Older People Meet Robots

Three Case Studies on the Domestication of Robots in Everyday Life

Frennert, Susanne

2016

Document Version:
Publisher's PDF, also known as Version of record

Older People Meet Robots

Three Case Studies on the Domestication of Robots in Everyday Life

Susanne Frennert

LUND
UNIVERSITY

DOCTORAL DISSERTATION
by due permission of the Faculty Engineering, Lund University, Sweden.

To be defended at Stora Hörsalen, IKDC, Lund.

9th September 2016 at 9:15.

Faculty opponent

Professor Birgit Jæger

Department of Society and Globalisation, Roskilde University.

Organization	Document name
LUND UNIVERSITY Department of Design Sciences Division of Rehabilitation Engineering and Design	DOCTORAL DISSERTATION
Author(s): Susanne Frennert	Date of issue: 20 of June 2016

Title and subtitle: Older People Meet Robots - Three Case Studies on the Domestication of Robots in Everyday Life

Abstract: This thesis explores how older people construct meaning, use and make sense of three kinds of robots in their homes. The exploration is undertaken in empirical studies of an assistive robot, an eHealth system, and robotic vacuum cleaners.

The research draws on data collected through interviews and observations of older people in relation to three robots. The results show that older people's domestication of robots cannot be condensed into one universal formula that fits all older people and all robots. The domestication of a robot is a process of constant shaping through negotiations with other people, other technologies, everyday life practice, society, and in relation to and with the robot and ourselves. For robots to be meaningfully and seamlessly integrated into older people's everyday lives they need to be easy to use and desirable. But they also need to fit into the participants' home practices. These include older person's household activities, hobbies, interests, network of people, and the technology cluster in which the older person is situated. The usage of a robot needs to make sense to the older person; she needs to feel that she is in control of the robot and that the level of maintenance is reasonable. If the usage of a robot makes sense to the older person she will be willing to alter stable practices and routines.

An important insight that emerged is how stereotypes of older people as weak, ill and housebound are embodied in robots intended for older people. These stereotypes are also constructed or reinforced by society, developers and older people themselves. The research presented demonstrates how this understanding of older people is situated in the home trials and shaped and maintained through them, which has powerful implications for the future development of robots. The findings further demonstrate that there is a difference between what older people say and what they do. The constructed and socially pervasive image of older people as weak, ill and housebound is apparent in how the older participants talk about robots and their potential. They incorporated robots into their everyday lives (as well as other technologies) that made sense to them, but they were unable to do so with robots that did not make sense to them. Instead the "practice of trying out a robot at home" ran parallel with the practices of everyday life during the home trials and became an end in itself. The main finding is not the serious implications of the stereotypical image of older people per se, but rather an understanding of how this stereotype is situated, shaped and maintained in the development. The thesis argues that by recognising the form older people's participation and influence takes in current robotic developments, we can gain an understanding of the aspects that need to be scrutinised in order to find alternatives to current robotic developments.

Key words: Older people, social robots, domestication theory, gerotranscendence

Classification system and/or index terms (if any)

Supplementary bibliographical information		Language English
ISSN and key title		ISBN 978-91-7623-906-3
Recipient's notes	Number of pages 220	Price
	Security classification	

Older People Meet Robots

Three Case Studies on the Domestication of Robots in Everyday Life

Susanne Frennert

LUND
UNIVERSITY

Susanne Frennert

Faculty of Engineering, Department of Design Sciences

Division of Rehabilitation Engineering and Design
ISBN 978-91-7623-906-3 (print)
ISBN 978-91-7623-907-0 (pdf)

Printed in Sweden by Media-Tryck, Lund University
Lund 2016

CONTENTS

ABSTRACT

This thesis explores how older people construct meaning, use and make sense of three kinds of robots in their homes. The exploration is undertaken in empirical studies of an assistive robot, an eHealth system, and robotic vacuum cleaners. The aims are: a) to review and analyse the scientific literature on older people in relation to robots; b) to investigate older peoples' initial perceptions of an eHealth system in the making; c) to explore the domestication of robotic vacuum cleaners among older people in their own homes; d) to explore what happens when older people participate in new eHealth schemes in their own homes; and e) to offer insights into the main implications of doing research on socially assistive robots in real homes.

The research draws on data collected through interviews and observations of older people in relation to three robots. The results show that older people's domestication of robots cannot be condensed into one universal formula that fits all older people and all robots. The domestication of a robot is a process of constant shaping through negotiations with other people, other technologies, everyday life practice, society, and in relation to and with the robot and ourselves. For robots to be meaningfully and seamlessly integrated into older people's everyday lives they need to be easy to use and desirable. But they also need to fit into the participants' home practices. These include older person's household activities, hobbies, interests, network of people, and the technology cluster in which the older person is situated. The usage of a robot needs to make sense to the older person; she needs to feel that she is in control of the robot and that the level of maintenance is reasonable. If the usage of a robot makes sense to the older person she will be willing to alter stable practices and routines.

An important insight that emerged is how stereotypes of older people as weak, ill and housebound are embodied in robots intended for older people. These stereotypes are also constructed or reinforced by society, developers and older people themselves. The research presented demonstrates how this understanding of older people is situated in the home trials and shaped and maintained through them, which has powerful implications for the future development of robots. The findings further demonstrate that there is a difference between what older people say and what they do. The constructed and socially pervasive image of older people as weak, ill and housebound is apparent in how the older participants talk

about robots and their potential. They incorporated robots into their everyday lives (as well as other technologies) that made sense to them, but they were unable to do so with robots that did not make sense to them. Instead the "practice of trying out a robot at home" ran parallel with the practices of everyday life during the home trials and became an end in itself. The main finding is not the serious implications of the stereotypical image of older people per se, but rather an understanding of how this stereotype is situated, shaped and maintained in the development. The thesis argues that by recognising the form older people's participation and influence takes in current robotic developments, we can gain an understanding of the aspects that need to be scrutinised in order to find alternatives to current robotic developments.

SAMMANFATTNING

Med en allt äldre befolkning är det nödvändigt att hitta nya sätt att arbeta med stöd i hemmet. Robotar i hemmet kan vara ett av dessa sätt. Syftet med denna avhandling är att bidra med kunskap om vad som händer i äldre människors vardagsliv när robotar flyttar in, samt att öka förståelsen för hur robotar kan domesticeras av äldre människor.

Avhandlingen bygger på fem delstudier: en litteraturstudie, en studie om äldres föreställningar och förväntningar på ett eHälsosystem samt tre intervju- och observationsstudier med äldre som prövar olika sorters robotar (telerobotar, servicerobotar och dammsugarrobotar) i sina egna hem.

Teleroboten *Giraff* möjliggör videosamtal mellan anhöriga och vårdgivare samt hämtar in data via sensorer om äldres aktiviteter i sina egna hem. Resultaten visar att det är viktigt för äldre användare att deras egna uppfattningar om sig själva, sin hälsa och livssituation förmedlas via roboten men inte signalerar att de är sjukare än de i själva verket är. En annan iakttagelse är att vårdgivare behöver strategier för hur de ska använda insamlad data om äldres aktiviteter hemma, och mer kunskap om hur robottekniken kan implementeras i vårdgivarnas nuvarande arbetsprocesser.

I studien med servicerobotar fick äldre bo, leva och interagera under tre veckor med roboten *Hobbit*. Resultaten visar att *Hobbit* har problem att navigera autonomt i ett vanligt hem med mycket möbler, saker och besök. Användarstudien med Hobbit visar att roboten fungerar mer som en sorts underhållning än ett faktiskt stöd. I studien med *Robotdammsugaren* blev resultaten annorlunda. Robotdammsugaren var till en början främst ett komplement till den ordinarie dammsugaren, men efter hand användes den mer och mer, fick ett namn och den vanliga dammsugaren blev ett komplement. Avhandlingen visar att robotdammsugaren förmänskligades och domesticerades.

En viktig insikt är att robotar bör utvecklas utan stereotypa uppfattningar om hur äldre är och vad äldre vill ha. Avhandlingen visar att äldre inte känner sig adresserade av tekniken ämnade för dem utan anpassar sig själva till stereotypen om att äldre generellt uppfattas som svaga, sjuka och bundna till hemmet när de berättar om vad andra äldre behöver. Avhandlingen pekar också på att utvecklingen av robotteknik kräver en helhetssyn. Slutsatsen är att framtidens robotar måste anpassas till människan, den fysiska miljön, den tekniska miljön och det sociala sammanhanget för att robotar ska kunna fungera i praktiken.

PREFACE AND ACKNOWLEDGEMENTS

The work presented in this thesis is a result of a four-year research endeavour. When I started in 2012 I had worked in the fields of cognitive science, human factors and ergonomics for several years. I had experience of working with product development, developing electronic program guides, web-based user interfaces, educational digital games and other digital products for the general public. I also had the opportunity to work with older people and to study their everyday life. However, I did not know much about robots and the discourse surrounding the field. The advertisement for a PhD position in the field caught my attention and the fact that it concerned older people in relation to robots made me apply. Luckily I was offered the job, which became a starting point for a fantastic research endeavour. At times it has been challenging and difficult but it has always been great fun and very rewarding. Many people have contributed to making this journey memorable.

During my time as a PhD student I had the privilege to travel around the world and meet colleagues in the field of gerontechnology and robotics. I have presented my research and spent several days discussing it and that of others on older people and social robots. I have profited enormously from these meetings and discussions. I have also had the privilege to spend two months at the Robot Innovation Research Centre at AIST (Advanced Industrial Science and Technology) in Tsukuba, Japan. Professor Yoshio Matsumoto and his team made me feel very welcome and they introduced me to Japanese culture and the field of social robotics in Japan. Thank you for welcoming me and for introducing me to Japan and Japanese robotic innovations!

