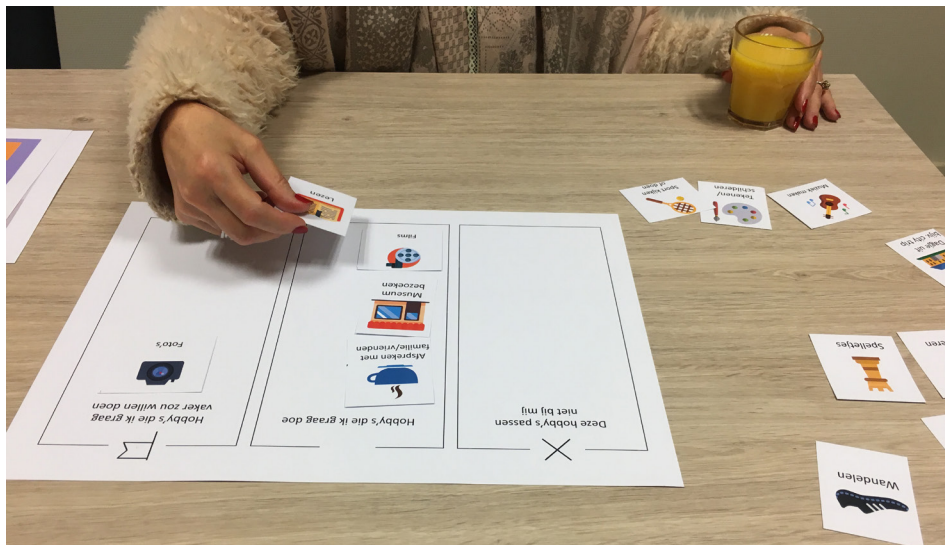

Figure 21. Participant Anna is using the Leisure Time Canvas in a session with design researcher Naomi (picture taken by the design researcher).

All sessions were audio-recorded and transcribed anonymously by the design researchers.

Participants

All older adults were recruited by a partner organisation and signed a consent form after understanding the project through a project briefing. Thereby they gave permission to make audio recordings and take pictures where they were unrecognisable. Furthermore, they understood they could withdraw from the research at any point.

All design researchers that participated in this research were Industrial Design undergraduate students. This project was their final project for receiving their Bachelor's Diploma. At the University of Technology Eindhoven, they are educated to become independent designers, and for this, they use a competency framework. The education focusses on designing for complex societal problems through user-centered design (Hummels and Frens 2009). In this self-directed learning and developing their own identity as a designer are essential. Therefore, the open assignment of this project allows them to approach the project in line with their personal identity ambition as designers.

Collecting and Analyzing the Data

A co-researcher conducted individual semi-structured interviews with the design researchers at the end of their project. The interviews were transcribed, and a thematic analysis was carried out following the six stages presented by Braun and Clarke (2006). Furthermore, we used the project reports of the design researchers to further report their processes and activities.

5.4 Three Cases

In Table 5, we describe the profile and aims of the three design researchers and the older adults involved in their project as participants. Furthermore, this section summarizes the three cases with the design processes and the personalised design outcomes.

Design researchers' age, gender and project goal	Participants' age and gender	Participant characteristics
Naomi (22, F, Dutch) aims at creating value for people with memory challenges, by designing to enrich their lives	Anna (57, F)	Enjoys music, diagnosed with Alzheimer's disease
	Bert (88, M)	Loves spending time with family and four lifelong friends, diagnosed with early-stage dementia
	Cor (75, M)	Loves cooking and music, lives with a brain tumour
Gwen (21, F, Italian) aims at exploring older adults' attitude towards artificial intelligence by designing open artefacts	Emma (98, F)	Great passion for music
	Sophia (75, F)	Enjoys cycling, visiting museums and cooking
Vivian (21, F, Dutch) aims at designing to empower and socially engage older adults	Saar (83, F)	A caring lady who loves her voluntary work
	Johan (73, M)	A true storyteller and information gatherer
	Alice (67, F)	A lady characterised by her sense of humour and high ability to put things in perspective

Table 5. Design researchers and participants information.

The Design Processes of the Three Cases

In this study, we adapted the designing for one approach to cater to the different experiences of the participants and allow those to feed the design concept.

The design researcher conducted two personal design processes in parallel (see Figure 22 – left side) with the goal to derive insights from both processes until a personal design was created for them.

We call this phase 1, and after the first design outcomes, they reflected on how to proceed, based on their own experiences and suitability for the individual processes (see Figure 22 – right side):

-in case 1, one design is further developed with a third older adult,

-in case 2, the design is further developed with the same participants,

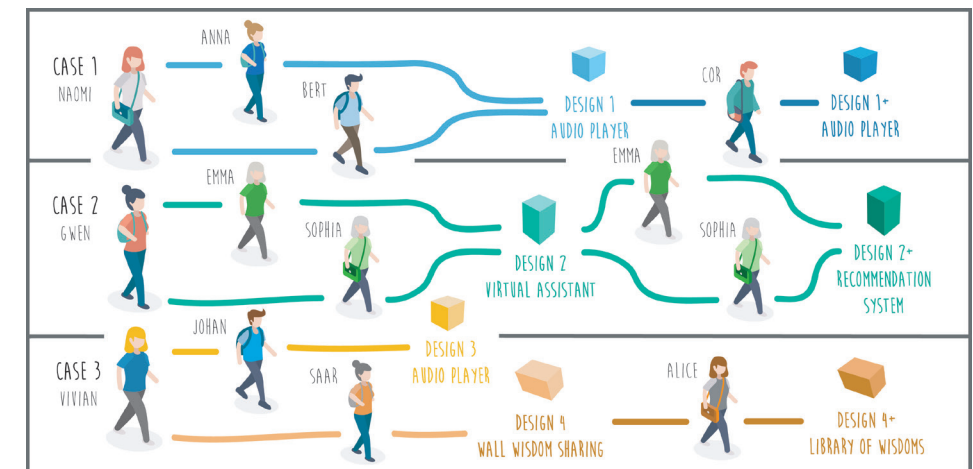-in case 3, participant Alice chose to continue with Saar's design.

Figure 22. A visualization of the design processes of the three cases.

The Personal Design Outcomes of the Three Cases

Case 1: Naomi

In this case, Naomi created an audio player that could store personalised content, with music, audiobooks, and spoken memories selected together with the person with dementia – intended for them to listen to by themselves (see Figure 23). This device is designed for people with memory challenges and stores personal memories of moments in their life to facilitate staying in touch with what you like and who you are.

The scenario of using 'Your moments' starts with turning on the product by touching the button in the middle (see Figure 23 - left). An audio explanation is given on the products' functions and its personalized contents. All buttons emit different coloured light, but when the user selects one, this particular one remains coloured while the others turn white (see Figure 23 - right). Then the audio starts playing, and to stop the audio, the user can touch the same button again or touch the button in the middle.

Figure 23. 'Your moments' turns on by touching the middle button (left) and when touching one button, the other buttons turn white (right).

One interesting finding in the first phase of this project is what types of audio to include in the audio player. For example, Bruce's response on his audio file was positive as he described he felt 'happy, proud and amusing': 'Listening to the story of the event [a story about going to a fair with his friends] makes me nostalgic, and I find it a funny story to tell, which I do every time in a café as well'. However, intertwined with this positive feeling, it reminded him of a current event that one of his best friends from this story was not feeling well. Another confronting example was with Adele (the other participant). She faced her forgetfulness through one audio file, as she went for dinner with friends and to the beach last week, but she did not remember exactly anymore. Therefore, while this is still a valuable reflection, we concluded that we did not want the audio player to become a tedious reminder of forgotten events, and we believe this is an argument to not only have autobiographic memories but other audio samples as well. However, we do not completely want to remove memories, as they potentially also trigger meaningful, emotional, and vivid responses, which shows the design proposal also causes positive feelings, nostalgia, and storytelling.

At the end of phase 1, a home context study was done in which participant Adele wrote down her experience of using the audio player in a user diary for four days (Bartlett 2012). The diary consisted of four daily questions about her experiences of when she used it, what she listened to, why she chose this audio, and her experience while listening.

From this evaluation, we learned that Adele used the audio player when she wanted a moment for herself. She perceived the music of her uncle's band as a beautifully nostalgic reminder to him because he is deceased. Although hearing her voice was sometimes perceived unpleasantly, she did perceive the spoken memory via a voice-over as pleasant.

In phase 2, Chris, a new participant, was introduced to the concept. By bringing it to a new participant, we wanted to find out if the design would be meaningful to someone else as well and how it could be personalized further. We describe here the outcome of sessions 1 and 4, of which the set-up was similar to Adele's sessions. In addition, we had one session to prepare for the home study by determining the content of the audio files. During the first session, we learned that Chris likes to listen to music more (as opposed to memories) which we facilitated with our design. To determine the content, Chris was asked to bring some stories.

He did this by bringing CDs to select songs that he would like to be on the audio player. Chris tested the audio player in his home context for five days, and we learned that Chris enjoyed singing along with his favourite music and that the music positively reminded him of previous experiences and joyful memories. The device was also used together with his spouse to include her in his memories and lived experience. Furthermore, we learned that from all the audio files accessible through different tokens, Chris wants to keep access to the memory tokens, while the tokens with music may be changed from time to time.

Case 2: Gwen

In this case, design researcher Gwen created virtual assistants to give recommendations to older adults for their context of interest, namely listening to music and visiting a museum. Over the course of the sessions, Gwen facilitated her participants to formulate an opinion on what their virtual assistant should look like (see Figure 24) and let them experience how they perceive novel and unfamiliar technology such as artificial intelligence. The perception towards technology was very contradictory between her two participants. Emma was so enthusiastic about computers and new technology that she independently took some courses to improve her skills and asked Gwen many times for help to install apps. Sophia showed a deep and almost complete rejection towards digital systems, which made the range of digital devices in her home extremely limited. For example, she does not have a mobile phone.

Gwen introduced the aim of the experiment, to co-design a virtual assistant personalized to their liking, followed by showing interactive examples such as Siri by Apple and Alexa by Amazon. She was inspired by reflective design, which uses design and technology to encourage reflection on unconscious values and matters (Sengers et al. 2005). She chose to present virtual assistants to her participants which they would extremely dislike. This would provoke her participants to reflect and raise awareness about the topic in question (Ozkaramanli and Desmet 2016) and generate an opinion about it. In this experiment, she also asked her participants to perform specific tasks such as setting a timer and asking the assistant to send a text message to a family member.

Figure 24. Co-creation session to let the older adult formulate an opinion on what her virtual assistant should look like (Picture from the design process of Gwen).

Then the making process of the personal virtual assistants started, where her participants could choose between inspirational images using a multiple-choice visual questionnaire. With this, the attempt is to encourage the users to make their own choices by providing them with inspirational images that will act as explanatory examples and help them determine what they like or dislike. Inspired by Andersen (2012), the aim is to adopt a creative technique where doing is used as thinking, to stimulate the participants to build their own narrative by expressing and organizing their knowledge, values and preferences (Sanders and Stappers 2008). By actually needing to build the prototype, the process slows down, particularly decision-making, in favour of making well-thought-out decisions (Ozkaramanli and Desmet 2016).

Both participants had a very clear idea of what their virtual assistant should look like. Emma expressed really strong values in terms of aesthetics: "She must look beautiful: she should not have any wrinkles or a double chin". The formality and femininity of the virtual assistant were fundamental points: she expressed it was crucial that she (the virtual assistant) would wear a pink skirt.

Sophia opted for recreating a familiar person: her granddaughter. She did not express any other need or value regarding the appearance, as long as it resembled her and wore appropriate clothes for a child.

To apply these virtual assistants in context, the research prototype consists of a song-recommender comparable to Spotify, as Emma had an evident passion for music. For Sophia, instead, it consists instead of an artwork recommender tested in a museum (see Figure 25). In this case, the choice was more influenced by the social part of her daily life: most of the activities she loves she performs in her husband's company, while visiting a museum is an activity that she usually does by herself. The prototype's goal is to communicate through an animation the recommendation and give space of feedback about the correctness through a positive or negative response, represented respectively by a thumb up and a thumb down. Both will periodically be recommended some songs/artworks through a notification of the prototype, and they can give feedback to the system. The user is given in one hour six recommendations (one recommendation every ten minutes).

Figure 25. The research prototype consisted of an artwork-recommender tested in a museum (Picture from Gwen's design process).

Figure 26. The final design shows a wall design to share wisdom quotes (Picture from Vivian's design process).

By this experiment in context, the design researcher aimed to investigate algorithmic transparency, so transparency about the inner workings of an artificial intelligence system. In spite of the different starting points in terms of awareness of the two elderly women, the experiment showed clearly an increase of it: Emma became conscious not only about the content of the input information she provided to the system: "This song is chosen based on the years, this one about the words", but also about its nature "I would tell the system I like this song better [in order to improve it]".