Without all the older people who participated in the fieldwork, this research would not have been possible. The knowledge that emerged is a conjoint venture between the older people who participated and myself as the researcher. Thank you for welcoming me into your homes, for taking time and effort to share your most inner thoughts about robots, eHealth systems and everyday life as one grows older.

This thesis would not have been written without the support from Professor Britt Östlund, my main supervisor. She has been an outstanding mentor with her encouragement, help, and guidance in the "scientific jungle", but most of all for her positive attitude and trust in me. Thank you for giving me the opportunity to do something I truly enjoy and love doing!

I have also profited from my cooperation with colleagues and co-authors from Spain, Italy, Greece, Sweden and Austria in both the EU funded projects (HOBBIT and GiraffPlus) in which I have conducted my fieldwork. Thank you all!

The Department of Design Science at the Faculty of Engineering at Lund University has been a brilliant workplace and I would particularly like to thank all my colleagues at the Division of Ergonomics and Aerosol Technology, and the Division of Rehabilitation Engineering (CERTEC). Specifically, I wish to thank Dr Per-Olof Hedvall for his valuable and insightful comments on this thesis; Dr Håkan Eftring for his cooperation and supervision in the HOBBIT project and foremost for his optimism; Eileen Deaner for proofreading and giving valuable feedback on all my papers and this thesis; Dr Mattias Wallergård for sharing his view and valuable insights of my Licentiate thesis; Dr Elisabeth Dalholm Hornyanszky for her support and who has given valuable comments on some of my papers; Jessika Sellergren for her fantastic work with making my research visible to the general public, her friendship and for designing the cover of this thesis; Johanna Rydeman for her help with editing the cover picture; my fellow PhD candidates (Christofer Rydenfält, Jonas Borell, Hillevi Hemphälä, Karin Lundgren-Kownacki, Johanna Persson, Lena Petersson, Per Gustafsson and Delphine Szymczak) with whom I have enjoyed our Friday lunches and vivid discussions. I would like to thank Dr Pernilla Ulfvengren, who acted as an external reviewer at my final seminar, for her valuable input on an earlier version of this thesis.

I also wish to thank my Mum and Dad. If my parenting is half as good as yours, that would be my greatest achievement! I consider myself blessed with fantastic friends, former and present colleagues as well as a great big family. All of you have given me great encouragement, support and help in difficult, as well as, good times. Particularly, I wish to thank Dr Hilma Holm – our regular lunch dates have been an invaluable source of inspiration and strength. I also wish to thank Stina Svensson, Cecilia Heimstein Brentzen, Karolina Hellman, Matilda Jägerden and Helena Winblad – the best girlfriends one can have. I love our girls' nights out – we always have such a positive open attitude, which pushes all the negative energy out of one's system.

Last but not the least, I would like to thank my husband, Niklas Gustafsson, for your love and support. My love and thanks to my three children – Julia, Jonathan and Johanna – for keeping me grounded and showing me what life is really all about!

I will end his section with a note (in Swedish) I received from one of the participants: Ulf Lindoff. Unfortunately, he passed away during the study.

Fått kvinnlig betjänt!

Hon heter Suga - men tro för all del inte nåt konstigt. Hon är en robot, specialitet dammtussar, rätt obegåvad, så hennes kompletta namn är Suga Dumtuss.

Efter en tur i vardagsrum, hall och kök stannade hon blinkande. Hon var full - en kompakt samling dammråttor hade knäckt henne.Trodde det var rätt välstädat, men hon avslöja mig - den fulingen. Tvekar inför pappersflagor och smågrus, och ratar gem och småspik.

Kul bekantskap - skall släppa ut henne då och då. Är parkerad mot "elstolpe" i vardags-rummet, hon sköts bekvämast via fjärrkontroll. Enkelklick - och hon vaknar, ett till och hon är i tjänst med ett rätt behagligt brummande. Undrade bekymrat vad hon hade för sig i hallen. Hon flytta på mina skor, och det var nog där hon fyllnade till.

Enligt ryktet skulle hon på engelska berätta om sin belägenhet, hörde inget vid första stoppet - var kanske blyg i starten. Släppte ut henne igen och då stanna hon halvvägs uppför tröskel, och börja kvida "Take me to another place and restart me" tyckte jag hon sa.

Hon och jag ingår i EU-projekt med uppgift att underlätta för gamlingar med värkande leder att leva lite gladare och ev. längre, innan man får en slut-remiss till Fonus. Motprestationen är att skriva dagbok över vad jag pysslar med under en vecka, och samtidigt berätta hur jag själv och de leda lederna mår. Gör jag det så får Suga bli här en månad, och om jag är riktigt duktig ännu längre - eller plocka upp plånboken. 4400 säger nätet.

Den söta flickan som levererade Suga skall få hop en avhandling om gamlingars behov att robot-tröst. Lär också finnas spinnande mjukiskatter och dito hundar med vädjande ögon för oss i nedförsbacken, att krama och klappa. Skall köa för ett ex. av doktors-avhandlingen om inte remissen kommer först.....

English translation

> I got a female servant!
>
> Her name is Dusty – but don't think it's strange. She is a robot. Her speciality is dust. She's not very intelligent and that's why her full name is Dust Dummy.
>
> After a tour in the living room, hallway and kitchen she stops and blinks. She is full with a compact load of dust bunnies. I thought the place was clean but she reveals my secrets – that rascal! She hesitates when confronted with paper scraps and sand, and straight out rejects paper clips and small nails.
>
> She's a pleasant acquaintance – I let her out from time to time. She parks at a docking station in the living room and is easiest to operate by remote control. One click and she wakes up, one more and she is at my service with a nice humming sound. I worry about what she does in the hallway. She moves my shoes and I think that's where she gets tipsy.
>
> She's supposed to tell me in English about her situation, but I didn't hear anything when she first stopped – maybe she was shy in the beginning. I let her out again and this time she stops on the threshold and starts whining, "Take me to another place and restart me" – or at least that's what I think she said.
>
> She and I are part of an EU project that's supposed to make life easier for old people with aching joints so that they can live a little longer and happier before kicking the bucket. In return, I have to keep a diary about what I busy myself with during the week and how my joints and I are doing. If I do that, Dusty will be with me for a month, and if I do a really good job, even longer – or take out my wallet. 4400 crowns it what it says online.
>
> The pretty girl who delivered Dusty is going to put together a thesis on the need of old folks for robot consolation. I've also heard that there are purring stuffed cats and dogs with entreating eyes for us to hug and pet as we shuffle off. I'm going to put myself in line for a copy of that PhD thesis, if I don't kick the bucket first . . .

In this story, the robot vacuum cleaner is portrayed as something new and interesting. To him she is a female servant. He explores its functionality and effectiveness. The story also reveals that he likes to challenge the vacuum cleaner by putting paper clips and small metal objects in its way. He notices that it is not very intelligent but that it finds dust that he did not think existed. He expresses gratitude that he can use a remote control to operate her and that she makes a pleasant sound, but he also feels that he lacks control because he cannot hear nor does he know what she is doing all the time. He mentions the possibility of dying, and his relation with the robotic vacuum cleaner as partners in a research study. The story is similar to and shares features with what others expressed in the multiple case studies.

PUBLICATIONS

PAPERS INCLUDED IN THIS THESIS

Paper 1 **Frennert**, S., & Östlund, B. (2014). **Review: Seven Matters of Concern of Social Robots and Older People.** *International Journal of Social Robotics*, 6(2), 299-310.

I independently planned and carried out the literature review. Britt Östlund critically reviewed the text and added valuable comments.

Paper 2 **Frennert**, S., Forsberg, A., & Östlund, B. (2013). **Elderly People's Perceptions of a Telehealthcare System: Relative Advantage, Compatibility, Complexity and Observability.** *Journal of Technology in Human Services*, 31(3), 218-237.

The usability trials on which the article is based were planned with Britt Östlund and conducted with Anette Forsberg. I independently analysed the data that was collected concerning elderly people's perceptions of an eHealth system, while the Fosberg collected and analysed data concerning the users' physical capabilities. Fosberg wrote the text on the users' physical capabilities while I wrote the rest. Britt Östlund and Anette Forsberg equally contributed to critically reviewing the manuscript.

Paper 3 **Frennert**, S., & Östlund, B. (2014). **The Domestication of Robotic Vacuum Cleaners Among Seniors.** *Gerontechnology*, 12(3), 159-168.

I independently planned and carried out the study. Britt Östlund critically reviewed the manuscript.

Paper 4 **Frennert**, S., & Östlund, B. (2015). **What Happens When Seniors Participate in New eHealth Schemes?** *Disability and Rehabilitation: Assistive Technology*, 1-9.

The partners in the GiraffPlus project jointly planned the methods used in this study. I independently conducted the interviews and observations in Sweden. The results were assembled and analysed by me who also wrote the text. Britt Östlund critically reviewed the manuscript.

Paper 5 **Frennert**, S., Eftring, H., & Östlund, B. (2016). **Case Report – Implications of Doing Research on Socially Assistive Robots in Real Homes** (submitted to a scientific journal).

The partners in the HOBBIT project jointly planned the methods used in this study. I independently conducted the interviews and observations in Sweden. The results were assembled and analysed by me who also wrote the text. Britt Östlund and Håkan Eftring equally contributed to critically reviewing the manuscript.

RELATED PUBLICATIONS

- Bajones, M., Fischinger, D., Einramhof, P., Wohlkinger, W., Papoutsakis, K., Mayer, P., Panek, P., Koertner, T., Hofmann, S., Argyros, A., Pripfl, J., Körtner, T., Batko-Klein, D., Hebesberger, D., Weninger, M., Gisinger, C., **Frennert, S**., Eftring, H., Antona, M., Adami, I., & Vincze, M. (2016). **Exploring an Assistive Social Care Robot for Older Adults in Real-world Homes: Lessons learned from Field Trials with the Hobbit Robot**, *In Press: Robotics and Autonomous Systems*
- Coradeschi, S., Cesta, A., Cortellessa, G., Coraci, L., Galindo, C., Gonzalez, J., Karlsson, L., Forsberg, A., **Frennert**, S., Furfari, F., & Östlund, B. (2014). **GiraffPlus: A System for Monitoring Activities and Physiological Parameters and Promoting Social Interaction for Elderly.** *Human-Computer Systems Interaction: Backgrounds and Applications 3, Springer: 261-271.*
- **Frennert**, S. (2012). **I want one too! Domestication of Assistive Robots.** *Paper presented at the PDC2012, Denmark.*
- **Frennert**, S., Östlund, B., & Eftring, H. (2012). **Capturing Seniors' Requirements for Assistive Robots by the Use of Attention Cards.** *Paper presented in the Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design, Denmark.*
- **Frennert**, S., Östlund, B., & Eftring, H. (2012). **Would Granny Let an Assistive Robot into Her Home?** *Social Robotics (128-137): Springer, UK.*

- **Frennert**, S. (2013). **Social Companion Robots in Eldercare – Who Gains and Who Loses?** *Paper presented in the Proceeding at ICSR2013 at the Workshop on Social Companion Robots, UK.*
- **Frennert**, S., Eftring, H., & Östlund, B. (2013). **Using Attention Cards to Facilitate Active Participation in Eliciting Old Adults' Requirements for Assistive Robots.** *Paper presented at the RO-MAN, 2013 IEEE, Korea.*
- **Frennert**, S., Eftring, H., & Östlund, B. (2013). **Older People's Involvement in the Development of a Social Assistive Robot.** *Social Robotics (8-18): Springer, UK.*
- **Frennert**, S., Eftring, H., & Östlund, B. (2013). **What Older People Expect of Robots: A Mixed Methods Approach.** *Social Robotics (19-29): Springer, UK.*
- **Frennert**, S. (2014). **Older People and the Adoption of Innovations: A study of the expectations on the use of social assistive robots and telehealthcare systems**. *Licentiate Thesis, Dept. of Design Science, LTH, Lund University.*
- **Frennert**, S., & Östlund, B. (2014). **Domestication of a Telehealthcare System.** *Gerontechnology, 13(2), 197.*
- **Frennert**, S. (2015). **Utopi eller dystopi?** *Ikaros-tidskrift om människan och vetenskapen, 15(2), 15-16.*
- Eftring, H., & **Frennert**, S. (2016). **Designing a Social and Assistive Robot for Seniors** *(accepted by the German journal, Gerontologie and Geriatrie)*
- Pripfl, J., Körtner, T., Batko-Klein, D., Hebesberger, D., Weninger, M., Gisinger, C., **Frennert**, S., Eftring, H., Antona, M., & Adami, I. (2016). **Results of a Real World Trial with a Mobile Social Service Robot for Older Adults**. *11th ACM/IEEE International Conference on Human Robot Interaction, IEEE Press, New Zealand.*
- Östlund, B., & **Frennert**, S. (2015). **Deconstructing the Path Towards "Homo Digitalis"** *Paper presented by Britt Östlund at Existential Terrains: Memory and Meaning in Cultures of Connectivity, Sweden.*

- Östlund, B., Olander, E., Jonsson, O., & **Frennert**, S. (2015). **STS-inspired Design to Meet the Challenges of Modern Aging. Welfare Technology as a Tool to Promote User Driven Innovations or Another Way to Keep Older Users Hostage?** *Technological Forecasting and Social Change, 93, 82-90.*
- Östlund, B., Scandurra, I., & **Frennert**, S. (2015). **Lessons Learnt to Promote Nurses Participation in Implementation of Home Healthcare Systems.** *Paper accepted for presentation at Nursing Informatics 2016, Switzerland.*

Some parts of the work presented in this thesis have been presented at conferences, in my papers and in my Licentiate thesis.

1 INTRODUCTION

Discussions and opinions are often very polarised when it comes to innovations: The innovations are either seen as a threat or a promise to improve our way of living. The topic of robots is no exception to this polarised discussion: Some believe robots will take over our lives and make humans less needed, de-skilled and alienated from other humans, while others believe robots will improve our quality of life by providing undemanding companionship and by performing dangerous, dirty and dull work tasks for us. The analysis of the impact of the prospective robotisation of society reflects technological determinism in which technology is seen as a normative choice (Fuglsang, 2001). However, if we instead use the mutual shaping of society and technology as a framework for the analysis, the experience becomes more diverse and multiple (Donald & Wajcman, 1985).

Robots can either be developed for older people or with them. By involving older people in the development process, they learn more about robots and how to use them. By trying out robots at home, through different activities, older people can either integrate robots into their everyday life or not. In the procedure, older people will go through a process of meaning making. The initial meaning they had when they decided to take part in the first place can be transformed through their experience of robots. The experience can change their view of robots, resulting in changes in behaviour, attitudes and everyday practices. Their negotiation of the meaning of the specific robot is related to existing technologies, social practices and the users' previous experiences of similar innovations (Silverstone & Hirsh, 2003). The meaning-making process is created through a complex network of users, engineers, designers, manufactures, mass media, etc. (Brown & Webster, 2004).

This thesis explores the process of meaning making when older people participate in the development of two robotic solutions and the use of one existing robotic solution. In it, I ask the following questions: What motivates older people to participate in the projects? How do they initially perceive the robotic solutions? What influence do the situations and contexts of exposure and usage of robots have on the participants' meaning construction? Does the participation result in changes in behaviour, attitudes and everyday practices? The artefacts explored are an eHealth system and an assistive robot in the making, as well as robotic vacuum cleaners already on the market. It is not about the robotic solutions per se, it is

about how older people construct meaning, use and make sense of robots. An increased and nuanced understanding of older people in relation to robots can offer new ways of thinking in the development and evaluation of robots aimed for older people.

1.1 SETTING THE SCENE

Older people are becoming a target group for political and economic interests. The aging population has been referred to as the grand challenge of the 21st century (Laviolette & Hanson, 2007; Peine, Faulkner, Jæger, & Moors, 2015). Demographics show that people live longer and healthier lives than in the past (Kluge, Zagheni, Loichinger, & Vogt, 2014). Although the progress that has enabled people to live longer is positive, there are also worries about the drawbacks associated with an aging population such as increased economic and societal costs.

One way to meet these drawbacks is the development of technologies such as robots and eHealth systems (Bouma, Fozard, Bouwhuis, & Taipale, 2007; Fukuda, 2011; Lesnoff-Caravaglia, 2007; Peine, Rollwagen, & Neven, 2014). Rising healthcare costs and the shortage of trained healthcare workers have led the European Union to invest millions of euros in innovative technologies for healthcare such as robotic projects (EC.europa.eu, 2015a) as well as innovations for living well in old age (EC.europa.eu, 2015b). The rhetoric to support these investments focuses on the ability of innovative technologies to decrease healthcare costs, empower patients and older people, as well as provide better and more efficient care (Pols & Willems, 2011). The promise of social assistive robots is to solve the challenges created by an increased aging population by enabling older people to take care of themselves (i.e. with the help of domestic robots) and for them to become more socially engaged with friends, family and the society in which they live (i.e. by use of the Internet and telepresence). Robots and eHealth systems are often developed to prevent the need for institutional care, for example, by identifying changes in activity patterns, sleep patterns, and by enabling remote visits to check on a person's health status. The development is driven both by technological possibilities, economic and political interests of promoting older people to age at home (Mort, Roberts, & Milligan, 2009). However, far too little attention has been paid to the involvement of older people in the development of robots for their use. The teams that carry out this development usually lack age differentiations in their makeup, a fact that has not been recognised or addressed. All these factors raise questions such as: How do older people perceive robots? What role and meaning do they ascribe to robots? What influence do older people have on the development of robotic solutions intended for them?

1.2 RESEARCH ON AND THE DEVELOPMENT OF ROBOTS FOR OLDER PEOPLE

The progress in technical robot development has taken place in the field of human-robot interaction (HRI) research. This is a rapidly growing field which has a number of conferences and journals, such as the ACM/IEEE International Conference on Human-Robot Interaction (HRI), the International Conference on Social Robotics (ICSR), the *International Journal of Social Robotics* and the *Journal of Human-Robot Interaction*. The main assumptions according to (Forlizzi, DiSalvo, & Gemperle, 2004; Gelderblom, De Wilt, Cremers, & Rensma, 2009; Lesnoff-Caravaglia, 2007) are that in the Western world:

- People in the forthcoming aging population have a higher level of education and are financially better off than their parents;
- Their expectations, economic power and knowledge will increase their determination to remain in control of their lives;
- Their perceived control of their situation has proven to be crucial for wellbeing;
- As a result, robots have the potential to be useful tools to decrease their dependency on human help/others; and
- Robots may increase the self-esteem and dignity of older people.