To conclude, by being aware of the nature and content of the input used by the algorithm to work and its association to the output, the elderly user is now able to identify what can be improved or changed, but shows difficulties in employing an action which would achieve it. Furthermore, the increased awareness about the factors playing a role, makes the participants perceive the algorithm as an active agent, making choices and mistakes. This last point has a meaningful effect on the accountability dynamics: from blaming oneself because of the lack of familiarity with the technology presented, now the participant is holding the system responsible for its performance. This results in a shift of the participant feeling confused or passive towards the system to becoming more analytical and understanding.

Case 3: Vivian

In this case, Vivian created two completely different designs with her two participants individually. Saar is a very caring lady who enjoys doing voluntary work as she can be amongst people and facilitate a chat with them. For her, she created a design in a community centre to share wisdom quotes on paper tiles to inspire others and acknowledge their wisdoms because Saar used to give wisdom tiles to her friends as gifts. For Johan, an audio player was created to easily store and playback audio fragments. Johan has a visual impairment yet is still very independent and tries to look at things from a positive perspective. He is a true storyteller and enjoys being up to date about what is happening in the world. He uses an audio player already to listen to audio CDs which contain amongst others books and newspapers. However, the problem he experienced with this is he cannot save a particular story to easily listen to it again, but has to listen to the CD from the start again.

To reflect more on personalizing the design, Vivian invited a new participant to develop one of the designs further. The third involved participant, Alice, chose to collaborate on Saar's concept and develop it towards the library of wisdoms, where people could write and collect wisdom cards in photo frames (see Figure 26). Alice's most important daily life pleasures include voluntary work, animal care, cleaning and visiting her family. To further personalize the design to Alice's preferences, some changes were made. For example, to use more appealing materials for the frames and to increase the number of wisdoms so people can read more wisdoms.

The design adapted by Alice was evaluated over a period of one week on a wall close to the entrance of the activity centre. Most of the shared quotes contained humour and advice, such as "rather than sitting behind the geraniums, it is better to go to a florist" (meaning: instead of having an inactive life, do something!). Furthermore, one participant shared: "I expect people can recognize themselves in the wisdoms, or think about the past."

5.5 Results

To close the research project, interviews were conducted with each design researcher individually. These took place in June 2019 and lasted approximately 50 minutes. There were four sets of questions based on our research questions to explore and understand the personal design process. We wanted to find out the experiences of the design researchers and their understanding of the participants' experiences. In addition, we wanted to reflect on how personalisation could be expressed in the design and the process. Therefore, the following four categories of questions were formulated for the interview: 1) what they experienced as advantages and disadvantages of the project, 2) their learning moments, 3) personalisation in the design, and 4) personalisation in the process.

Case 1: Naomi

Naomi found it valuable to get her participants' opinions quickly and frequently: "It's very beautiful, meaningful… it was very valuable to me to be able to iterate. … and then go back to check what they think, back and forth.".

She made her participants see what she's doing by creating an overview of her intended design process: "I tried to explain what it [the design process] included, but it was very difficult for them to understand without any image, a product. So, they found it difficult to think along with it. Bert found it a bit scary, but switch from reservedly to active participant.". This shows that Bert perhaps had to gain confidence in the project to switch from a more passive to an active contributor.

At times though, Naomi had a hard time as a perfectionist: "Actually the plan that I prepared was fine, but then I start to worry." and "I have something in mind, and then I executed that, and then I think it would be nice to do this and this and this as well.". On the one hand, this says something about the characteristics and skills of the design researcher. On the other hand, we could critically reflect whether a design researcher could benefit from more structure or limitations in the project, so he or she can know better what to expect for a workshop, interview, or design outcome.

Case 2: Gwen

Gwen found it challenging to start the project, as portrayed by the following quotes: "I really struggled because I had never done qualitative research before." and "You don't know what you need to find out and through this kind of study you can find the unknown unknown… and take it further. So that's what I think is so meaningful.". So, Gwen describes a similar experience as Naomi that along the way, she found out what she wanted to gain from her participants. However, Naomi describes it more as an uncertainty of wanting to do more and more, while Gwen describes it as gaining clarity along the way.

Furthermore, getting to know her participants helped Gwen interpreting information: "And in this case, it was really nice to really get to know the person in front of you, so you're really able to analyse the results that you have in a personalised way. You have a clear idea of all the factors that are playing a role. Well, not all of them, but a lot of them. And then, you have a much clearer idea of how to interpret the results or how to analyse the results that you have. (…) But if you know someone, because you have so much extra information on them, you understand what their ten is and what is their one.".

So, by getting to know her participant so well during the project, she felt like she could make better sense of her collected data, even towards positioning what they like and dislike.

Case 3: Vivian

Vivian started the project a bit hesitant: "Wow, that sounds intense! [laughs] How am I going to do that? All those co-design sessions?". This feeling continued during her project as she found the projects' workload quite high. On the one hand, because of the time spent preparing the user sessions: "as a designer, you have to prepare, organise and be in contact with your participants as well as the activity centre – all by yourself" and, on the other hand, by being a perfectionist: "I have to do everything very elaborately".

Then, to elaborate upon the participants' positive experiences: "Johan just really likes to talk to people, so he enjoyed being part of it [the design process]." Furthermore, empowerment was not just Vivian's personal goal for this project, but it was also notable while executing her research: "Alice said she was really proud. Proud of the design. And that she was part of something that was actually present in the activity centre, and part of something which I could use for my research. And that she contributed to research." and "Saar felt empowered by the process, it gave her insights on her daily life, e.g., that she needed to accept help".

However, Saar did consider withdrawing from the study. And although Vivian did not want to force her participant to stay, Vivian was interested in understanding why Saar wanted to stop, so Vivian discussed this with a care professional in the activity centre who knew Saar very well. Thereby Vivian learned it was mostly a matter of insecurity, so Vivian should explain more clearly to Saar how much she valued Saar's contribution. This is interesting because we were aware that Vivian was learning a lot from Saar, and she also stated this herself: "Both very lovely people to have met and to learn from.", but perhaps this was not communicated clearly or frequently enough to Saar. After the care professional carefully discussed this with Saar as well, she decided to continue her participation in the research.

Personalisation in the Process and Design

Here we will describe per case how personalisation is shown in the process and design, but we will further elaborate upon this in the discussion section. In case 1, Naomi explains she still gave her participant priority over her wishes: "It's [the design] very personalised to the user, so I took that into account, and if I would make this [design] for myself, it would probably look very different.". Furthermore, in case 2, Gwen facilitated her users to think along with a completely new topic for her users: "it evolved to a really interesting conversation [about artificial intelligence], they [her participants] really… they never talked about it before… and in industrial design, we talk about these topics while drinking a beer.". This example shows personalisation is a two-way road, so it is influenced by the design researchers' interests as well. Vivian, from case 3, personalized the process to her participant Johan who was visually impaired: "I found ways to verbally explain my concepts [instead of showing sketches].". And when the third participant, Alice, further co-designed Saar's personal design, we asked Saar whether the developed design still felt personal to her. She said: "Not at all actually." and Vivian adds: "She thought it looked nice, but it did not belong to her anymore.". This shows a design can easily be personalized to a new participant, yet this means – in this particular case - less personalized for the previous participant.

5.6 Discussion

Throughout our study, we have gained insights with regard to our research question on how to improve the design of technology for successful ageing through personalized design. The first aspect we focused on was capturing the experiences of the design researchers and older adults. For example, in Naomi's case, we found that visually communicating the timeline and contents of a session by the designer provides confidence to users to participate. Furthermore, we found that this more personal design process contributes to understanding the users and interpreting user sessions as design researchers start to get to know the person.

Though, we found that the design researchers sometimes struggled with the personal design process, for example, in terms of the workload. We will suggest some ideas to manage the workload better, e.g., by working in teams or scope the data collection further, and we will discuss in this section the consequences this may have by doing so.

Then the second aspect we focused on to answer our research question, was reflecting on how personalization could be expressed in the design and the process. We suggest personalization can be extended further in the process by defining the users' creative strengths beforehand. Furthermore, we discuss applying the personal design process with other target groups. And we reflect on the success criteria of the project: we suggest evaluating the impact of the personal design process beyond the design, and to what extent it affects the participants' daily lives. To conclude, we discuss how to generalize personalization by 'cumulating the particular'.

Improving the Process Based on the Experiences of the Design Researchers and Participants

The following examples illustrate how we can improve our personal design process based on the experiences of the design researchers and participants.

Naomi's participants indicated uncertainty in the design process as they had difficulties understanding her and the process aims without concrete visuals to respond to. Illustrating design researchers should clearly visualize the main aim or steps of a conversation, although providing clarity should not steer the user into giving specific answers. Righi, Sayago, and Blat (2017) also described this participant uncertainty where some of their participants stated they did not know what to offer. So, we have to communicate clearly to participants that a session was fruitful.

Also, the personal design process enabled the design researcher to explore a for the participants unknown topic, as we have seen in Gwen's project, and make it concrete and formulate an opinion about it, similarly as seen in reflective design (Sengers et al. 2005). In this way, Gwen's participants could learn about something new and contribute to the virtual assistant from their perspective. This can be beneficial to bring other new topics to participants as well.

Furthermore, Gwen explained that because she had so much extra information on them, she could better understand "what is their ten and what is their one" with regard to her participants assessing their experience with the prototype. In our study, the design researcher did both the fieldwork and the analysis, and this process would spark different results when executed by and shared with multiple design researchers. This is because design researchers use their creative understanding of the users' experiences to identify opportunities and generate concepts, so the concepts that designers create will be different (Postma et al. 2012). It may be challenging to do this kind of personal process in teams, yet possible when one design researcher is in charge of the participant sessions, builds a relationship, and properly shares this knowledge with the rest of the team. We have to be aware though, that it may be challenging to show empathy when a design researcher cannot meet with a user in person (Smeenk et al. 2018).

All design researchers may have collected information that was less useful than other information, which we call 'extra' information. However, the design researchers understood better how to interpret the results through this extensive user information. One may argue if we know better what to collect beforehand, we may decrease the workload for both the participant and design researcher. Yet, we do value the little side-tracks in data gathering during design, as these may contribute later as well and provide new perspectives. Although it is a very time-consuming process to collaborate with one individual, it served the purpose of creating a personal design and was a way to include a participant who potentially would not share as much in a group setting, Vivian: "Saar really enjoyed the way she was involved as it was less chaotic than in a group, which she could not handle that well.". Perhaps to overcome the high workload, in future projects people could execute this type of project in teams, so the workload can be shared. However, as mentioned earlier, it has to be considered, that a value of co-designing something personal is that a trustworthy relationship is being built between the design researcher and older adult, so by having multiple design researchers participating in the user sessions, this may not be reached.

In addition, it remains important to involve professional caregivers to interpret the experiences of participants. For example, while Vivian really valued Saar's contribution, Saar felt insecure about her participation.

The activity center that recruited the participants recommended communicating more clearly about the value and expected input of the participants. This advice resulted in Saar realized the project impacted her daily life practice positively.

Currently, the personal design process aims to deeply connect with a person and create something meaningful for this person. The end-stage is that the person tests the design outcome to evaluate how they experience the personal prototype. However, the personal design process offers more. In Alice's case, we saw that she was proud of the design, proud to be part of the research, and proud it was actually presented in the activity center to her peers. The latter could be an interesting direction to include in the personal design process to involve recognition or acknowledgment by others, and using this process to achieve that.

Personalization in the Processes and Designs

To reflect on how personalization could be expressed in the design and the process, we align with Hendriks, Slegers, & Duysburgh (2015). They advocate for adjusting co-design techniques for people living with a cognitive or sensory impairment towards a highly individual approach. Our study shows the design researchers were flexible around the participants' abilities and adjusted their approach where needed, for example in the very particular case of the visual impairment. However, personalization could also be pushed further in defining the creative strengths of older adults before the design process starts, to facilitate them to decide where they feel confident to contribute. This was shown in Vivian's process with Alice (design case 3), who continued on Saar's design by, e.g., changing the wisdom quotes to her liking, choosing new materials for the frames, and enlarging the design so not all of them can be seen at once, but people need to take the time to read. Though this case also showed that small changes in a design, while keeping the same idea, already highly influences to what extent the design is perceived as personal. Next to the design, also in the process, the participant characteristics are present. One participant might be a true storyteller, while the other is more comfortable reflecting on ideas: "I think by already having something really concrete, it [a new person testing the previous design] was an easier transition.". Differences between the designers were present as well, for example, in Gwen's case as she was interested in working around Artificial Intelligence which steered her designing for one process.

In addition, when experienced designers (e.g., not students) had been engaged, the outcomes would have been different too. This could be due to multiple factors such as more experience with the design process, more advanced prototyping skills and more comfortable with engaging users and build empathy. However, all design cases showed how to adapt the activities and type of involvement more to the skills and interests of the participants and that methods cannot simply be taken from the shelf (Wilkinson and Stones 2018) and are shaped by the designers' identity as well.