The HRI field is closely related to that of human-computer interaction (HCI). Traditional HCI has focused on the design, evaluation and implementation of interactive computing systems for human usage (Rogers, 2012). HCI has its roots in human factors and cognitive psychology, with a focus on human perception, cognition and problem solving. As such, the epistemological issues in the fields of traditional HCI and HRI concern memory, learning, attention, cognition, problem solving, etc. (Rogers, 2012). To date, various methods have been developed and introduced to involve users in the development process (Battarbee et al., 2005; Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011; Rogers, 2012). Historically, the idea of involving the users in the development of innovations has a long history in HCI, although the activities and method on how to go about doing it have changed (Rogers, 2012). The development of HCI has been transformed from the 1970s and 1980s, drawing on cognitive theories in order to

understand the users' capabilities and limitations when interacting with computers to perform tasks. In the late 1980s and into the 1990s, studies were moved out of the lab (decontextualised experiments) into "the wild" (situated actions) by drawing on multidisciplinary theories such as ethnomethodology and ethnography. Recently, in the 2000s, HCI has drawn on cultural theories and the social sciences by considering human values and user experiences (McCarthy & Wright, 2004; Rogers, 2012). The development in the HCI field reflects societal change. In the 1980s computers were used mostly at work while in 2000s computers are ambiguous and part of everyday practices. The view of the user has transformed from that of a worker who has to be able to do her job with great efficiency and speed, to that of a customer who wants to have a great user experience (Bannon, 1986; Bødker, 2006; Lazar, Feng, & Hochheiser, 2010; McCarthy & Wright, 2004). As a consequence, the context of use has changed from a specific workplace to almost anywhere. As Sanders points out, the usability aspect of a specific technology in this context is not enough; it also has to fulfil unmet needs (be useful) and be something people want to use (desirable) (Sanders, 1999). Human values are seen as incorporated in the user's experience (Sanders, 1999), and as Belk argues:

> We cannot hope to understand consumer behavior without first gaining some understanding of the meanings that consumers attach to possessions. A key to understanding what possessions mean is recognizing that, knowingly, intentionally or unintentionally, we regard our possessions as part of ourselves.
>
> (Belk, 1988, p. 139)

When it comes to the field of HRI today, most robotic solutions are studied in laboratory-controlled settings (Bedaf, Gelderblom, & De Witte, 2015). The existing research in HRI often tends to focus on one or two aspects such as attitudes (Broadbent et al., 2012), human-robot interaction (Kidd & Breazeal, 2008), social behaviours (Mataric, 2015) and caregiving (Broekens, Heerink, & Rosendal, 2009; Burton, 2013; van Wynsberghe, 2013). Frequently raised questions concern how presumptive users perceive different kinds of robots and the information their interfaces contains, how easy and effective the robot is to use, and how easy or difficult the robot or robotic solutions is to learn and remember. In the lab, both the robot and the human are perceived as senders and receivers. The human initiates an action, interprets and decodes the robot's output and encodes a response while the robot reacts to the human input and encodes a response. The developers inscribe certain actions such as "Press A, then B, then C" (inscription) (Akrich & Latour, 1992). According to Akrich's terminology, designers develop "a script" (like an actor using a script in a movie) to guide the user's usage and actions when interacting with a specific artefact (Akrich, 1992). Users, on the other hand, interpret the "script" and carry out the action that makes sense to them (description). How users make sense, interpret and react to the script

of the robot is grounded in their background, education, physical and mental conditions, life experiences, previous technology experiences, etc. If there is a discrepancy between the developers' "script" and the users' "description", the robot-human-interaction can fail.

Laboratory studies enable researchers and developers to investigate how users perceive the robot, and how they perceive what they can and cannot do (usability and acceptance). Lab studies are also useful to investigate the safety and reliability of the robotic solution and other technologies. However, in lab studies the users' attributes, needs, wants, and desires are assumed to be static (Lazar et al., 2010). Labs provide a controlled, artificial and context-independent environment. The presumptive users are often first-time users of the technology tested. In the lab, we get a cross-sectional study of first-time users' behaviours and interactions with the robot. However, laboratory studies do not provide insights and understandings of the mutual adaption of the user to the robot and the robot to the user as users become more advanced.

In relation to technology, people are often viewed as users. The controversy about using the word "users" has been widely debated (Bannon, 1986; Kuutti, 2001). The term "user" configures the role and meaning of the individual to being defined by using a specific innovation. When targeting older people there is a tendency to engineer their needs, wants and desires into a one-to-one relationship between their impairments and the functionality offered by the technological solution, as for example by providing digital reminders for people with cognitive impairments or larger font size and high background/figure contrast for people with visual impairments (Hedvall, 2009; Hedvall & Jönsson, 2015, p. 22). This model is dominated by linear thinking. The simplicity of this model is that engineers can focus on one or a couple of utility aspects and reduce people into representing their impairments instead of their full faculties, wants, needs and desires. There has been little discussion so far, however, about the adaption and usage of robots being an open-ended process that does not have clear boundaries. It might be even more so for older people since aging is also an open-ended process with no clear boundaries. Older people as a group vary considerably in individual abilities, skills and experiences (Czaja & Lee, 2007). Age is likely to increase the differentiation within the "group" more than most other "groups" due to life experiences and physical conditions. Kuutti (2001) suggests that we need to consider users as learners, and in the process of adapting an innovation, the individual becomes someone else who might change and also shape their environment to fit their construction of their "new identity" (in this case as users of robots). As such, the attributes, needs, wants and desires of older users are not static but dynamic depending on the older individuals' backgrounds and experiences of the innovation, as well as on past and current experiences of wellness and illness.

1.3 ROBOTISATION AND AGING PROBLEMATISED

Initially, I reviewed the literature on how social robots and older people were portrayed and described in the field of social robots from the point of view of Science and Technology Studies (Susanne Frennert & Östlund, 2014b). The review revealed that the mainstream developments of social robots are driven by a deterministic approach. Results from the literature review indicated and confirmed previous research (Mol, Moser, & Pols, 2010; Neven, 2010; Neven, 2011), showing that older people are implicated but not present in the development of robots and that their matters of concern were not identified in the design process. They are ascribed the general needs of social robots based on societal changes such as aging demographics and demands from the healthcare industry. The conceptualisation of older people seemed plagued with stereotypic views such as that they are lonely, frail and in need of robotic assistance. The literature review indicates the need to re-examine and perhaps redefine the perception of older people in order to fairly represent who they are. The literature review also showed that more research on older people as social robotic users is needed (Susanne Frennert & Östlund, 2014b). If involved in the development, older people often have a passive role of evaluating usability and acceptability of predesigned, specific robotic solutions (Bedaf et al., 2015; Neven, 2010).

The repeated failures of many gerontechnologies (technologies for older people) indicate a mismatch between the older potential users and the technology intended for them (Peine et al., 2015; Peine & Herrmann, 2012; Peine et al., 2014). It has been argued that the design and development of gerontechnologies are driven by strong paternalistic values associating old age with disability and illness, and are focused on the "needs" of older people (Peine et al., 2014). This, under the guise of good intentions, turns into false charity because it encourages passivity and alienation and thereby embodies and sustains the oppression of older people. As a result, many gerontechnologies are rejected (Peine et al., 2014). As such, the methods used to develop gerontechnologies have failed to predict and optimise a successful relationship between the older individual and the technology. I have mentioned that the reasons for these failures can be the reductionist attempts to reduce older people's capabilities in order to match their impairments to technological solutions. This results in developing gerontechnologies that are based on the output from lab trials with first-time users in a controlled, context-free and artificial environment, and viewing the presumptive users' needs, wants and desires as being static. Other reasons given for the problematic and challenging diffusion of technologies for older people is the "universalising" of technical solutions and evaluation methods, which fails to consider local practices and all the actors and devices involved (Mort, Roberts, & Callen, 2013). Popular

methods in the field of medicine, such as quantified measurements and randomised controlled trials (RCT), fail to identify and acknowledge that innovative care involves collaborative work and local practices (Mort, Roberts, Pols, Domenech, & Moser, 2013; Pols, 2012). Furthermore, Pol (2012) claims that standardised methods are designed to ask some questions but not others, and are fit to evaluate simple stable innovations in controlled environments such as drug trials (Pols, 2012). Similarly, Lopez et al. (2014) argue that there is a need to move away from the hope and promises of designing and developing standardised plug-and-play technologies for older people and instead pay attention to the fact that care is an ongoing open-ended collective adaption process (López & Sánchez-Criado, 2015). Relatedly, Suchman showed that human behaviour is situated and that human behaviour needs to be understood in the context and practice of use (Suchman, 2007).

If these assertions are accurate, then the adoption and adaption of robots is not just about the pleasing design and usability of the robotic solution: It is about the situation of use.

1.4 WHAT NEW KNOWLEDGE IS NEEDED?

To assure that technological solutions in general and robotics in particular are worth using for older people, we need to understand something about the conditions for aging in our time and we need to involve them in the design and evaluation. Participation in the design process of the developments of concepts, technologies and services is nothing new. Participatory design has been well known in the Scandinavian countries for 30 years (Halskov & Hansen, 2015). The aim is threefold: 1) to provide potential users or workers with knowledge and skills so that their views can be better articulated; 2) to elicit knowledge and values from users or workers in the design process; 3) to use designs or artefacts as boundary objects to challenge the perception of stakeholders or provoke discussion about emerging technologies and improvements of existing technologies (Vines, Clarke, Wright, McCarthy, & Olivier, 2013). A fundamental principle for participatory design is that people such as potential users or workers are considered as valuable sources of know-how, creativity and competence.

In the traditional, deterministic "black box technology" perspective, the configuration of the older user is not questioned; technologies are seen as neutral and taken for granted. From a technological deterministic point of view, technological change is often seen as being a beneficial and forward-thinking solution. However, when explored from an older person's point of view, this image of technological changes becomes more complex. "Older people" as a

concept does not exist on its own, but as a social construction, influenced by the attitudes in society in a particular historical and cultural context (Baars, Dohmen, Grenier, & Phillipson, 2013). Lessons learnt from Science and Technology Studies (STS) direct us to an understanding that the same technology will have different meanings in different situations for different users (Hackett, Amsterdamska, Lynch, & Wajcman, 2008). Research on older people's acceptance of innovative technological solutions for social care and healthcare has shown that new technologies cannot be treated separately from the social, cultural and economic contexts in which they are situated (Prendergast & Garattini, 2015). Robots will most likely have different meaning and consequences for older people in different situations in these contexts (Lie & Sørensen, 1996; MacKenzie & Wajcman, 1999; Silverstone & Haddon, 1996). Thus, it becomes ever more important to focus and understand how older people construct meanings about robots and how older people can make use of and incorporate robots as parts of their everyday life.

This is the point of departure for this thesis. To explore it, I examined two cases of emerging robotic solutions: an eHealth system including a telepresence robot, and an assistive robot. The fieldwork was conducted as part of two European Union funded projects on independent living technologies for older people (GiraffPlus and HOBBIT). The projects involved people from a variety of disciplines (engineering, medicine, psychology and social sciences) that rely on different kinds of knowledge and methods to create knowledge. Likewise, there were many decisions to be made in the two projects concerning the various technical options and the range of issues involved in making these decisions. Moreover, the prospective older users had different backgrounds, educations, socio-economic status, experience of technologies and experiences of illness and wellness. Haraway argues that knowledge is situated and that different people have different ways of knowing and that they rely differently on different kinds of knowledge (Haraway, 1988). Meanings are also constructed by people in specific contexts and situations through collaboration with other people, through artefacts and through interactions (Latour, 2005). A basic assumption of this thesis is that the meaning of a specific artefact is constructed in a specific context and practice. The proposed robotic solutions are products shaped by the techno-social environments in which they are developed and exist. They are patterned by the conditions of their development and usage.

The emerging robotic solutions were prototypes and not products, and were deployed as independent living technology prototypes. In addition, I also explored how and if a current robotic solution (robotic vacuum cleaners), not particularly aimed for older people, was accommodated and became domesticated by older people in their everyday life. I drew upon the framework of domestication in which meaning making and technology adaption are argued to be a dual process in

which the innovations as well as people may change (Lie & Sørensen, 1996). The domestication of technology can be described as a process:

> "artefacts need to be acquired (i.e. bought or in some way made accessible), placed (i.e. it is put in a mental and/or physical space), interpreted (i.e. to be given a meaning as well as a symbolic value to the outside world) and integrated into social practice of actions"
>
> (Sørensen, Aune, & Hatling, 2000, p. 240)

The domestication framework concerns the process in which a technology becomes meaningful and understandable to a person. In this thesis the domestication framework is used as an analytic tool (Lie & Sørensen, 1996; Silverstone & Hirsh, 2003; Sørensen et al., 2000).

1.5 ORGANISATION OF THIS THESIS

This thesis consists of nine chapters and five appended papers. Chapter 1 introduces the research area, discusses what is known and what new knowledge is needed. Chapter 2 details the research aim and explains main concepts, the fieldwork and contextual settings. Chapter 3 presents the state of the art of the field of older people in relation to technology and robots. Chapter 4 describes the most relevant theoretical perspectives of meaning making as it is understood and used in this thesis. Chapter 5 describes the methods used to achieve the aim of the thesis. Chapter 6 summarises the appended papers. Chapter 7 presents the main results of the five research studies and comments on what has been learnt from each study. The findings are discussed in chapter 8. The thesis ends with conclusions and a look at the future in chapter 9.

2 RESEARCH AIM

The overall aim of this thesis is to expand the knowledge base of how older people construct meaning, use and make sense of robots in order to gain a better understanding.

The above aim will be accomplished by addressing following questions:

RQ 1. How are older people and social robots currently portrayed in the literature from the point of view of Science and Technology Studies? (Paper 1)

RQ 2. How do potential older users perceive an eHealth system in the making? (Paper 2)

RQ 3. How do older people and their everyday practices shape the role and meaning of a robotic vacuum cleaner? How does the robotic vacuum cleaner form everyday practices among the older participants? (Paper 3)

RQ 4. What motivates older people to participate in home trials of an eHealth system? What factors act as barriers to older people's participation in home trials of an eHealth system? (Paper 4)

RQ 5. What are the main implications of doing research on socially assistive robots in real homes? (Paper 5)

2.1 FIVE STUDIES

This thesis builds on five studies that correspond to the aim of gaining an understanding of how older people construct meaning, use or reject robots in the social circumstances in which the robots are developed and used. The five studies mirror my own research process, which started with a review of the literature (Paper 1), was followed by an evaluation of one of the robotic solutions in a lab (Paper 2) and moved on to explore three kinds of robots in the older participants' homes (Papers 3-5):

1) In the first study, literature in the area of social robots in relation to older people was evaluated, described and summarised. The literature review provided the context for the thesis, knowledge about the field, and identified gaps where more research is needed. A more holistic understanding of the field of social robots and older people was achieved by focusing on the studies carried out by different researchers, and by trying to connect the ideas and results.

2) The second study involved letting potential users (11 older people) try out an eHealth system in the making (GiraffPlus) in a lab. Potential users were provided with scenarios and were asked to use the robot. They were also asked to comment on the eHealth system's acceptability, usefulness and helpfulness. During the lab trials the older participants were both interviewed and observed while carrying out different scenarios. A deductive analysis of the collected data was applied, based on Roger's Diffusion of Innovation Theory (Rogers, 1995).

3) In the third study, the domestication of robotic vacuum cleaning robots by older people was analysed.

4) In the fourth study, we explored how seniors constructed meaning about an eHealth system through their interpretation of participating in home trials with an eHealth system (GiraffPlus). The study describes and analyses what motivates seniors to participate in home trials of an eHealth system in the making, and what factors act as barriers to the participation.

5) The fifth study involved letting seven potential users try out an assistive robot (HOBBIT) in the making in their homes for three weeks. We explored the ways in which the participants constructed, negotiated and mediated the idea of robots in relation to the actual abilities of the robot. The study provides a better understanding of the research design challenges involved in evaluating and developing assistive robots to be integrated into older people's everyday practices.

2.2 CONCEPTS

It is now time to introduce and clarify the central concepts used: older people, robots, and the home.

2.2.1 OLDER PEOPLE

The core assumption is that older people are not a homogenised group but vary (as everybody else) in psychological, physical and mental ability. "Older people" is a main concept used in this thesis. However, "elderly people" and "seniors" are also concepts that have been used interchangeably in the attached publications. An old person in most developed countries is often defined as a person with 65 birthdays and more (chronological age). However, this definition has been questioned because retirement tends to become an extended process encompassing a period of several years (Biggs, Lowenstein, & Hendricks, 2003; Sanderson & Scherbov, 2008; WHO, 2015). It is argued that "There is no 'typical' older person," but a diversity in older age when it comes to health and life experiences (WHO, 2015, p. vii). The literature on aging and old age mirrors the dynamic and varying nature of aging by means of different perspectives, varieties and interpretations. In this thesis the focus is on how people over the age of 65 construct meaning about participating in home trials, testing robots in real life and how they construct meaning, use or reject robots in their everyday life.

2.2.2 ROBOTS

Technology can be defined in different ways, but according to Mackenzie and Wajcams, technology is comprised of: (1) artefacts and technical systems, (2) knowledge about these systems, and (3) practice of handling these systems and artefacts (MacKenzie & Wajcman, 1999). Technology in relation to change and society can be seen as neutral or deterministic or autonomous or as socially

constructed (Kaplan, 2009). This thesis draws on the last of the four and assumes that the utilitarian, emotional and symbolic meaning of robots has been negotiated socially and historically.

Winfield alerts us to the difficulty of defining robots and determining what they do, given their ubiquity (Winfield, 2012). In spite of the diversity of robots, most can be analysed as consisting of one or more of the following components depending on what they are supposed to do: sensors, cameras, microphones, motors, a battery and grippers. The concept of a robot is that it is a manufactured artefact that can "sense its environment" via its sensors and "purposefully act on or in that environment" (Winfield, 2012, p 8). Winfield also notes that a robot should be useful and autonomous. He emphasises that robots are not autonomous like humans, but they can be perceived as autonomous if they are able to carry out preprogramed tasks without continual help from humans. To date no social robot is entirely autonomous in the sense that it reacts to its environment without any human intervention (via pre-programming) or control, but some behave as *if* they were autonomous and intelligent (Winfield, 2012).

The definition of robots used in this thesis is comprehensive in nature and a robot is seen as a manufactured artefact that can take a variety of forms (e.g. a telepresence robot, a vacuum cleaner robot and an assistive robot). The users need various levels of knowledge and practice to handle the robot depending on the utilitarian, emotional and symbolic values of the robot.

2.2.3 THE HOME

The fieldwork on which this thesis is based was carried out in older peoples' home settings. In this regard an understanding of the meaning of home is important. Dahlin-Ivanhoff et al. interviewed 40 Swedish men and women, 80 to 89 years of age, about the meaning of home (Dahlin-Ivanoff, Haak, Fänge, & Iwarsson, 2007). Their study reports that the concept of home meant security and freedom for the participants and had a central place in their lives. Home was associated with a place where the older participants felt safe and in control to do what they wanted to do, when they wanted to do it; the older participants had adapted their homes according to their needs and abilities; home was characterised by familiarity, memories, comfort and warmth (Dahlin-Ivanoff et al., 2007). Similarly, a study by Wiles et al. shows that older people are attached to their homes and the communities they live in; that the meaning of home is related to their identity and that home offered a feeling of security and familiarity (Wiles, Leibing, Guberman, Reeve, & Allen, 2011).

Silverstone (1994) describes the concept of home eloquently as:

> Home is a construct. It is a place not a space. It is the object of more or less intense emotion. It is where we belong … Home can be anything from a nation to a tent or a neighbourhood. Home, substantial or insubstantial, fixed or shifting, singular or plural, is what we can make of it.
>
> (Silverstone, 1994, p. 26)

In the lab it is not possible to observe the actual use and appropriation of a given robot in its natural settings. Consequently, the data gathered in the homes of the participants constituted the most important and valuable sources of information for this thesis.

2.3 THE FIELDWORK

The fieldwork presented was conducted as part of two EU-funded projects (GiraffPlus and HOBBIT), and in an additional study of the domestication of robotic vacuum cleaners among older people (Fig. 1).