Lastly, it is challenging to assess when personalization is successful. Is it the level of excitement of the participant involved (process), or the potential of the design for a wider group as well? Perhaps one of the success criteria could be to determine its impact beyond the design. So, in the case of Saar (Vivian's participant), she learned, for example, that she needed to accept help in her daily life. This is something she realized in a session with the design researcher. This is a clear example of the impact the design (process) has on someone's daily life, which we believe can be an important element to assess its success.

We were questioning to what extent a personal design can be useful for others. Vivian (design case 3) said the following about the potential of the design for a wider group: "You see you create a design which really fits a person, but on the other hand, shows so many opportunities to be translated to other people.". In the research of Bertelsen et al. (2019), they warn for generalization, the reality might become too abstract so that the results cannot be taken towards actual design questions. Therefore, they argue for a cumulation of particulars, because the particulars stand on their own, and reducing them to their generalizable aspects would eliminate what makes them particular in the first place.

If we look at our three cases through this lens to cumulate particulars, we would argue that from Naomi's design case 1, where an audio player was designed, we take a general concept that can be personalized by any user in terms of music or audio content. From Gwen's design case 2, with the creation of a recommendation system by virtual assistants, we see a process to let the user get acquainted with something unfamiliar by building something themselves that they can identify with.

From Vivian's design case 3, the concept of wisdom sharing, you see the expression of certain values and views on life by selecting particular quotes and wisdoms to share. We can generally conclude that all designs show that a personal design process is a strong approach to making usable and acceptable ideas where users feel it belongs to them. Yet, we also value the particular cases as stand-alone examples to show the fit of a design with a person in a particular context.

The Limitations

We explored three cases, and although with more design researchers executing a personal design process, we would potentially gain new insights, we believe this study already enabled us to gather insights of the design researchers and participant experiences. Also, because of coaching and guiding the design researchers by academic design research staff, we could have monitored the academic staffs' input to separate the design researchers' and academic staff's decisions in the project. However, this effect was minimalized by only having meetings once a week at most, and these were not steering conversations but coaching.

5.7 Concluding this Chapter

We elaborated upon the design researchers' and participants' experiences to reflect on the process and improve it so other design researchers can build further on this. The personalisation in the design process could be pushed even further by actively inviting older adults to activities they resonate with most and feel confident in. We have shown three cases that departed from the same starting point, and emerged into three very different cases, topics, and outcomes. By cumulating these particulars rather than generalising, we found how these meaningful personalised design processes and outcomes contributed in their particular context.

CHAPTER 6

Discussion and Conclusion

First, we provide our three research questions and a summary of our research. Then we reflect on our research through design approach. We share our contribution to knowledge, followed by our contribution in the form of interventions. Lastly, we discuss the societal impact of this work and its limitations.

6.1 Summary of this Research

In this thesis, we investigated the design process on how designers can get close to participants to create personalized meaningful designs. We aimed at addressing the following research questions:

1. How can we better understand why older adults use technology that supports successful ageing and how they learn to use it?

2. How can the personal interests and leisure activities of older adults inform design for successful ageing?

3. How can we improve the design of technology for successful ageing through a personalized process?

We will first shortly summarize our studies and then elaborate on how this work contributes to the field.

Chapter 2 addressed our first research question and discussed the field study that explored why older adults start and continue using the GoLivePhone, and their learning process. In Chapters 3 and 4, we addressed our second research question by engaging with older adults and their personal interests to generate input for design. We developed a storytelling tool called the Leisure Time Canvas that provides insights into older adults' personal interests and leisure time activities. This resulted in the walking application Ommetje. With this, we show a design case that invites older adults through a community approach to increasing their walks. Chapter 5 addressed our third research question by conducting three personal design processes with eight older adults to enrich their lives, presenting three design cases that exemplify personalization in design.

6.2 Reflections and Implications for Design

First, we reflect on our research through design approach. Then we share our contribution to knowledge, followed by our contribution in the form of interventions. Lastly, we discuss the societal impact of this thesis work and its limitations.

Reflection on the Research through Design Approach

We started this thesis with field research with older adults using and learning technology (Chapter 2). We moved to a research through design approach (Zimmerman, Forlizzi, and Evenson 2007) by designing technology with older adults (Chapter 4 and 5). Building on the insights of our Leisure Time Canvas (Chapter 3) and other methods, Ommetje (Chapter 4) and three other personal designs were created that build further on the personal interests of older adults (Chapter 5).

We emphasize the need to build and maintain a relationship between participant and design researcher in the design process (Correia de Barros, Rêgo, and Antunes, 2014). We contribute our canvas as an easy tool to be used by other design researchers to get closer to and form a stronger relationship with participants by elaborating on the hobbies and interests they are passionate about. This relationship and approach provide participants with a safe space to explore their experiences, for example, in Chapter 5, in which the designer co-designed virtual assistants with two older adults (see Figure 27). In collaboration with the participants, their values and themes were distilled from their stories and subsequentially used in the design process. For example, we described one participant in Chapter 5 by her sense of humor and ability to put things in perspective. We then used these characteristics in the design, where wisdom quotes could be shared. As such, the participatory design process transcends the individual research activities. The cases Chapter 4 and 5) illustrate that it is important that the activities build on top of each other with concrete design outputs.

It is well established that the users are the experts of their own experience (Visser et al. 2005). In addition, we can acknowledge the designer as the creative expert. We, therefore, emphasize the need for them to collaborate to design personalized and meaningful technologies – both experts are needed. When a designer collaborates with older adults and aims to find out what is important for them, a meaningful design can be created that provides a new experience based on their values.

Next to working participatory in this research, the designing for one process (Wilkinson and Stones 2018) provided a tool to translate personal insights transparently to design.

Figure 27. A co-creation session to let the older adult formulate an opinion on what her virtual assistant should look like (Picture from the design process of Gwen).

Figure 28. Prototypes are placeholders for something else, representing a future outcome.

In addition, we found that working reciprocally with the participants, where the participants directly benefit from the research as well, came more naturally in this individual process (Kenning 2020). We elaborated on this in Chapter 5 because one of the participants realized in a session with the design research that she needed support personally, and was motivated through this process to get it.

As Odom et al. (2016) discuss, prototypes are placeholders for something else, representing a future outcome (see Figure 28). In our design cases (Chapter 4 and 5) prototypes were essential to convey our ideas and allow participants to experience them. However, some participants assumed these were market-ready products, revealing a tension between our research approach and the perceived results by participants. For example, in Chapter 4, about Ommetje, because of the participants' perception of it being a market-ready product, they shared high expectations of what the app should be able to do. Designers should obviously be clear about the process and research and discuss with the participants they are part of an iterative process and that the design is only a prototype.

However, reflecting on a reciprocal relationship (Kenning 2020), the prototypes should also spark the participant's interest and be meaningful – even it is not the final design. Nevertheless, next to explaining clear limitations of what an intermediate design can offer, it is also rewarding to see a design trigger a positive response and stimulate further ideas for improvement. In the end, the designer needs to balance the user insights and ideas with the purpose of the design. For example, in Chapter 4, we found it was important to keep Ommetje simple, which meant not all desired functionality and ideas from the participants could be included, resulting in a more user-friendly application. It is important for designers to weigh the user's role constantly in the design process and simultaneously invite them to contribute and protect the design process and intentions.

Contribution to Knowledge

Positive Ageing in Design

More and more research suggests framing ageing positively rather than focusing on problems in HTI and design research (Vines et al. 2015). Following this perspective, we do not disregard experienced barriers and disability, aspects like a decreasing social network and increasing inability are an inevitable part of growing older (Charles and Carstensen 2010).

By adhering to a positive design lens, we can pay attention to other values that eventually bring a broader perspective addressing and enriching more facets of an individual's daily life. As discussed in Chapter 4, we provided older adults with Ommetje to explore new beautiful walks, being invited to experience new things while also staying active by making these walks (see Figure 29). We advise designers and researchers to balance the functional requirements with the emotional requirements of participants, as is also discussed by Barnard et al. (2013) by looking for why something brings joy to the user.

Overcoming the Not For Me Perspective: Designing for and by Themselves

Like previous work (Lazar and Nguyen 2017; Neven 2010; Waycott et al. 2016), we found that older adults have the tendency to voice their feedback towards researchers 'for others' but not for themselves.

Pradhan et al. (2020) aim to counter this 'for others' effect by focusing on the participants' own needs. They customized object cards to common things that participants mentioned using and included the quotes of participants for this. In the same line of thinking, we addressed overcoming the 'it's not for me'-perspective right from the start of our project. We do this by a personal design process (Chapter 5), which facilitates users to influence the direction of where the design is developing towards to ultimately create meaningful designs for them. This possibility as a user to actually influence the direction and outcome of the design is often lacking (Halskov and Hansen 2015). We recommend that design researchers provide insight into the design process by being transparent on data collected from previous sessions and letting the users reflect on to what extent the ideas generated would be of interest to them.

The Roles of Participants and Designer in the Design Process

We put our individual users in the position of 'experts on their own experience' (Visser et al. 2005). This meant that we initiated a conversation with individuals but let the outcome be quite open to making time and space to listen (Kenning 2020).

Figure 29. An older adult exploring new beautiful walks, being invited to experience new things while also staying active by making these walks.

Figure 30. The study presented in Chapter 2 with the GoLivePhone.

Figure 31. The study presented in Chapter 4 developing Ommetje together with older adults.

However, there will always remain a power imbalance between the designer (researcher) and participants. This is also discussed in the work of Robertson, Mansfield, and Loke (2006) as they were concerned to, on the one hand, maintain the power of the artists to communicate a certain vision, yet, on the other hand, equally maintain the power of the audience to generate their own experience of it. Though, the least we can do as designers is to acknowledge all contributions, as there may be differences in the level of user participation (Kenning 2020). This also shapes the role of designers to make decisions with the available information, to the best of their knowledge, to the best of their participants' interests. We believe designers should stay in the lead but make their decisions based on the user's needs and other gathered insights.

We deliberately position ourselves using the 'user as partner' approach, described in the work of Sanders and Stappers (2008). They state as a partner, participants get more influence and room for taking the initiative in roles, share their experience, and already in the early design phase partake in activities to inform, ideate, and conceptualize. With 'user as subject' trained researchers who observe or interview passive users, execute instructed tasks or share their opinion about concepts that others have created.

Particularly in Chapters 2 and 4 (see Figure 30 and 31) the shifts between these two approaches are notable, from investigating people's needs and co-developing a design (active), to testing the prototype with the same users (slightly passive) and then the continuation of product development based on user insights (active). We assume when starting active and continuing slightly passive, we may positively impact the use of the design, because people influenced the design from the start and thereby fits them better.

Finally, we expect, and also see in related work, that once you provide the older adult with too much decision-making power, there is a risk of staying too much within a comfort zone, also referred to as 'sameness in design' (van der Panne, van Beers, and Kleinknecht 2003) and thus future designs may be less out-of-the-box and more similar to existing experiences or products. This is reflected in the work of Chapter 5, more particularly, the Artificial Intelligence museum guide, where the older adult had never even thought about Artificial Intelligence. Because the design researcher facilitated to build an opinion about a virtual assistant, the older adult got acquainted with a new topic and was able to co-design this further. This is also described in research as identifying latent needs, that one cannot simply translate what users are able to express but should go beyond expression (Carlgren 2013). Thus, while the user's input is valuable and almost a condition for design, the expertise, and role of the designer is needed as well to get novel and innovative proposals.

Creating Anchor Points to Connect Technology with People's Daily Lives

We discussed changing social, technological, and environmental personal motivations to maintain engagement with a design. Müller et al. (2015) states the importance to create anchor points to connect technology with people's daily lives. We contribute specific anchor points by not only preparing for the future, as technology often focusses on solving aging problems (Lazar et al. 2017), but we recognized and emphasized the need to make both the learning experience and the use of technology fun, for example in Chapter 2 by facilitating get togethers in an informal atmosphere to learn and inviting older adults to use new technology. However, older adults continue to develop themselves, both in their technology learning curve as their identity (Brewer and Piper 2016).

We have identified some impactful life events in Chapter 3 that cause a change of hobbies and personal interests (see Figure 32). This implies it is not just essential to be aware of the reason why people start to use a product, yet it is as important as addressing the current personal motivations to keep capturing older adults' interest over time through the product (Azevedo 2013). We invite technology designers to create flexible designs which can grow along the users' interest and capability. We suggest technology designers can design for these changing personal motivations from two different directions: from the system, and from the user. From a system-level this implies that older adults need to be able to work with such technology and cope with the demands that accompany smart systems (Moor and Mohammadi 2020). For example, firstly, from the system, Gwen developed a growing and smart system by applying Artificial Intelligence (Chapter 5), based on the changing personal interests of the user. Here a recommendation system was built for one older adult to recommend songs, and for another older adult to provide a museum tour (see Figure 33).

Secondly, from the user, as the user has the possibility to change or control the system as desired. So, creating a system that relies on the input of the users themselves.

Figure 33. The research prototype consisted of an artwork-recommender tested in a museum (Picture from Gwen's design process).

Figure 34. The final design shows a wall design to share wisdom quotes (Picture from Vivian's design process).
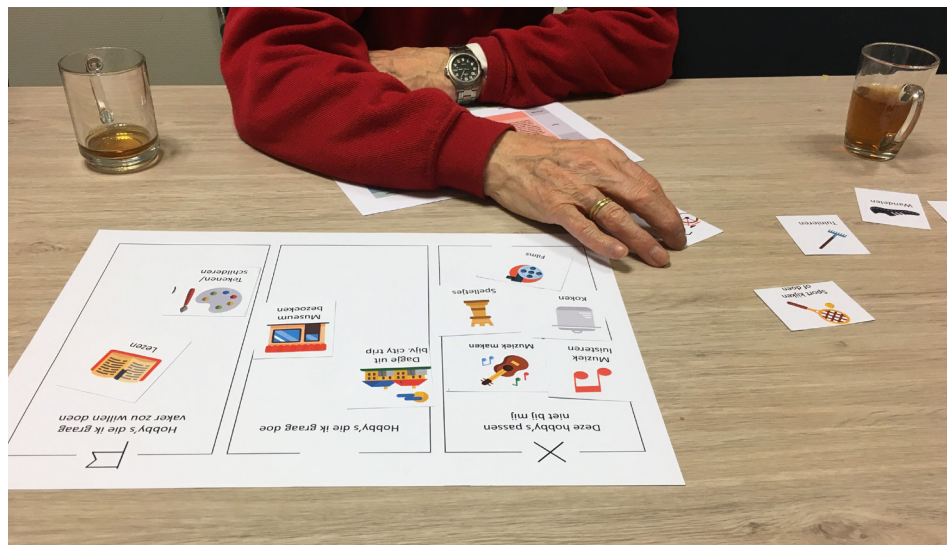
Figure 32. Identifying some impactful life events through the Leisure Time Canvas.

Figure 35. An audio player to store memories (Picture from Naomi's design process).

We elaborated on two designs in Chapter 5, one where a wisdom library was created to exchange inspirational quotes (see Figure 34), and the other where an audio player was created to store memories (see Figure 35). In fact, the system can propose a certain behavior proactively, but the user has the final decision. In this way, it offers an opportunity for automation and is responsive, but the user stays in control.

To reflect further on these anchor points, these are not just connected with an individual, but also with the community surrounding the individual – particularly in the context of leisure time. In Chapter 3, we found that most participants executed their favorite hobbies for many years already and it is not just the activity itself that they enjoy, but also the people that they routinely do the activity with. A hobby is actually a concrete token that often represents being part of a community. In a way, it could be questioned if the activity itself is the personal motivation or the person who accompanies you (Lazar and Nguyen 2017). However, we argue that the hobby and the particular 'hobby friend' are so connected, it is difficult to see these apart from each other. This is potentially a disadvantage that we need to be aware of when framing new designs, as some of our participants felt like they did not know who to execute a new hobby with as their friends were fixed to a particular activity or within a community. This is not an uncommon phenomenon, as Righi, Sayago, and Blat (2017) discuss designing for 'situated communities to which they belong' rather than older adults in general. We have also seen this in Chapter 4, that participants did not want to record an ordinary walk to the supermarket because everyone would already be familiar with the route. Thus, recognizing hobbies are connected to the people with whom the activity is being performed, and the awareness that the meaning of a design or technology is shaped within a community, this asks designers to co-create potential future social scenarios together with participants.

Contribution in the Form of Interventions

We contributed a storytelling tool in the leisure time context that deeply engages people to design something meaningful based on their hobbies, such as Ommetje. The Leisure Time Canvas showcases in the landscape of probes (Gaver, Dunne, and Pacenti 1999; Suijkerbuijk et al. 2015) how to leverage personal interests and leisure time activities to design interventions for successful ageing.

We saw in our study that participants, with the help of our canvas, were eager to share their needs which is sometimes perceived as challenging (van Kleef, van Trijp, and Luning 2005), even including unrequested and personal topics such as surgery, anxiety, and people who deceased. It facilitates both the design researcher and the older adult to easily unfold the older adults' leisure time activities and stories together, and jointly create a personal design based on these insights. This resulted in a walking application whereby older adults can easily record and share walks.

6.3 Limitations

Here we will discuss recommendations for future work by reflecting on the limitations of our work.

There are three main topics that we want to address here:

1) The context of where our research took place. This could be extended to a larger variety of contexts.

2) The duration of our interventions. The research should be lengthened to be able to investigate the acceptance and adoption.

3) The quality of our interventions. It should be a very conscious decision on what design quality to use for what purpose in what stage.

Firstly, a larger variety of contexts could be used, as our field studies took place with older adults from a very homogenous community, for example, a class of older adults who were learning to use smartphones, or were participating in an activity center together. If we would include other contexts in the future and account for cultural diversity, we can clarify the impact of the social context more elaborately. Another possibility would be to follow different groups in different regions and cover a wider diversity of backgrounds.

Secondly, long-term field studies will be necessary to understand the acceptance and adoption of designs, as we mostly did exploratory design studies to bring us new perspectives with regard to our research questions.

By extending the period from a few months towards at least a year, we would be able to confirm the users' feedback from earlier phases. In other words, whether the users' intended use matches actual use.

Thirdly, our cases express diversity in the quality of the interventions, ranging from a low-fi prototype to an on-the-market product. Although prototypes enable older adults to build an opinion on a design, their expectations should be matched. Sometimes, a design was expected to offer more or function better, for example, with fewer errors. This tells us older adults already have high expectations of technology, what it could and should offer. It is essential to contribute to a proper view of technology instead of generating feelings of frustration.

6.4 Conclusion

Over the years, participatory work with older adults gained attention in the form of research work, inclusive practice, and design. We contributed by untangling participation practice and moved forward working with older adults by empowering older adults through concrete tools and design processes to jointly discover their opinion in a playful way. With this work, we have positively impacted the lives of our participants directly in the research and potentially future older adults as well by contributing ways to involve users in the design process and offer new perspectives in design with and for older adults. Future advances are needed to develop this field of research further, and continuous reflection by design researchers is essential to cater and facilitate a pleasant environment to grow old in. This thesis aimed to demonstrate a positive view on ageing, by involvement, empathy, and opportunity.

REFERENCES

A

Ahlqvist, Anette, Hanna Nyfors, and Riitta Suhonen. 2015. "Factors Associated with Older People's Independent Living from the Viewpoint of Health and Functional Capacity: A Register-Based Study." Nursing Open 3 (2): 79–89.

Aldrich, N. 2004. "CDC Targets Sedentary Older Adults." Aging Today 25 (1): 7–8.

Ambe, Aloha Hufana, 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 CHI, 1–15.

Andersen, Kristina. 2012. "Making Magic Machines." In 10th European Academy of Design Conference - Crafting the Future, 1–11.

Azevedo, Flávio S. 2013. "The Tailored Practice of Hobbies and Its Implication for the Design of Interest-Driven Learning Environments The Tailored Practice of Hobbies and Its Implication for the Design of Interest-Driven Learning Environments." Journal of the Learning Sciences 22 (3): 462–510.

B

Barnard, Yvonne, Mike Bradley, Frances Hodgson, and Ashley Lloyd. 2013. "Learning to Use New Technologies by Older Adults: Perceived Difficulties, Experimentation Behaviour and Usability." Computers in Human Behavior 29 (4): 1715–24.

Barrett, Julia, and Stuart Kirk. 2000. "Running Focus Groups with Elderly and Disabled Elderly Participants." Applied Ergonomics 31 (6): 621–29.

Barrett, Patrick, Beatrice Hale, and Robin Gauld. 2011. "Social Inclusion through Ageing-in-Place with Care?" Ageing and Society 32 (03): 361–78.

Barros, Ana Correia de, Roxanne Leitão, and Jorge Ribeiro. 2014. "Design and Evaluation of a Mobile User Interface for Older Adults: Navigation, Interaction and Visual Design Recommendations." In Procedia Computer Science, 27:369–78. Elsevier Masson SAS.

Bartlett, Ruth. 2012. "Modifying the Diary Interview Method to Research the Lives of People With Dementia." Qualitative Health Research 22 (12): 1717–26.

Bergvall-Kåreborn, Birgitta, and Anna Ståhlbröst. 2009. "Living Lab: An Open and Citizen-Centric Approach for Innovation Innovation." International Journal of Innovation and Regional Development 1 (4): 356.

Bertelsen, Olav W, Susanne Bødker, Eva Eriksson, Eve Hoggan, and Jo Vermeulen. 2019. "Beyond Generalization: Research for the Very Particular." Interactions, 35–38.

Boldy, Duncan, Linda Grenade, Gill Lewin, Elizabeth Karol, and Elissa Burton. 2011. "Older People's Decisions Regarding 'Ageing in Place': A Western Australian Case Study." Australasian Journal on Ageing 30 (3): 136–42.

Botero, Andrea, and Sampsa Hyysalo. 2013. "Ageing Together: Steps towards Evolutionary Co-Design in Everyday Practices." CoDesign 9 (1): 37–54.

Bowen, Simon, and Paul Chamberlain. 2008. "Engaging the Ageing: Designing Artefacts to Provoke Dialogue." In Designing Inclusive Futures, edited by Robinson P. Langdon P., Clarkson J., 35–44. Springer, London.

Branco, Rita Maldonado, Joana Quental, and Óscar Ribeiro. 2017. "Personalised Participation: An Approach to Involve People with Dementia and Their Families in a Participatory Design Project." CoDesign, 127–43.

Brankaert, Rens, and Elke den Ouden. 2017. "The Design-Driven Living Lab: A New Approach to Exploring Solutions to Complex Societal Challenges." Technology Innovation Management Review 7 (1): 44–51.

Braun, Virginia, and Victoria Clarke. 2006. "Using Thematic Analysis in Psychology." Qualitative Research in Psychology 3 (2): 77–101.

Brewer, Robin, and Anne Marie Piper. 2016. "'Tell It Like It Really Is': A Case of Online Content Creation and Sharing Among Older Adult Bloggers." In CHI, 5529–42.

Brown, Tim, and Barry Katz. 2011. "Change by Design." Journal of Product Innovation Management 28 (3): 381–83.

Burrows, Alison, Val Mitchell, and Colette Nicolle. 2015. "Cultural Probes and Levels of Creativity." MobileHCI, 920–23.

C

Cabrita, Miriam, Mohammad Hossein Nassabi, Harm op den Akker, Monique Tabak, Hermie Hermens, and Miriam Vollenbroek. 2015. "An Unobtrusive System to Monitor Physical Functioning of the Older Adults: Results of a Pilot Study." In International Workshop on Personalization and Adaptation in Technology for Health Held in Conjunction with the 23rd Conference on User Modelling, Adaptation and Personalisation.

Calvert, Isaac. 2014. "Investigating the One-on-One Master-Apprentice Relationship: A Case Study in Traditional Craft Apprenticeship." https://scholarsarchive.byu.edu/etd/4154.

Carlgren, Lisa. 2013. "Identifying Latent Needs: Towards a Competence Perspective on Attractive Quality Creation." Total Quality Management and Business Excellence 24 (11–12): 1347–63.

Carroll, John M., Gregorio Convertino, Umer Farooq, and Mary Beth Rosson. 2011. "The Firekeepers: Aging Considered as a Resource." Universal Access in the Information Society 11 (1): 7–15.

CBS. 2017. "Increasing Number of Elderly Using Social Media." 2017. https://www.cbs.nl/nl-nl/nieuws/2017/52/steeds-meer-ouderen-op-sociale-media.

Cedervall, Ylva, Sandra Torres, and Anna Cristina Åberg. 2015. "Maintaining Well-Being and Selfhood through Physical Activity: Experiences of People with Mild Alzheimer's Disease." Aging & Mental Health 19 (8): 679–88.

Chamberlain, Paul, Claire Craig, and Nick Dulake. 2019. "'Thinking through Things' to Support Cooperative Design in the Development of Technology to Support Health & Wellbeing." Multi Conference on Computer Science and Information Systems, MCCSIS 2019 - Proceedings of the International Conferences on Interfaces and Human Computer Interaction 2019, Game and Entertainment Technologies 2019 and Computer Graphics, Visualization, Comp, 19–26.

Chang, Po-Ju, Linda Wray, and Yeqiang Lin. 2014. "Social Relationships, Leisure Activity, and Health in Older Adults." Health Psychology 33 (6): 516–23.

Chapman, Benjamin P, Sarah Hampson, and John Clarkin. 2014. "Personality-Informed Interventions for Healthy Aging: Conclusions From a National Institute on Aging Workgroup" 50 (5): 1426–41.

Charles, Susan, and Laura Carstensen. 2010. "Social and Emotional Aging." Annual Review of Psychology 61: 383–409.

Chen, Jiandong, Yun Wang, Jie Wen, Fuqian Fang, and Malin Song. 2016. "The Influences of Aging Population and Economic Growth on Chinese Rural Poverty." Journal of Rural Studies 47: 665–76.