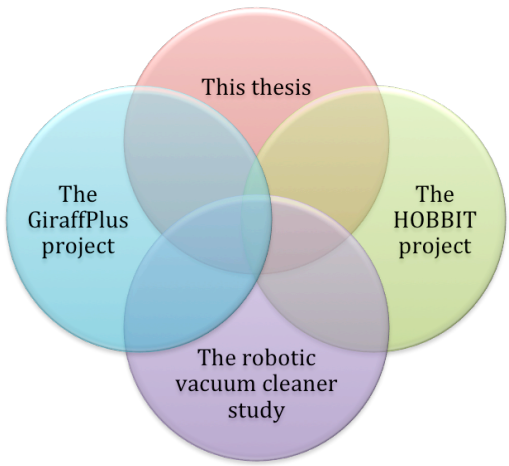


Figure 1: The fieldwork research that constitutes this thesis.

2.3.1 THE eHEALTH PROJECT (GiraffPlus)

The fieldwork was undertaken in a 36-month long EU-funded project on eHealth technologies for older people at home (www.giraffplus.eu). GiraffPlus was a joint project between three countries: Spain, Italy and Sweden. The aim of

the eHealth project was to prolong independent living for older people in their own homes. The promises of the system were to fulfil older peoples wishes to stay in their own homes as long as possible, as well as to address the economic perspective of residential care. Home care was viewed as being equivalent but with decreased costs for the caretaking of older people. The issues addressed in the project were: (1) early detection of possible deterioration of health in order to identify problems and remediate them at an early stage, (2) providing support in coping with age-related impairments, (3) enabling social interaction with relatives and caretakers. The eHealth system collected daily behavioural and physiological data from sensors, performed context recognition, and in particular, long-term trend analysis. The system consisted of a network of wireless home sensors and a semi-autonomous telepresence robot (Fig. 2). The sensors measured blood pressure, bed/chair occupancy and detected when somebody had fallen down. At the centre of the system is a unique telepresence robot: The Giraff (for more detailed information see Coradeschi et al., 2014).

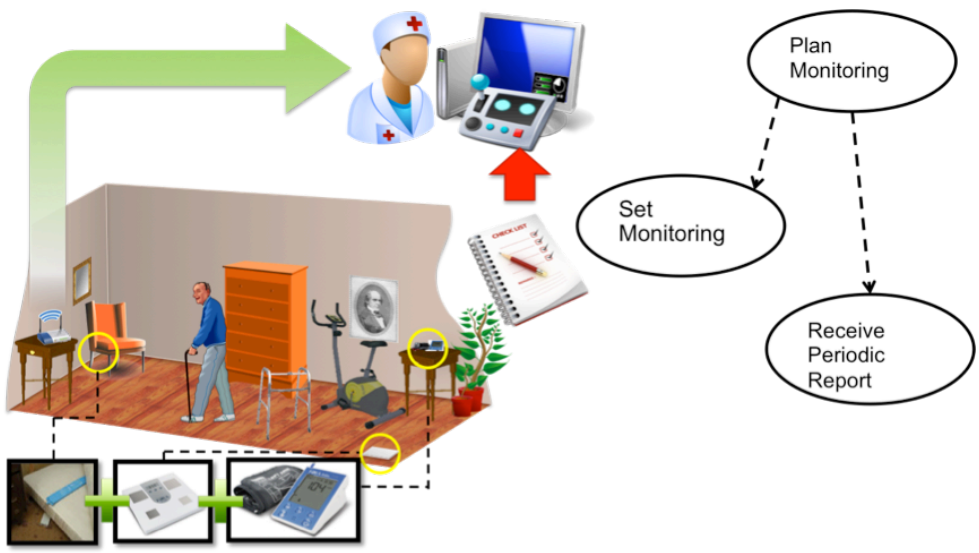


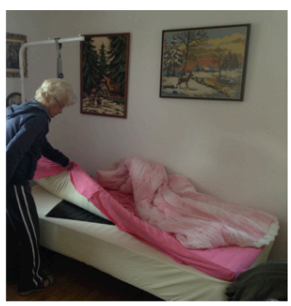
Figure 2: The GiraffPlus system (CNR-ISTC in Italy provided the picture).

The target users were people who were 65 years of age or older. This selection criterion was from the Eurostat definition of older persons (Eurostat, Retrived 1st July, 2013). The person was to be living in his or her own home. The selection criteria also included frailty when walking, instability and risk of falling, feelings of insecurity, having at least one chronic condition, and receiving medical treatment. Secondary users were family, friends and healthcare professionals. Relatives and friends were those appointed by the older participants; healthcare

professionals were those who had regular contact with the older users concerning their health.

The GiraffPlus system was first tested in a lab environment and then further developed and eventually deployed in the homes of 15 older individuals in Sweden, Spain and Italy. At the time of the deployment, the GiraffPlus system included a semiautonomous telepresence robot, and a network of non-invasive wireless home sensors (Figs. 3a, b, c). The robot was remotely operated by caregivers and relatives, and was used as a communication tool. The choice of sensors was individually fitted but measures often included bed/chair occupancy, presence in a room, and time watching television by measuring electric usage. Some physiological parameters could also be monitored if appropriate based on the individual's medical condition: blood pressure, blood glucose, weight. The data was then transmitted, and presented to caregivers and relatives. The part of the GiraffPlus project presented in this thesis focuses on the lab trials and home trials conducted in Sweden.

The terminology in telemedicine lacks clarity and agreement on definition of the concept (Fatehi & Wootton, 2012). Terms such as *eHealth*, *telehealth* and *telemedicine* are used interchangeably. In Paper 2, the term *telehealthcare system* is used while in the Paper 4, *eHealth system* is used. The reason for using *eHealth system* was based on a request from an anonymous journal reviewer. The term *eHealth system* in also used in this thesis. According to Fatehi & Wootton, there is a rapid growth of the term *eHealth* and it will become a more popular term than *telemedicine* and *telehealth* in the next ten years (Fatehi & Wootton, 2012). The use of the concept *eHealth systems* in this thesis refers to technological solutions for providing healthcare at a distance, such as via a telepresence and sensors. With the help of virtual interaction (telepresence robot, Fig. 3a) and monitoring devices (door usage sensors, electrical usage sensors, bed occupancy sensors, Fig. 3b, and movement sensors. Fig. 3c), healthcare professionals can monitor and follow up diseases or health changes, access medical data for diagnosis or interact with the older person/patient in her home without being physically present (Figs. 3a, b, c).



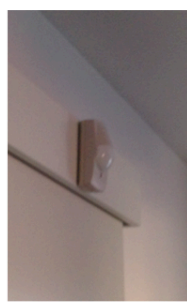


Figure 3a: The Giraff robot **Figure 3b: A bed sensor** **Figure 3c: Environmental sensor**

2.3.2 THE ASSISTIVE ROBOT PROJECT (HOBBIT)

HOBBIT was a research project of the EU's 7th Framework Programme aimed at developing a socially assistive robot that helps seniors and old people at home (www.hobbit-project.eu). HOBBIT was a joint project between four countries: Austria, Germany, Greece and Sweden. The assistive robot was developed during a period of 42 months (2012-2015). The aim of the project was to develop a robot system that assisted and enabled older people to continuing living in the own homes for a longer period of time. Several assistive robot projects have focused on developing robot systems to assist older people and support independent living (Bemelmans, Gelderblom, Jonker, & de Witte, 2012; Broadbent, Stafford, & MacDonald, 2009; Broekens et al., 2009), but the uniqueness of the HOBBIT project was the focus on bonding and mutual care between the older user and the robot. Mutual care is a framework for facilitating a mutual relationship between the user and an assistive robot (Lammer, Huber, Zagler, & Vincze, 2011). The hypothesis was that mutual care would increase the acceptance of robots by older people.

The primary target group was older people, 70 years of age or older, who in the near future will need assistance in order to stay at home. The selection criteria also included minor, moderate and severe vision, hearing and/or mobility impairments. People who were in regular contact with the older people, such as relatives, were considered as secondary users.

Initially user requirements were gathered through focus groups, workshops, interviews and questionnaires. The first HOBBIT prototype (Fig. 4) was tested in a lab and then further developed and eventually deployed in the homes of 18 older individuals in Austria, Greece and Sweden.

Figure 4: The first HOBBIT prototype tested in a lab.

At the time of the deployment the assistive robot (Fig. 5) was semi-autonomous and had an arm that was able to pick up objects from the floor. The part of the HOBBIT project presented in this thesis focuses on the home trials conducted in Sweden.

Figure 5: The assistive robot prototype.

2.3.3 THE ROBOTIC VACUUM CLEANER STUDY

In the case of this study, 10 robotic vacuum cleaners (Roomba 780) were used. They were autonomous circular robots programmed to detect dirt and to avoid objects such as furniture and walls. At the time of the deployment, the robotic vacuum cleaners had dirt sensors and optical acoustic detectors to tell where the dirt was and when the bin was full (Fig. 6). The study was carried out over a 2-year period (2013-2015) and focused on the domestication of robotic vacuum cleaners by ten older people.

Figure 6: Three of the robotic vacuum cleaners.

2.4 TECHNOLOGY USAGE AMONG OLDER PEOPLE IN SWEDEN

To understand the context the older research participants are part of, a brief overview is provided of technology usage among old people in Sweden and the basic principles of Swedish healthcare settings.