Clark, Fiona, Anita Fochs Heller, Carolynn Rafman, and Joan Walker. 1997. "Peer Learning: A Popular Model for Seniors Education." Educational Gerontology 23 (8): 751–62.

Cohen-Mansfield, Jiska, Aleksandra Parpura-Gill, and Hava Golander. 2006. "Utilization of Self-Identity Roles for Designing Interventions for Persons With Dementia." Journal of Gerontology 61B (4): 202–12.

Coleman, Graeme W., Lorna Gibson, Vicki L. Hanson, Ania Bobrowicz, and Alison McKay. 2010. "Engaging the Disengaged: How Do We Design Technology for Digitally Excluded Older Adults?" DIS 2010 - Proceedings of the 8th ACM Conference on Designing Interactive Systems, no. January: 175–78.

Correia de Barros, Ana, SíLvia Rêgo, and João Antunes. 2014. "Aspects of Human-Centred Design in HCI with Older Adults: Experiences from the Field." In 5th International Conference on Human-Centred Software Engineering (HCSE), 8742:235–42.

Creswell, John W, and Vicki L Piano Clark. 2007. "Designing and Conducting Mixed Methods Research." Australian and New Zealand Journal of Public Health 31 (4): 388–388.

D

Dell'Era, Claudio, and Paolo Landoni. 2014. "Living Lab: A Methodology between User-Centred Design and Participatory Design." Creativity and Innovation Management 23 (2): 137–54.

Docampo Rama, Maria. 2001. "Technology Generations Handling Complex User Interfaces." Eindhoven: Technische Universiteit Eindhoven.

Doorn, Fenne van, and Remke Klapwijk. 2013. "Human-Centered Design in Primary Schools: A Method to Develop Empathy with and Knowledge of the Needs of Elderly." In 2nd International Conference for Design Education Researchers.

Durick, Jeannette, Toni Robertson, Margot Brereton, Frank Vetere, and Bjorn Nansen. 2013. "Dispelling Ageing Myths in Technology Design." Proceedings of the 25th Australian Computer-Human Interaction Conference: Augmentation, Application, Innovation, Collaboration, OzCHI 2013, 467–76.

E

Eckert, J. Kevin, Leslie A. Morgan, and Namratha Swamy. 2004. "Preferences for Receipt of Care among Community-Dwelling Adults." Journal of Aging and Social Policy 16 (2): 49–65.

Eisma, R, A Dickinson, J Goodman, O Mival, A Syme, and L Tiwari. 2003. "Mutual Inspiration in the Development of New Technology for Older People." In Include.

Eurostat. 2018. "Population Structure and Ageing." 2018.

F

Fausset, C.B., L. Harley, S. Farmer, and B. Fain. 2013. "Older Adults' Perceptions and Use of Technology: A Novel Approach." In International Conference on Universal Access in Human-Computer Interaction, 51–58.

Fernandez-Ballesteros, R. 2019. "The Concept of Successful Aging and Related Terms." In The Cambridge Handbook of Successful Aging, edited by R. Fernandez-Ballesteros, A. Benetos, and J-M Robine, 6–22. Cambridge University Press 2019.

Fischer, Shira H., Daniel David, Bradley H. Crotty, Meghan Dierks, and Charles Safran. 2014. "Acceptance and Use of Health Information Technology by Community-Dwelling Elders." International Journal of Medical Informatics 83 (9): 624–35.

Fondevila Gascon, Joan Francesc, Marta Carreras-Alcalde, Swen Seebach, and María Jesús Pesqueira Zamora. 2015. "How Elders Evaluate Apps: A Contribution to the Study of Smartphones and to the Analysis of the Usefulness and Accessibility of ICTS for Older Adults." Mobile Media & Communication 3 (2): 250–66.

G

Gaver, Bill, Tony Dunne, and Elena Pacenti. 1999. "Design: Cultural Probes." Interactions 6 (1): 21–29.

GocietySolutions. 2020. "The Functionalities of the GoLivePhone." 2020. https://www.goliveclip.eu/solutions/golivephone-app/.

Gregor, Peter, Alan Newell, and Mary Zajicek. 2002. "Designing for Dynamic Diversity - Interfaces for Older People." In Assets '02.

Guest, Greg, Emily Namey, and Kevin McKenna. 2017. "How Many Focus Groups Are Enough? Building an Evidence Base for Nonprobability Sample Sizes." Field Methods 29 (1): 3–22.

H

Haan, Marjolein den, Rens Brankaert, Gail Kenning, and Yuan Lu. 2021. "Creating a Social Learning Environment for and by Older Adults in the Use and Adoption of Smartphone Technology to Age In." Frontiers in Public Health 9 (June): 1–10.

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2018. "What Moves You? Designing a Walking App for and with Older Adults." In Design4Health, edited by Kirsty Christer, Claire Craig, and Dan Wolstenholme.

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2019. "The Leisure Time Canvas: Eliciting Empathy for Older Adults through Activities and Hobbies." In Academy for Design Innovation Management.

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2020a. "Applying Design Methods to Promote Older Adults' Walking Activities Based on Their Hobbies and Personal Interests." In Design of Assistive Technology for Ageing Populations, edited by Andree Woodcock, Louise Moody, Deana McDonagh, Ajita Jain, and Lakhmi C. Jain, 257–73. Springer.

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2020b. "Design for One: Personalisation and Experiences of Design Researchers and Participants." In ICDC.

Haan, Marjolein den, Nicole van Essen, Rens Brankaert, and Yuan Lu. 2021. "Your Moments: Co-Designing a Personalized Audio Player." In Dementia Lab 2021: Supporting Ability Through Design, edited by Brankaert Rens, Caylee Raber, Maarten Houben, Paulina Malcolm, and Jon Hannan, 63–71. Springer, Cham.

Hakobyan, Lilit, Jo Lumsden, and Dympna O'Sullivan. 2015. "How to Engage Older Adults in Participatory Design Activities." International Journal of Mobile Human Computer Interaction 7(3): 78–92.

Halskov, Kim, and Nicolai Brodersen Hansen. 2015. "The Diversity of Participatory Design Research Practice at PDC 2002-2012." International Journal of Human Computer Studies 74: 81–92.

Hatcher, Deborah, Esther Chang, Virginia Schmied, and Sandra Garrido. 2019. "Exploring the Perspectives of Older People on the Concept of Home." Journal of Aging Research 2019.

Hendriks, Niels, Karin Slegers, and Pieter Duysburgh. 2015. "Codesign with People Living with Cognitive or Sensory Impairments: A Case for Method Stories and Uniqueness." CoDesign 11 (1): 70–82.

Hickman, Jamye M., Wendy A. Rogers, and Arthur D. Fisk. 2007. "Training Older Adults To Use New Technology." Journals of Gerontology: Series B 62B (1): 77–84.

Hoven, Elise Van Den, Joep Frens, Dima Aliakseyeu, Jean Bernard Martens, Kees Overbeeke, and Peter Peters. 2007. "Design Research & Tangible Interaction." TEI'07: First International Conference on Tangible and Embedded Interaction, no. January: 109–15.

Huang, C., L. Lee, and M. Chang. 2007. "The Influences of Personality and Motivation on Exercise Participation and Quality of Life." Social Behavior and Personality 35: 1189–1210.

Hummels, Caroline, and Joep Frens. 2009. "The Reflective Transformative Design Process." CHI EA '09: Proceedings of the 27th International Conference Extended Abstracts on Human Factors in Computing Systems, 2655–58.

I

Ireland, Christopher. 2003. "Qualitative Methods: From Boring to Brilliant." In Design Research: Methods and Perspectives, edited by Brenda Laurel, 23–29. MIT Press.

J

Joe, Jonathan, and George Demiris. 2013. "Older Adults and Mobile Phones for Health : A Review." Journal of Biomedical Informatics 46 (5): 947–54.

K

Kahlbaugh, Patricia, and Loreen Huffman. 2017. "Personality, Emotional Qualities of Leisure, and Subjective Well-Being in the Elderly." The International Journal of Aging and Human Development 85 (2): 164–84.

Keitsch, Martina Maria. 2014. "Integrating Different User Involvement Methods in Design Curriculum." Proceedings of the 16th International Conference on Engineering and Product Design Education: Design Education and Human Technology Relations, E and PDE 2014, no. September: 606–11.

Kenning, Gail. 2020. "Reciprocal Design." In HCI and Design in the Context of Dementia, edited by Rens Brankaert and Gail Kenning, 17–32. Springer.

Klasnja, Predrag, and Wanda Pratt. 2012. "Healthcare in the Pocket: Mapping the Space of Mobile-Phone Health Interventions." Journal of Biomedical Informatics 45 (1): 184–98.

Kleef, Ellen van, Hans C.M. van Trijp, and Pieternel Luning. 2005. "Consumer Research in the Early Stages of New Product Development: A Critical Review of Methods and Techniques." Food Quality and Preference 16 (3): 181–201.

Klimova, Blanka, and Martin Valis. 2018. "Smartphone Applications Can Serve as Effective Cognitive Training Tools in Healthy Aging." Frontiers in Aging Neuroscience 9: 1–4.

Knight, Tess, and Lina A Ricciardelli. 2003. "Successful Aging: Perceptions of Adults Aged between 70 and 101 Years." International Journal of Ageing and Human Development 56 (3): 223–45.

Koskinen, Ilpo, John Zimmerman, Thomas Binder, Johan Redström, and Stephan Wensveen. 2011. Design Research Through Practice: From the Lab, Field, and Showroom.

Kouprie, Merlijn, and Froukje Sleeswijk Visser. 2009. "A Framework for Empathy in Design: Stepping into and out of the User's Life" 20 (5): 437–48.

Krueger, Richard. 1998. Developing Questions for Focus Groups. SAGE Publications, Inc.

Kujala, Sari. 2003. "User Involvement: A Review of the Benefits and Challenges." Behaviour and Information Technology 22 (1): 1–16.

L

Lampinen, P., R. L. Heikkinen, M. Kauppinen, and E. Heikkinen. 2006. "Activity as a Predictor of Mental Well-Being among Older Adults." Aging and Mental Health 10 (5): 454–66.

Lazar, Amanda, Mark Diaz, Robin Brewer, Chelsea Kim, and Anne Marie Piper. 2017. "Going Gray, Failure to Hire, and the Ick Factor: Analyzing How Older Bloggers Talk about Ageism." In CSCW '17, 655–68.

Lazar, Amanda, and David H Nguyen. 2017. "Successful Leisure in Independent Living Communities: Understanding Older Adults' Motivations to Engage in Leisure Activities."

Leonardi, C., C. Mennecozzi, E. Not, F. Pianesi, and M. Zancanaro. 2008. "Designing a Familiar Technology For Elderly People." Gerontechnology 7 (2): 151.

Leong, T, and Toni Robertson. 2016. "Voicing Values: Laying Foundations for Ageing People to Participate in Design." Participatory Design Conference, 31–40.

Lerouge, Cynthia, Jiao Ma, Sweta Sneha, and Kristin Tolle. 2011. "User Profiles and Personas in the Design and Development of Consumer Health Technologies." International Journal of Medical Informatics 82 (11): e251–68.

Light, Ann, Tuck W. Leong, and Toni Robertson. 2015. "Ageing Well with CSCW." ECSCW 2015: Proceedings of the 14th European Conference on Computer Supported Cooperative Work, 19-23 September 2015, Oslo, Norway, 295–304.

Lindley, Siân E, Richard Harper, and Abigail Sellen. 2009. "Desiring to Be in Touch in a Changing Communications Landscape: Attitudes of Older Adults." In Proceedings of the 27th International Conference on Human Factors in Computing Systems - CHI 09.

Litwin, Howard, Ella Schwartz, and Noam Damri. 2017. "Cognitively Stimulating Leisure Activity and Subsequent Cognitive Function: A SHARE-Based Analysis." Gerontologist 57 (5): 940–48.

Lu, Y., Brankaert, R.G.A., Valk, C.A.L., Wintermans, M.C., Ren., X. 2019. "Designing Digital Services to Enhance Older Person's Access to Public Transport." In Urban Environments for Healthy Ageing, edited by A.P. Lane, 209–25. Oxfordshire: Taylor and Francis Ltd.

Lu, Yuan, Ad van Berlo, Xipei Ren, Carlijn Valk, Marjolein den Haan-Wintermans, Peixun Li, Tianming Li, Jianfen Li, and Guang Yang. 2018. "Situating Societal Challenges in an Industrial Design Classroom." In Academic Design Management Conference, 1268–78.

Lu, Yuan, Rens Brankaert, Carlijn Valk, Marjolein den Haan, and Xipei Ren. 2019. "Designing Digital Services to Enhance Older Person's Access to Public Transport." In Urban Environments for Healthy Ageing, edited by Anna P. Lane, 209–25. Taylor & Francis.

M

Manzini, E. 2015. Design When Everybody Designs. An Introduction to Design for Social Innovation. Cambridge MA: MIT Press.

Martínez-Alcalá, Claudia I., Alejandra Rosales-Lagarde, María de los ángeles Alonso-Lavernia, José A. Ramírez-Salvador, Brenda Jiménez-Rodríguez, Rosario M. Cepeda-Rebollar, José Sócrates López-Noguerola, María Leticia Bautista-Díaz, and Raúl Azael Agis-Juárez. 2018. "Digital Inclusion in Older Adults: A Comparison between Face-to-Face and Blended Digital Literacy Workshops." Frontiers in ICT 5 (21): 1–17.

Massimi, Michael, Ronald M Baecker, and Michael Wu. 2007. "Using Participatory Activities with Seniors to Critique, Build, and Evaluate Mobile Phones." In Assets '07, 155–62.

Matsumoto, Hiroshige, Takashi Naruse, Mahiro Sakai, and Satoko Nagata. 2016. "Who Prefers to Age in Place? Cross-Sectional Survey of Middle-Aged People in Japan." Geriatrics and Gerontology International 16 (5): 631–37.

Mattelmäki, Tuuli, and Katja Battarbee. 2002. "Empathy Probes." In Participatory Design Conference, 266–71.

McPake, Barbara, and Ajay Mahal. 2017. "Addressing the Needs of an Aging Population in the Health System: The Australian Case." Health Systems and Reform 3 (3): 236–47.

Mittelstadt, Brent, Ben Fairweather, Mark Shaw, and Neil McBride. 2011. "Ethical Issues of Personal Health Monitoring." ETHICOMP 2011 Conference Proceedings.

Mitzner, Tracy, Julie Boron, Cara Fausset, Anne Adams, Neil Charness, Sara Czaja, Katinka Dijkstra, Arthur Fisk, Wendy Rogers, and Joseph Sharit. 2010. "Older Adults Talk Technology: Technology Usage and Attitudes." Computers in Human Behavior 26 (6): 1710–21.

Mitzner, Tracy L, Cara Bailey Fausset, Julie B Boron, Anne E Adams, Katinka Dijkstra, Chin Chin Lee, Wendy A Rogers, and Arthur D Fisk. 2008. "Older Adults ' Training Preferences for Learning to Use Technology," 2047–51.

Moor, Nienke, and Masi Mohammadi. 2020. "Grey Smart Societies: Supporting the Social Inclusion of Older Adults by Smart Spatial Design." In Data-Driven Multivalence in the Built Environment, edited by Nimish Biloria, 157–80. Springer.

Morrison, Dirk, and Jessica McCutheon. 2019. "Empowering Older Adults' Informal, Self-Directed Learning: Harnessing the Potential of Online Personal Learning Networks." Research and Practice in Technology Enhanced Learning 14 (1).

Müller, Claudia, Dominik Hornung, Theodor Hamm, and Volker Wulf. 2015. "Measures and Tools for Supporting ICT Appropriation by Elderly and Non Tech-Savvy Persons in a Long-Term Perspective." In ECSCW 2015: Proceedings of the 14th European Conference on Computer Supported Cooperative Work.

N

Nassir, Soud, Tuck Wah Leong, and Toni Robertson. 2015. "Positive Ageing: Elements and Factors for Design." OzCHI.

Neven, Louis. 2010. "'But Obviously Not for Me': Robots, Laboratories and the Defiant Identity of Elder Test Users." Sociology of Health and Illness 32 (2): 335–47.

NIDI and CBS. 2020. "Bevolking 2050 in Beeld Drukker, Diverser En Dubbelgrijs."

Niemeijer, Alistair R., Marja F.I.A. Depla, Brenda J.M. Frederiks, and Cees M.P.M. Hertogh. 2015. "The Experiences of People with Dementia and Intellectual Disabilities with Surveillance Technologies in Residential Care." Nursing Ethics 22 (3): 307–20.

O

O'Keefe, Paul A., Carol S. Dweck, and Gregory M. Walton. 2018. "Implicit Theories of Interest: Finding Your Passion or Developing It?" Psychological Science 29 (10): 1653–64.

Odom, William, Ron Wakkary, Youn Kyung Lim, Audrey Desjardins, Bart Hengeveld, and Richard Banks. 2016. "From Research Prototype to Research Product." Conference on Human Factors in Computing Systems - Proceedings, no. May: 2549–61.

Orso, V, A Spagnolli, L Gamberini, F Ibañez, and M E Fabregat. 2015. "Involving Older Adults in Designing Interactive Technology: The Case of Seniorchannel." In ACM International Conference Proceeding Series.

Orth, Daniel, and Elise van den Hoven. 2016. "'I Wouldn't Choose That Key Ring; It's Not Me': A Design Study of Cherished Possessions and the Self." In OzCHI '16.

Orth, Daniel, Clementine Thurgood, and Elise van den Hoven. 2018. "Designing Objects with Meaningful Associations." International Journal of Design 12 (2): 91–104.

Ory, Marcia G, Shinduk Lee, Gang Han, Samuel D Jr Towne, Cindy Quinn, Taylor Neher, Alan

Stevens, and Matthew Lee Smith. 2018. "Effectiveness of a Lifestyle Intervention on Social Support , Self-Efficacy , and Physical Activity among Older Adults : Evaluation of Texercise Select." International Journal of Environmental Research and Public Health 15 (234).

Ozkaramanli, Deger, and Pieter M. A. Desmet. 2016. "Provocative Design for Unprovocative Designers: Strategies Fo r Triggering Personal Dilemmas." DRS2016: Future-Focused Thinking 5.

P

Panne, Gerben van der, Cees van Beers, and Alfred Kleinknecht. 2003. "Success and Failure of Innovation: A Literature Review." International Journal of Innovation Management 7 (3): 309–38.

Peek, Sebastiaan, Katrien Luijkx, Maurice Rijnaard, Marianne Nieboer, Claire van der Voort, Sil Aarts, Joost van Hoof, Hubertus Vrijhoef, and Eveline Wouters. 2015. "Older Adults' Reasons for Using Technology While Aging in Place." Gerontology 62 (2): 226–37.

Peek, Sebastiaan, Eveline Wouters, Katrien Luijkx, and Hubertus Vrijhoef. 2016. "What It Takes to Successfully Implement Technology for Aging in Place: Focus Groups with Stakeholders." Journal of Medical Internet Research 18 (5): 1–13.

Pericu, Silvia. 2017. "Designing for an Ageing Society: Products and Services." The Design Journal 6925: S2178–89.

Postma, Carolien E, Elly Zwartkruis-pelgrim, Elke Daemen, and Jia Du. 2012. "Challenges of Doing Empathic Design : Experiences from Industry." International Journal of Design 6 (1): 59–70.

Pradhan, Alisha, Ben Jelen, Katie A. Siek, Joel Chan, and Amanda Lazar. 2020. "Understanding Older Adults' Participation in Design Workshops," 1–15.

Pullin, Graham, and Alan Newell. 2007. "Focussing on Extra-Ordinary Users." In UAHCI 2007, 253–62.

R

Righi, Valeria, 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.

Robertson, Toni, Jeannette Durick, Margot Brereton, Frank Vetere, Steve Howard, and Bjorn Nansen. 2012. "Knowing Our Users: Scoping Interviews in Design Research with Ageing Participants." Proceedings of the 24th Australian Computer-Human Interaction Conference, OzCHI 2012, 517–20.

Robertson, Toni, Tim Mansfield, and Lian Loke. 2006. "Designing an Immersive Environment for Public Use." Proceedings of the 9th Conference on Participatory Design: Expanding Boundaries in Design, PDC 2006, 31–40.

Rogers, Yvonne, and Gary Marsden. 2013. "Does He Take Sugar? Moving beyond the Rhetoric of Compassion." Interactions 20 (4): 48–57.

Rogers, Yvonne, Jeni Paay, Margot Brereton, Kate Vaisutis, Gary Marsden, and Frank Vetere. 2014. "Never Too Old: Engaging Retired People Inventing the Future with MaKey MaKey." In CHI.

Roozen, Hendrik, Hans Wiersema, Martin Strietman, Jan Feij, Peter Lewinsohn, Robert Meyers, Margot Koks, and Ad Vingerhoets. 2008. "Development and Psychometric Evaluation of the Pleasant Activities List." The American Journal on Addictions 17 (5): 422–35.

Rosales, Andrea, Mireia Fernández-ardèvol, Francesca Comunello, Simone Mulargia, and Núria Ferran-ferrer. 2017. "Older People and Smartwatches, Initial Experiences." El Profesional de La Informacion 26 (3): 457–63.

Rosenthal, Meagen. 2016. "Qualitative Research Methods: Why, When, and How to Conduct Interviews and Focus Groups in Pharmacy Research." Currents in Pharmacy Teaching and Learning 8 (4): 509–16.

Rousseau, François L., and Robert J. Vallerand. 2008. "An Examination of the Relationship between Passion and Subjective Well-Being in Older Adults." The International Journal of Aging and Human Development 66 (3): 195–211.

Rowe, John W, and Robert L Kahn. 1997. "Succesful Aging." The Gerontologist 37 (4): 433–40.

Ruis, Margit. 2017. "The ENSAFE Pilots Kicked off in the Four Regions!" 2017. https://www.ensafe-aal.com/the-ensafe-pilots-kicked-off-in-the-four-regions/.

S

Sales, Márcia Barros de, Ricardo Azumbuja Silveira, André Barros de Sales, and Rita de Cássia Guarezi. 2009. "Learning by Peers: An Alternative Learning Model for Digital Inclusion of Elderly People." IFIP International Federation for Information Processing 302: 436–44.

Sanders, and Pieter Jan Stappers. 2008. "Co-Creation and the New Landscapes of Design." CoDesign 4 (1): 5–18.

Sayago, Sergio, Paula Forbes, and Josep Blat. 2013. "Older People Becoming Successful ICT Learners Over Time: Challenges and Strategies Through an Ethnographical Lens." Educational Gerontology 39 (7): 527–44.

Seifert, Alexander, Dominique Alexandra Reinwand, and Anna Schlomann. 2019. "Designing and Using Digital Mental Health Interventions for Older Adults: Being Aware of Digital Inequality." Frontiers in Psychiatry 10 (568): 1–4.

Sengers, Phoebe, Kirsten Boehner, Shay David, and Joseph Kaye. 2005. "Reflective Design." Critical Computing - Between Sense and Sensibility - Proceedings of the 4th Decennial Aarhus Conference, 49–58.

Smeenk, Wina, Janienke Sturm, Jaques Terken, and Berry Eggen. 2018. "A Systematic Validation of the Empathic Handover Approach Guided by Five Factors That Foster Empathy in Design A Systematic Validation of the Empathic Handover Approach Guided by Five Factors That Foster Empathy in Design." CoDesign 0882: 1–21.

Sorgalla, Jonas, Peter Schabsky, Sabine Sachweh, Miriam Grates, and Elisabeth Heite. 2017. "Improving Representativeness in Participatory Design Processes with Elderly." In CHI EA '17.

Stappers, P, F Sleeswijk-Visser, and I Keller. 2003. "Mapping the Experiential Context of Product Use: Generative Techniques beyond Questions and Observations." In 6th Asian Design International Conference, 1–8.

Steen, Marc, Lotte Kuijt-Evers, and Jente Klok. 2007. "Early User Involvement in Research and Design Projects–A Review of Methods and Practices." Paper for the 23rd EGOS Colloquium, 1–21.

Stuckey, Melanie I, Shawn W Carter, and Emily Knight. 2017. "The Role of Smartphones in Encouraging Physical Activity in Adults." International Journal of General Medicine 10: 293–303.

Suijkerbuijk, Sandra, Rens Brankaert, Yvonne A W De Kort, Liselore J A E Snaphaan, and Elke Den Ouden. 2015. "Seeing the First-Person Perspective in Dementia: A Qualitative Personal Evaluation Game to Evaluate Assistive Technology for People Affected by Dementia in the Home Context." Interacting with Computers. Oxford University Press.

Sumner, Jennifer, Lin Siew Chong, Anjali Bundele, and Yee Wei Lim. 2020. "Co-Designing Technology for Aging in Place: A Systematic Review." The Gerontologist XX (Xx): 1–15.

Swallow, David, Helen Petrie, Christopher Power, Andrew Lewis, and Alistair D N Edwards. 2016. "Involving Older Adults in the Technology Design Process: A Case Study on Mobility and Wellbeing in the Built Environment." Studies in Health Technology and Informatics 229: 615–23.

U

Urtamo, Annele, Satu K. Jyväkorpi, and Timo E. Strandberg. 2019. "Definitions of Successful Ageing: A Brief Review of a Multidimensional Concept." Acta Biomedica 90 (2): 359–63.

V

Valk, Carlijn, Yuan Lu, Xipei Ren, Marjolein Wintermans, Ivar Kraaijevanger, Jim Steenbakkers, and Vincent Visser. 2017. "Towards Personalized Persuasive Strategies for Active Ageing." Gerontechnology 16 (3): 160–72.

Valk, Carlijn, Marjolein Wintermans, Yuan Lu, Tilde Bekker, and Rens Brankaert. 2018. "Identifying Factors for Personalized Strategies to Motivate Seniors to Adopt a More Active Lifestyle." Gerontechnology 17.