2.4.1 TECHNOLOGY USAGE

In 2014, 2 million Swedish citizens were over the age of the 65 (Findahl, 2014). This is about one-fifth of the Swedish population, 5% of which is over 80 (Brundell, 2014). The difference within the group is more diverse than any other age group when it comes to Internet usage. More than half (56%) of the people between the ages of 66 and 75 use the Internet every day or every few days, while one-fourth (24%) over the age of 75 use the Internet every day or every few days. Only one out of ten of those aged 75 and older has a smartphone or a tablet, while one out of three between 66 years and 75 own a smartphone or tablet. Almost all people between 66 to 75 own a mobile phone (97%) and one third use the Internet via their smartphone or tablet, while three-fourths (81%) of the people over 75 own a mobile phone, but only very few access the Internet via their smartphone or tablet. For people 75 and older, the mobile phone is mostly used for making phone calls. Findahl's (2014) study shows that the digital divide is great between people under 75 and those over 75. The low rate of Internet usage among the older group is thought to be a consequence of their low level of education, lack of interest, lack of exposure and training and lack of financial resources. Since the level of education is higher among people who are now turning 75, there is a belief that the digital divide will decrease over time (Findahl, 2014). This is in contrast to Ranada & Hagberg (2014) who argue that some older people are highly unwilling to take in new objects, technical or non-technical, since they want to simplify their lives and facilitate the dissolution of their homes (Ranada & Hagberg, 2014). A Swedish study, conducted in 2013, shows that older Swedish people mostly rely on personal contacts or landline telephones as their main means of communicating with healthcare services (Wiklund Axelsson, Melander Wikman, Näslund, & Nyberg, 2013).

One of the most common eHealth systems for older people is the user-activated safety bracelet or pendant alarm. In October 2012, 163 000 people above the age of 65 had a pendant alarm, which is about 9% of the age group (Brundell, 2014). Sjölinder et al.'s (2013) research on safety alarms shows that older Swedish people perceive several problems with them, such as their limited range and that they are designed for indoor usage. As a result, some older people stayed indoors

and were reluctant to leave their home which meant that they had less physical and social contact. The safety alarm was also perceived by some as stigmatising because of its unpleasant design.

2.4.2 ROBOT USAGE

Although robots such as robotic vacuum cleaners and robotic lawn movers are becoming more commonplace in Sweden, most robots are still studied in laboratory-controlled settings and never reach further than the development phase (Bedaf et al., 2015). As a consequence, older Swedish people have very little or no experience of robots in everyday life. *Bestic*, a robotic eating aid (Jiménez Villarreal & Ljungblad, 2011) and *JustoCat*, a robotic cat (Gustafsson, Svanberg, & Müllersdorf, 2015) have been studied in a Swedish context during their development phase. A study involving *Bestic* showed that it can offer privacy and independence with family and friends during meals since no human aid is needed. However, the robotic device could not replace human assistance in everyday life and other situations. Moreover, the food had to be put on the plate and cut before the robot aid could assist with the feeding (Nylander, Ljungblad, & Villareal, 2012). A pilot study with the *JustoCat* in Swedish dementia care showed that it had positive effects on the participants with dementia (Gustafsson et al., 2015). They were less agitated and their wellbeing and quality of life increased. Although both of these empirical studies were small, they still raise interesting questions about the roles robots can play in the movement towards home-centred elderly care: for whom, when and in which situations?

2.4.3 HEALTHCARE SETTINGS

Unfortunately, older people are often described as weaker, sicker and more miserable than they are in reality (Friedan, 1993; Tornstam, 2005). The majority of older people in Sweden live long and healthy lives (Lagergren, Johnell, Schön, & Danielsson, 2015). But for the ones who are in need of help, relatives and children have no lawful responsibility to take care of their older parents or relatives. The legislative responsibility for care services for older people is at the local decentralised municipal level, while national policy and regulations are established at the national level by the Swedish government (Szebehely & Trydegård, 2012). Hospital care and primary care are provided at a regional level by the county councils. The foundation of the contemporary Swedish system of eldercare dates to 1992 (Motion Ädelreformen/ Elderly Reform Act, 1992) when the responsibility for care services for older people was moved from a regional level to the municipalities. Sweden has 290 municipalities with local jurisdiction. The municipalities range in size and number of senior citizens. All citizens are eligible

for care services if they need it. The local authorities have the responsibility to assess the individual's needs and to provide care if needed. According to the national care service policy (Social Service Act), the municipality should provide support that enables older citizens to have independent, active, social and meaningful lives while preserving their self-determination (Harnett & Larsson, 2011). As a result, elderly people and all other citizens can receive help with cleaning, shopping, cooking, hygiene as well as social and emotional support if needed (Szebehely & Trydegård, 2012). They can also receive a user-activated social safety alarm (that can be worn on a string around the neck or as a wrist band). The user-activated social safety alarms provide a 24-hour response service and when the user presses the button a handler responds to the call and acts accordingly. Swedish care services are largely funded through municipal taxes and users only pay a fraction of the actual costs. Costs for the care service should be affordable for all and the user fee is typically related to the amount of help provided and income. Reduced hospital beds and length of hospital stays are an effect of the Ädelreformen and have put huge economical demands on the municipalities (Szebehely & Trydegård, 2012). The number of beds at hospitals was reduced by almost 50% between 1992 and 2005, and the average length of stay in geriatric care has been reduced from 21.5 days in 1993 to 12 days in 2005. This means that seniors who leave the hospital often still need a lot of care and home service. In this regard, it is interesting to note that past research shows that only around 10% of Swedish seniors would like to receive help from their children and relatives (Szebehely & Trydegård, 2007). This research also shows that seniors do not like to get intimate help (e.g. showers, hygiene) from relatives but are more open to getting cleaning or laundry help from relatives. In this regard, technology has been portrayed as an answer to caring for people who are in need of care in their own home (Brooks, 2004; Socialdepartementet, 2010).

3 STATE OF THE ART

This chapter provides an account of the field of older people in relation to technology to give the reader the necessary background. The thesis aims to add knowledge to this body of research literature.

3.1 OLDER PEOPLE IN RELATION TO TECHNOLOGY

Gerontechnology emerged as an interdisciplinary field in the late 20th century (Bouma, 2001) and is defined as: "The study of technology and aging for ensuring good health, full participation, and independent living throughout the entire life span, however much it may lengthen" (Harrington & Harrington, 2000). According to Harrington and Harrington, there are three central ideas in gerontechnology: (1) the dynamics of society are driven by technological developments; (2) age grading of motivation and abilities cannot be recognised independently of the technology; and (3) older people should be able to stay in control of their environment. Central idea (1) reflects a deterministic perspective in which "technology is the primary agent of change, not humans" (Kaplan, 2009, p. xvii). As Wyatt states:

> The simplicity in this model is, in large part, the reason for its endurance. It is also the model that makes most sense to many people's experience. For most of us, most of the time, the technologies we use every day are of mysterious origin and design. We have no idea whence they came and possibly less idea how they actually work. We simply adapt ourselves to their requirements and hope they continue to function in the predictable and expected ways promised by those who sold them to us.
>
> (Wyatt, 2008b, p. 169)

The problem with a technological deterministic perspective is that technology is accepted as "age" neutral without being questioned. A technological deterministic approach (central idea 1) is inadequate in understanding older peoples' lived experiences with technology, their adoption and adaption of technologies, and as a result, in understanding the emergence of new social practices, and if and how the design and implementation of a given technology

marginalise the older person. The central ideas (2 & 3) point out the importance of social and environmental factors such as technologies for physiological and mental development, as well as the power of choice. Through the lens of gerontechnology, technology can either enhance or decrease an older person's ability. Although previous researchers emphasise the heterogeneity and diversity among older people, and the social and environmental factors affecting the experience of growing old (Bouma, 2001; Harrington & Harrington, 2000), the focus has very much been on technologies to treat, repair, assist and protect older people (Peine et al., 2014). Peine et al. (2014) argue:

> A paternalistic stance thus prevails in the gerontechnology literature that downplays the capacity of older persons to be in charge of their technological environments. Older persons are assumed to follow what designers offer to them, and it is therefore the tasks of designers to understand and meet the needs of older persons. This involves an uncomfortable framing of older technology users as passive recipients of technology — recipients that are not expected to go beyond existing preconceived needs, whose playful engagement with technology is positioned within a rhetoric of overburdening and error, and that have to be comforted rather than challenged by new technology.
>
> (Peine et al., 2014, p. 204)

Similarly to Peine, Mort et al. (2013) argue that older people are treated as a homogeneous group and are often offered one-size-fits-all solutions that are static and leave no room for local, practice adaption (Mort, Roberts, & Callen, 2013).

3.1.1 DOMINANT TRENDS IN SCIENCE, TECHNOLOGY AND AGING

The phenomenon of older people in relation to technology is accompanied by a growing academic interest and includes a variety of perspectives and concepts. Some of these are ageism, medicalisation and technicalisation (Joyce & Loe, 2011; Kohlbacher & Herstatt, 2008; Neven, 2011; Peine et al., 2014; Roberts & Mort, 2009).

Joyce and Loe (2011, p. 5) identified two dominant trends in the area of science, technology and aging: (1) the biomedicalisation of the aging body in which age is understood as a pathology. The older body is seen as a deviation from a healthy normal body but with the help of plastic surgery, an active and healthy lifestyle or anti-aging medication it can be restored or cured; (2) technologies for older people (gerontechnologies) such as assistive robots, eHealth and mobile health devices (Joyce & Loe, 2011, p. 5). In this trend, age is taken for granted and technology is developed to support the older body. This approach focuses on older people's limitations such as lack of physical, sensory and/or

cognitive functioning and assumes that technology can help to reduce these limitations.

These two trends will have an impact on the meaning and experience of old age. As medicalisation and technicalisation become choices that were not available in the past and as care robots become a reality for the caring of older people at home, this will change the meaning of eldercare for everyone, even for those who do not use the technology. People will become aware of this new mode of care and will evaluate themselves and others in relation to it (Joyce & Loe, 2011). Current developments also emphasise the need to configure aging people into ageless people; as a result, what is considered normal and abnormal aging will be transformed (Kaufman, 2010).