Vaportzis, Eleftheria, Maria Giatsi Clausen, and Alan J Gow. 2017. "Older Adults Perceptions of Technology and Barriers to Interacting with Tablet Computers: A Focus Group Study." Frontiers in Psychology 8.

Venkatesh, Viswanath, and Fred D. Davis. 2000. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies." Management Science 46 (2): 186–204.

Verghese, Joe. 2003. "Leisure Activities and the Risk of Dementia in the Elderly." The New England Journal of Medicine, 2508–16.

Vines, J, G Pritchard, PC Wright, P Olivier, and K Brittain. 2015. "An Age-Old Problem: Examining the Discourses of Ageing in HCI and Strategies for Future Research." ACM Transactions on Computer-Human Interaction 22 (1): 27.

Vines, John, Mark Blythe, Stephen Lindsay, Paul Dunphy, Andrew Monk, and Patrick Olivier. 2012. "Questionable Concepts: Critique as a Resource for Designing with Eighty Somethings." Conference on Human Factors in Computing Systems - Proceedings, no. May: 1169–78.

Visser, Froukje Sleeswijk, Pieter Jan Stappers, Remko van der Lugt, and Elizabeth B-N Sanders. 2005. "Contextmapping: Experiences from Practice." CoDesign 1 (2): 119–49.

Vroman, Kerryellen G., Sajay Arthanat, and Catherine Lysack. 2015. "'Who over 65 Is Online?' Older Adults' Dispositions toward Information Communication Technology." Computers in Human Behavior 43: 156–66.

W

Wallace, Jayne, John McCarthy, Peter C. Wright, and Patrick Olivier. 2013. "Making Design Probes Work." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '13, 3441–50.

Wallace, Jayne, Peter C Wright, John Mccarthy, David Philip Green, James Thomas, and Patrick Olivier. 2013. "A Design-Led Inquiry into Personhood in Dementia." In CHI '13, 2617–26.

Wang, Shengzhi, Khalisa Bolling, Wenlin Mao, Jennifer Reichstadt, Dilip Jeste, Ho-Cheol Kim, and Camille Nebeker. 2019. "Technology to Support Aging in Place: Older Adults' Perspectives." Healthcare 7 (2): 60.

Warren-Findlow, Jan. 2013. "Qualitative Research in JG:SS-"i'll Take a Side of Coleslaw with That"." Journals of Gerontology - Series B Psychological Sciences and Social Sciences 68 (3): 407–8.

Waycott, Jenny, 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." CHI, 745–57.

Whitney, Gill, and Suzette Keith. 1998. "Bridging the Gap between Young Designers and Older Users." In The Good, the Bad and the Challenging: The User and the Future of ICT.

Wildenbos, G. A., Linda Peute, and Monique Jaspers. 2018. "Aging Barriers Influencing Mobile Health Usability for Older Adults: A Literature Based Framework (MOLD-US)." International Journal of Medical Informatics 114 (March): 66–75.

Wilkinson, Andrea, and Catherine Stones. 2018. "Designing For One; How Adjusting Variables Influenced Design Student Creativity." In ICDC.

Wintermans, Marjolein. 2017. "User Involvement for Personalised Service Design: Designing a Walking App for and with Senior Citizens." Technische Universiteit Eindhoven.

Wintermans, Marjolein, Rens Brankaert, and Yuan Lu. 2017. "Together We Do Not Forget: Co-Designing with People Living with Dementia towards a Design for Social Inclusion." Design Management Academy.

Wintermans, Marjolein, Carlijn Valk, Rens Brankaert, and Yuan Lu. 2018. "Not All Classrooms Have Four Walls: Analysing Experiences of Senior Citizens Using Novel Smartphone Technology." In Gerontechnology. Vol. 17.

World Health Organization. 2020. "Ageing." 2020.

Z

Zimmerman, John, Jodi Forlizzi, and Shelley Evenson. 2007. "Research Through Design as a Method for Interaction Design Research in HCI Design Research in HCI." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 493–502.

CURRICULUM VITAE

Marjolein den Haan – Wintermans was born in 1991 in Raamsdonk, The Netherlands. In 2009, she received her VWO diploma (pre-university education) at the Dongemond College in Raamsdonksveer. In 2012, she obtained her Bachelor of Science degree and, in 2015, her Master of Science degree, both at the Department of Industrial Design at the Eindhoven University of Technology. During her studies, in 2013, she exhibited at GLOW Next with the project 'IRIS' and was nominated in the top 20 for the Brains Award with the project 'Music tiles'. Her master graduation project on the co-design of a messaging radio – Stay Tuned! – with people with dementia, was rewarded with 'excellence', and got a top 3 nomination of the Innovate Dementia Award. Next to this, Stay Tuned! was exhibited at three venues: in 2014 during the Dutch Design Week and Festival The Energised Society (in Dutch: 'De energieke samenleving'), and in 2019 at Dementia Lab. As a part-time job during her studies, she worked in an elderly home for almost six years, which already expresses her interest in working with older adults.

In 2017, she obtained her Post Doctorate in Engineering (PDEng) degree at the Department of Industrial Design at the Eindhoven University of Technology, on User System Interaction. In 2016, in parallel with the PDEng, Marjolein started her PhD research in the Systemic Change group and was also involved in education as a lecturer and coach. During her PhD, she travelled to Sweden and Italy for the ENSAFE consortium meetings and participated in multiple conferences. These included 1) The Design Management Academy in Hong Kong, 2) ISG 2018 in Florida USA, 3) Design4Health in Sheffield UK, and 4) ICDC2020, which was hosted online due to COVID-19. For the ISG conference in Florida, a travel grant was gained. Furthermore, she both attended and volunteered at UX insight, and was a speaker (Dublin) and volunteered (Eindhoven) on UXcamp. She was a teacher during a Summer School 'making business from ideas' at the Zhejiang University in Hangzhou China. She participated in a Summer School about behavior change at the University of Bologna in Italy. Furthermore, she became one of 15 semi-finalists of the Smart Ageing Prize with her project 'Ommetje' and participated in the mentoring academy in Brussels, Belgium.

In 2019, Marjolein and her husband Erik became parents to their daughter Vera den Haan. Two years later, their second daughter, Milou den Haan, was born. In 2021, this thesis is the result of her PhD research on designing personalized and meaningful technology with older adults.

PUBLICATIONS BY MARJOLEIN DEN HAAN - WINTERMANS

2021

Haan, Marjolein den, Rens Brankaert, Gail Kenning, and Yuan Lu. 2021a. "Creating a Social Learning Environment for and by Older Adults in the Use and Adoption of Smartphone Technology to Age In Place." Frontiers in Public Health 9:568822.

Haan, Marjolein den, Nicole van Essen, Rens Brankaert, and Yuan Lu. 2021b. "Your Moments: Co-Designing a Personalized Audio Player." In: Rens Brankaert, Caylee Raber, Maarten Houben, Paulina Malcolm, and Jon Hannan (eds) Dementia Lab 2021: Supporting Ability Through Design. D-Lab 2021. Design For Inclusion, vol 2. Springer, Cham.

2020

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2020a. "Design for One: Personalisation and Experiences of Design Researchers and Participants." Proceedings of the Sixth International Conference on Design Creativity (ICDC 2020). Virtual Event, Finland: Design Society.

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2020b. "Applying Design Methods to Promote Older Adults' Walking Activities Based on Their Hobbies and Personal Interests." In: Andree Woodcock, Louise Moody, Deana McDonagh, Ajita Jain, and Lakhmi C. Jain (eds) Design of Assistive Technology for Ageing Populations, 257–73. Springer.

2019

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2019. "The Leisure Time Canvas: Eliciting Empathy for Older Adults through Activities and Hobbies." Conference proceedings of the Academy for Design Innovation Management. Research Perspectives In the era of Transformations. Londres: Academy for Design Innovation Management.

Lu, Yuan, Rens Brankaert, Carlijn Valk, **Marjolein den Haan**, and Xipei Ren. 2019. "Designing Digital Services to Enhance Older Person's Access to Public Transport." In: Anna P. Lane (editor) Urban Environments for Healthy Ageing, 209–25. Taylor & Francis.

2018

Haan, Marjolein den, Rens Brankaert, and Yuan Lu. 2018a. "What Moves You? Designing a Walking App for and with Older Adults." In: Kirsty Christer, Claire Craig, and Dan Wolstenholme (eds) Proceedings of the 5th International Conference on Design4Health, Sheffield, UK, 4th – 6th September 2018.

Wintermans, Marjolein, Carlijn Valk, Rens Brankaert, and Yuan Lu. 2018b. "Not All Classrooms Have Four Walls: Analysing Experiences of Senior Citizens Using Novel Smartphone Technology." 11th World Conference of Gerontechnology (ISG 2018) - St. Petersburg, United States.

Lu, Yuan, Ad van Berlo, Xipei Ren, Carlijn Valk, **Marjolein den Haan-Wintermans**, Peixun Li, Tianming Li, Jianfen Li, and Guang Yang. 2018. "Situating Societal Challenges in an Industrial Design Classroom." In: Next Wave: the 21st dmi: Academic Design Management Conference Proceedings (pp. 1268-1278). Design Management Institute.

Valk, Carlijn, **Marjolein Wintermans**, Yuan Lu, Tilde Bekker, and Rens Brankaert. 2018. "Identifying Factors for Personalized Strategies to Motivate Seniors to Adopt a More Active Lifestyle." 11th World Conference of Gerontechnology (ISG 2018) - St. Petersburg, United States.

2017

Wintermans, Marjolein, Rens Brankaert, and Yuan Lu. 2017a. "Together We Do Not Forget: Co-Designing with People Living with Dementia towards a Design for Social Inclusion." Design Management Academy Conference 2017, Hong Kong, China.

Wintermans, Marjolein. 2017b. "User Involvement for Personalised Service Design: Designing a Walking App for and with Senior Citizens." Technische Universiteit Eindhoven.

Valk, Carlijn, Yuan Lu, Xipei Ren, **Marjolein Wintermans**, Ivar Kraaijevanger, Jim Steenbakkers, and Vincent Visser. 2017. "Towards Personalized Persuasive Strategies for Active Ageing." Gerontechnology 16 (3): 160–72.

Other events

2019 – Dementia Lab Exhibition

2018 – Semi-Finalist for the AAL Smart Ageing Prize

2017 – Speaker at UXcamp Dublin

2016 – Speaker at Design for Dementia

2014 – Top 3 Innovation Award at the World Health and Design Forum

2014 – Exhibition G/OUD at the Dutch Design Week

2014 – Festival De Energieke Samenleving

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Lieve Erik, op het moment van het schrijven van deze tekst hebben we elkaar al 125 keer 'happy 21e' gewenst! 125 maanden gevuld met leuke avonturen, plezier en chillings. Van dat laatste gaan we de komende tijd misschien wat meer doen, maar misschien ook niet, want we zijn samen wel van 'in de zesde versnelling' 'vlammen' in vanalles ;). In 2015 studeerden we allebei af en verruilden we onze studentenwoningen voor een grote mensen appartement. In 2018 zijn we getrouwd en we kijken nog zeker ieder jaar bewust maar eigenlijk veel vaker nog onbewust zo fijn terug op die prachtige dag! In 2019 kregen we de sleutel van onze huidige woning, waar we 'alleen wat zouden witten' en ondertussen toch veel klusprojectjes samen gedaan hebben om het nog meer ons thuis te maken. Dat jaar werd ook onze dochter Vera geboren en 2 jaar later Milou. Gelukkig doen ze het allebei super goed en groeien als kool – lekker eten is er met de paplepel ingegoten ;). Met jou is dit alles doen gewoon zo leuk! Ik geniet er ook zo van dat we in de corona tijden zo'n fijn thuis hadden en hebben samen. 10 jaar zijn zo voorbij gevlogen maar nog steeds zo ontzettend blij met jou en trots op jou! Ik hoop dat we nog vele zakken blauwe chips leeg eten samen op de bank, maar ook nog veel avonturen buitenshuis zullen beleven. Zoals Vera nu zegt: PUFFEL.

SUMMARY

We are living longer than ever in many developed countries, which is a major accomplishment (Nassir, Leong, and Robertson 2015). Particularly in The Netherlands, they predict in 2050, there will be a phenomenon called double ageing. This means both the number of people of 65 years and older is increasing, which is expected to raise from 3.4 million in 2020 to 4.8 million in 2050 (CBS 2020) and we will live longer, causing the number of people aged 80 years and older to increase due to life expectancy increasing from 800.000 in 2020 up to 2.6 million in 2050 (CBS 2020). Ageing has typically been framed as a problem that can be "managed" by technology (Vines et al. 2015), which neglects the growth, creativity, and development occurring in older adulthood (Brewer and Piper 2016). Alternatively, we want to view technology as a facilitator to maintain quality of life and even enrich it – so taking a positive rather than a problem-related approach. Older adults are often seen as a homogenous user group while they, in fact, are an extremely diverse group (Lu, Y., Brankaert, R.G.A., Valk, C.A.L., Wintermans, M.C., Ren. 2019; Eisma et al. 2003; Hatcher et al. 2019). Users cannot be generalized because people have different needs, wants and dreams (Brown and Katz 2011). The diversity of older adults should be considered when designing technologies, products and services, as solutions will not be suitable for an entire population. Successfully creating meaningful concepts as designers or researchers largely depends on the level of understanding and empathy designers can gain for the target group (Smeenk et al. 2018). Designers can provide tools to assist the user in bringing forward the expertise of their own experience (Visser et al. 2005). Because leisure time contributes to successful ageing (Kahlbaugh and Huffman 2017), we chose this as our context. Ultimately aiming at empowering older adults through technology that is easy to use, to stay mentally and physically active, we co-discover their interests and co-create personal designs. Therefore, our research questions are:

RQ1: How can we better understand why older adults use technology that supports successful ageing and how they learn to use it?

RQ2: How can the personal interests and leisure activities of older adults inform design for successful ageing?

RQ3: How can we improve the design of technology for successful ageing through a personalized process?

We executed several design research studies, which can be divided into three parts: Explore, Engage, and Enrich, each addressing one research question. In the explore part, we aimed to understand older adults learning and using technology. Therefore, we conducted a field study to better understand the motivators of older adults to use smartphones, and their learning process. In the engage part, we created and used a storytelling tool based on leisure time activities, to get a better understanding of the daily lives of older adults, and empower them to express themselves. Based on these findings, we co-designed, built, and evaluated a smartphone walking application to stimulate physical activity and social contact. In the enrich part, we personalize designs together with older adults. We investigated the experiences of the older adults and the designers during the designing for one approach.

In the explore part, we evaluated the GoLivePhone with seven participants. We found motivating factors to smartphone use and factors that contributed to a pleasant smartphone learning environment, such as tools that grew along with older adults, and 'super-users' who facilitated learning in a social setting (Haan et al. 2021a). We provided technological designers with useful suggestions on how to design technologies with the needs and wishes of the older adults in mind. The products' main focus was health-related, and in the next part, we want to understand better how people spend their leisure.

In the engage part, we used the Leisure Time Canvas we created, with six participants (Haan et al. 2019) and developed a walking application based on this in co-design with 42 participants (Haan et al. 2020b). We found that the community valued Ommetje because it was based on their interests in hiking and social contact (Haan et al. 2018a). The participants preferred the quality rather than the quantity of physical activity. This study provided designers with the necessary knowledge of meaningful personal motivations to develop successful ageing interventions. Following this, we wanted to put more weight on their individual perspective.

In the enrich part, we analyzed three student design projects and formulated ways to improve the designing for one approach and further personalized the participation for older adults in the design (Haan et al. 2020a).

Thus, we were able to reflect on how such a personalization in the design and design processes contributes to the creation of suitable supportive technologies for older adults (Haan et al. 2021b).

Contribution 1.

We contribute changing social and technological personal motivations of older adults to maintain engagement with a design, both when learning and using it. We recommend technology designers to create flexible and adaptive products from two different directions: from the system, and from the user.

Contribution 2 (in the Form of an Intervention).

We contribute a storytelling tool in the leisure time context that deeply engages people to design something meaningful. By creating and applying the Leisure Time Canvas, we showcase how to leverage personal interests such as hobbies to design interventions for successful ageing, represented by walking application Ommetje.

Contribution 3.

We contribute our Personal Design Process, which aims to overcome the not for me perspective, by designing for and by themselves. This process helps the design researcher to interpret the qualitatively collected data, and facilitates the older adult to share stories to jointly create a personal design.

General contribution.

More and more research suggests framing ageing positively rather than focusing on problems in HTI and design research (Vines et al. 2015). By adhering to a positive design lens in this thesis, we can pay attention to other values that eventually bring a broader perspective addressing and enriching more facets of an individual's daily life.

SAMENVATTING

De vergrijzing wordt vaak gezien als een probleem wat door technologie opgelost dient te worden, waarbij de groei, creativiteit en ontwikkeling die gepaard gaat bij het ouder worden genegeerd wordt. Daarom ontwerpen wij met een positieve lens, waarbij we technologie zien als middel om kwaliteit van leven te behouden en te verrijken. Omdat senioren net als iedereen verschillend zijn, willen we niet uitgaan van het stereotype beeld dat senioren enkel hulpbehoevend zijn. Daarbij willen wij de oudere zien als volwaardig individu met allen verschillende wensen, vaardigheden en behoeften. Hier liggen echter verschillende uitdagingen die we verder hebben onderzocht.

Het kan bijvoorbeeld moeilijk zijn voor senioren om hun behoefte te verwoorden, en ook voor ontwerpers kan het een uitdaging zijn om hun perspectief en behoefte te begrijpen. Daarom willen we empathische designmethodes gebruiken om de communicatie tussen deze twee groepen te bevorderen. Daarnaast maken we ook prototypes om nieuwe ideeën vorm te geven en aan senioren voor te kunnen leggen om het hen te laten ervaren. In deze thesis richten we ons op ideeën om mensen te laten ontspannen en een zinvolle invulling te geven van hun dag, dit draagt namelijk bij aan succesvol ouder worden. Uiteindelijk is ons doel om senioren te motiveren en in staat te stellen mentaal en fysiek actiever te blijven, en ze te motiveren met iets dat ze leuk vinden om te doen. Om dit te onderzoeken hebben we de volgende drie onderzoeksvragen opgesteld:

OV1: Hoe kunnen we beter begrijpen waarom senioren technologie gebruiken om prettig oud te worden? En hoe leren ze dit te gebruiken?

OV2: Hoe kunnen we persoonlijke interesses en hobby's van senioren gebruiken bij het ontwerpen voor prettig oud worden?

OV3: Hoe kunnen we betere ontwerpvoorstellen doen om prettig oud te worden door middel van een gepersonaliseerd proces?

We hebben de verschillende studies in drie stukken opgedeeld: Explore, Engage, en Enrich. In elk onderdeel beantwoorden we een van de drie bovenstaande onderzoeksvragen.

Allereerst, in Explore wilden we beter begrijpen waarom senioren graag smartphones gebruiken en hoe ze deze leren te gebruiken.

Ten tweede, in Engage hebben we een canvas gemaakt waarbij senioren kunnen vertellen over hun hobby's, waardoor we inzicht kregen in hun dagelijks leven. Op basis van dit canvas hebben we samen met senioren een wandelapp ontworpen voor op hun smartphone. Ten derde, in Enrich hebben we onderzocht wat de ervaringen waren van senioren en ontwerpers terwijl ze "designing for one" toepassen, oftewel ontwerpen voor één persoon. Daar zijn de volgende resultaten uit gekomen.

Explore fase

We hebben de GoLivePhone geëvalueerd met zeven deelnemers en hun motivaties voor het smartphone gebruik in kaart gebracht. Verder hebben we factoren genoemd die bijdragen aan een fijne leeromgeving, zoals bijvoorbeeld hulpmiddelen die meegroeien met de bekwaamheid van de senioren, en super-users die een prettige sociale leeromgeving faciliteren (Haan et al. 2021a). We hebben nuttige suggesties gegeven voor technologie designers over hoe men kan ontwerpen voor de behoeftes en wensen van senioren. Omdat de GoLivePhone met name focuste op de gezondheid, willen we in het volgende stuk beter begrijpen hoe senioren hun vrijetijd besteden.

Engage fase

We hebben het Leisure Time Canvas ontwikkeld en daarna getest met zes deelnemers (Haan et al. 2019). Op basis hiervan hebben we een wandelapp gecodesigned met 42 deelnemers (Haan et a. 2020b). We hebben geleerd dat deze groep Ommetje waardevol vond omdat het gebaseerd was op hun wandel- en sociale interesses (Haan et al. 2018a). De deelnemers vonden de kwaliteit wel belangrijker dan de kwantiteit van hun fysieke activiteit. Door deze studie, hebben we bijgedragen aan de kennis voor ontwerpers om waardevolle en persoonlijke motivaties te gebruiken om interventies te ontwerpen voor het succesvol ouder worden.

Enrich fase

In deze fase hebben we nog meer ingezoomd op de individuele senioren en hun wensen door specifiek voor één persoon een passend ontwerp te maken. Dit hebben we drie student ontwerpers laten doen, en dit proces hebben we geanalyseerd.

Op basis van deze analyse hebben we suggesties geformuleerd om het "designing for one" proces te verbeteren en inzichten opgedaan om de deelname van senioren aan het ontwerpproces nog verder te personaliseren (Haan et al. 2020a). Ook reflecteerden we op het personaliseren in zowel het design als het proces, hoe dit bijdraagt aan het maken van ondersteunende technologie voor senioren (Haan et al. 2021b).

Dit heeft geleid tot de volgende drie bijdragen voor ontwerpers en onderzoekers:

Op basis van de persoonlijke motivaties van senioren op sociaal en technologisch gebied, weten we nu beter hoe senioren technologie aanleren en gebruiken. We raden ontwerpers van technologie aan om flexibel en aanpasbare producten te maken vanuit twee invalshoeken: vanuit het systeem en vanuit de gebruiker.

We hebben een hulpmiddel gemaakt om verhalen te vertellen over vrijetijdsbesteding, met als doel om een waardevol design te maken. Door het maken en toepassen van het Leisure Time Canvas, laten we zien hoe we persoonlijke interesses zoals hobby's kunnen gebruiken om interventies te ontwerpen voor het succesvol ouder worden, gepresenteerd door wandelapp Ommetje.

We delen ons "designing for one" proces wat erop gericht is om senioren voor en door zichzelf te laten ontwerpen. Dit proces helpt de design researcher om kwalitatieve data te interpreteren, en faciliteert de senioren om verhalen te delen, om samen tot een persoonlijk ontwerp te komen.

Algemene bijdragen

Steeds meer onderzoek stelt voor om het ouder worden als iets positiefs te zien, in plaats van enkel te focussen op problemen. Doordat we in deze thesis kijken met deze positieve design lens, kunnen we concrete richtlijnen vinden hoe we samen met senioren tot goede technologische oplossingen kunnen komen. In ons onderzoek hebben we ons gericht op waardes als kwaliteit van leven en persoonlijke interesses, deze hebben ons een breder perspectief gegeven op wat senioren belangrijk vinden. Voor ontwerpers en onderzoekers geven deze inzichten nieuwe mogelijkheden om tot nieuwe producten, diensten of systemen te komen om senioren te ondersteunen in hun alledag.

KIDS SUMMARY

for Vera and Milou den Haan

The next piece of text is written for my daughters Vera and Milou.

This is a story about mommy at work. But before I tell you about mommy's work, I want to go back to when mommy was a kid. I always loved doing crafts, just like grandpa and grandma. We created a million things together, even in university. One of the projects that I'm really proud of is a radio to listen to messages from friends and family.

This radio was made for a man who sometimes forgot things. And it was difficult for him to learn new things. That's why I made a radio that looked the same but did something else! The family could say something by using their phone, and the man could hear the message through the radio. He and his wife thought it was very special to get a message, especially for them.

Mommy likes taking care of older adults. When I was studying at university, I also worked in an elderly home for five years in the weekends. Bringing coffee, cleaning the room, and making food for them. I always made sure to bring a favourite cookie for one lady. Sometimes it's the small things that matter.

Mommy really appreciates working with older adults. They have so many stories to tell and experiences to share! But, sometimes, things are new for them. While you grow up using a smartphone, grandpa and grandma did not have that as a child. Therefore, I wanted to know what older adults think of a smartphone and how they learn it. Just like both of you will go to school once you grow older, they were going to a smartphone school. They liked the smartphone but wanted more fun.

That's why mommy wanted to know what they think is fun. I brought some cards with icons of leisure time activities to talk about it. I learned about what they liked and disliked and what hobbies they would like to do more often. That is where I wanted to make a design for! I made a fun app where people could record their short walks and see how many times they go for a walk. But also get inspiration for new walks from others.

Mommy is really inspired by some positive and enthusiastic people, especially one lady: Laila Cassim. She talked about her work, saying that someone said to her, 'it is great what designers can do'. But Laila did not want this. She tried to make people understand what they could do! This is something that I find really fascinating. It is called empowerment.

Mommy likes to empower non-designers as well. To give people tools, thoughts and tips to build things. I really enjoyed this during my previous jobs. During the PDEng, to co-design an app with children. And when working at Prisma, to give design thinking workshops to professional caregivers. But I also did this during my PhD, to design together with older adults. To make something personal for them. I also coached three students who designed something special for one person using the designing for one process.

To wrap up, mommy tried in this research to step by step better understand older adults. To enrich their lives. To invite them to stay active, to maintain the life they enjoy having. To create easy technology to interact with, to let them be part of the digital society. To facilitate fun, based on their hobbies. It has been an amazing adventure to dive into this topic. I hope you both find something you are passionate and excited about, but till that point – just be you, enjoy and play around lieve dametjes!