3.1.2 TENSION POINTS

There are many parallels between feminist theory and older people in relation to technology. Example are: (1) the struggle over the extent to which "the group" is defined by biology or social conditions; (2) the struggle over whether to consider the group as a whole (older people can both be seen as a single group or sub-groups depending on their ethnicity, gender, socio-economic class, marital status, etc.), or to be primarily concerned with those who suffer the greatest discriminations; and (3) the struggle to demonstrate the group's strengths or unfair treatment (Reinharz, 1986). There is no doubt that the feminist movement took off when women could make their voices heard (Friedan, 1993). Feminist theories of technology focus on the mutual shaping of technology and gender (Wajcman, 1991). A useful example is provided by the past developments of household technologies by men for women (Cockburn & Ormrod, 1993). Women doubted that men could invent technologies to improve housework when the men did not have any experience of doing housework. As a consequence, women got involved in testing, evaluating and recommending new technologies (Cockburn & Ormrod, 1993). However, the gender relation concerning the women's place in the home and kitchen were taken for granted and no demands that the men should partake in housework were raised (Landström, 1998).

Parallels can be seen in the development of technologies for older people where the developers are generally young males (Hanson, Percival, Aldred, Brownsell, & Hawley, 2007). This suggests that there is a belief that older people will passively accept the technology that someone else creates for them (Peine et al., 2014). However, the underpinnings of rules and routines in technology development processes are the unquestioned assumptions, and the power, knowledge and control relationships (Neven, 2011). Engineers, for example, identify the problems and develop the technology while the older users, if

involved, evaluate the interfaces and functionality (Battarbee et al., 2005). Mainstream technologies are too often designed with an able-bodied, youthful person in mind by young white males (Joyce , 2008; Lewis, Langdon, & Clarkson, 2006).

3.1.3 CURRENT VIEWS OF OLDER PEOPLE IN RELATION TO TECHNOLOGY

One common belief is that older people's technology adoption or lack of it can be "fixed" by reforming their attitudes and behaviours through training and education. A good example of this can be found Mitzner's et al. (2010) study, *Older Adults Talk Technology: Technology Usage and Attitudes*. The study reports on the usage of and attitudes about technology in the home of 109 older people. They had both positive and negative attitudes. The positive ones were that technology created convenience, while the negative ones were that technology could be inconvenient and unreliable. The study suggests that in order for older people to adopt technology, parameters such as awareness, training and educating are necessary. Similarly, it is believed that older people's acceptance of robots can be increased by modifying their expectations (Broadbent et al., 2009). Technology is seen unequivocally as something good, which older people will adopt if only the introduction and socialisation of the robot/technology is changed. The way older people often are portrayed in relationship to technology may stem from the cultural values of Western society in which young people are stereotypically portrayed as being interested in the latest technologies and eager to learn how to use them, while older people are stereotypically portrayed as being uninterested in technological change, having difficulties in learning new technologies and reduced physical and cognitive abilities (Ryan, Szechtman, & Bodkin, 1992).

3.1.4 OLDER VERSUS YOUNGER PEOPLE'S TECHNOLOGY ADOPTION

There is a tendency to compare older people's technology adoption with younger people and an orientation towards solving the "problem" of older people's lag in technology adoption (Charness & Bosman, 1990; Dijkstra, Charness, Yordon, & Price, 2015; Fisk, Rogers, Charness, Czaja, & Sharit, 2004; Hanson, 2010; Schulz, 2012). Older people are often treated as a homogenous group, nor is recognition given to the involvement of gender, race, ethnicity and class in addition to age in the technology experience (Joyce, 2008). In the diffusion of innovations theory, for example, older people are characterised as laggards (i.e. the last group who adopt a new technology and who have a negative attitude towards change) (Essén & Östlund, 2011; Rogers, 1995, pp. 284 - 300), while younger

people are characterised as early adopters and positive to change. Some researchers tend to cite the decline in perceptual, cognitive and psychomotor abilities in older people as a reason for different technology adoption behaviours in comparison to younger people (Charness & Boot, 2009; Czaja et al., 2006; Rogers & Fisk, 2010). Some argue that technologies for older people need to fit the needs and abilities of the older users and that older people need more training and instructional aids than younger people to overcome barriers and technology rejection (Czaja, Sharit, Charness, Fisk, & Rogers, 2001; Hickman, Rogers, & Fisk, 2007). However, design based on older people's perceptual, cognitive and psychomotor abilities does not automatically mean that older people will adopt it (Wherton, Sugarhood, Procter, & Greenhalgh, 2015). Biological age does not necessarily correlate to functional and social age. But mental and physical abilities do affect social practice, which is why everyday life practices need to be considered when designing technologies for older people. As Plowman et al. (2009) point out, "People want to focus on what they can do and not what they can't do" (Plowman, Prendergast, & Roberts, 2009, p. 31). Furthermore, socioemotional selectivity theory highlights that older people shape their environments in ways to fulfil the goals that they value most highly, maximising life satisfaction and maintaining a high level of emotional wellbeing (Carstensen, Fung, & Charles, 2003). It is not the comparison per se of older to younger people that is the difficulty, but when the younger people's technology adoption and usage is considered to be natural and the norm, which means that older people's difficulties are considered to be unnatural or abnormal.

3.1.5 OLDER PEOPLE AS ACTIVE TECHNOLOGY USERS AND CO-PRODUCERS

Nevertheless, contributions and developments are underway in the field of gerontechnology. Gerontechnology argues for a shift in the research perspective from older people as passive technology receivers to active technology users; from old age being constructed as a set of perceptual, cognitive and psychomotor incapacities (i.e. that old age is a problem that needs a "technological fix") to older users as co-producers; and on how society's values, policies and community norms shape gerontechnologies (Joyce & Loe, 2010; Leason & Neven, 2015; Peine et al., 2015; Wherton et al., 2015).

The sociologists Joyce and Loe (2010) coined the term "technogenarians" to describe older people: "individuals who create, use and adapt technologies to negotiate health and illness in daily life" (Joyce & Loe, 2010, p. 172). Based on Haraway's (1988) argument that there is a blurring of the boundaries between technology and humans (cyborgs) as well as between reality and fiction, it cannot be ignored that technology affects the identities of older individuals. The notion of

technogenarians includes a reconfiguration of the negative stereotypes of older individual's selective emancipation as tech users. Loe for example describes how older women in their nineties "are agentic, actively identifying, adjusting and rejecting a range of technologies to enable self-care" (Loe, 2010, p. 320). Loe goes on to suggest that if the technology reinforces social networks, ensures continuity across the life course, enables intellectual participation and physical wellbeing, it could support aging in place along with self-efficacy. Wherton et al. (2015) also highlights that people with multiple impairments value opportunistic and flexible interactions outside and inside their home, and that these interactions involve a degree of reciprocity such as checking in on each other, and insights into each other's routines and behaviours (knowing when to call and when to expect a call). Plowman et al. argue that "Aging in place means more than staying at home" and that older people need to and are willing to adopt technologies that enable mobility and safety in and outside the home (Plowman et al., 2009, p 33 - 34). Similarly, Wigg (2010) portrays how using technology can liberate wandering elders who are living with dementia. She describes how motion detectors can be used in homes for people with dementia, ensuring that human assistance is always available if the patient leaves the care setting (the motion sensors trigger an alert to staff). Instead of physical barriers, such as locked doors, the patient is granted more freedom to wander and as a result less stress is caused for the patient and the staff (Wigg, 2010).

However, there is other research that shows that technology to support older people can have unanticipated and adverse outcomes. Pritchard and Brittain (2015) explored the effectiveness of a pendant alarm and how the care it facilitated can dehumanize people; they also examined its effect on social relations. They argue that the pendent alarm has a dehumanising effect on social relations since it reduces human contact and replaces face-to-face care practice. As a result, the older participants used the pendant alarm seldom or not at all (Pritchard & Brittain, 2015).

As seen from these examples, older peoples describe roles and meanings of various kinds of technologies and it has been suggested that the role and meaning of one specific technology has to be analysed in the context of social practice (Joyce & Loe, 2010), which is to be done in this thesis.

3.2 OLDER PEOPLE IN RELATION TO ROBOTS

The idea of using robots is not new. Robots have been used for decades in manufacturing in auto factories, warehouses and food production, among others (Lin, Abney, & Bekey, 2011). In workplace environments the safety and usability

of a robotic system, its efficiency and effectiveness are crucial. In the home, older people's adoption of robots needs to be understood not in isolation but in relation to other activities in which non-human and human actors are involved.

In 1998, a Swedish study explored the acceptance of assistive robots among Swedish people (Khan, 1998). The results show that people are generally positive about having a robot that does household chores such as laundry, cleaning the house and windows, washing the dishes and other dull, time-consuming activities. However, most of the participants were opposed to the idea of robots taking care of older people. A study conducted in 2012 on public opinions of robots among EU citizens showed similar results (Eurobarometer, 2012): Most of the citizens in the EU who answered the questionnaire had a positive view of robots to be applied in areas that are dangerous for humans such as space exploration, manufacturing, military and security. However, the study also shows strong aversion to robots taking care of children or older people. It is interesting to note that although the Swedish study (1998) and the European study (2012) are 12 years apart, the results are very similar. Similar results can also be found in (Dautenhahn et al., 2005; Scopelliti, Giuliani, & Fornara, 2005). The latter study claims that age is a critical factor: people become more critical of robots with age. Broadbent et al. carried out a literature study on older people's acceptance of robots and suggest that it could be increased by modifying their expectations of robots (Broadbent et al., 2009).

While many studies can be found on people's preferences and attitudes towards robots, only a few HRI studies has been conducted with "real users" in "real homes". Forlizzi and DiSalvo let 14 households try out a robotic vacuum cleaner for a month. Their results suggest that how the robots are introduced is critical since the expectations were initially too high. Their study also shows that the participants became socially connected to the robots and that they adapted their homes to fit the robot (Forlizzi & DiSalvo, 2006). Similarly, another study suggests that people feel gratitude towards their robotic vacuum cleaner since it keeps their home neat; they also feel companionship with their robotic vacuum cleaner and recommend it to others (Sung, Guo, Grinter, & Christensen, 2007). A study carried out with Pleo (a robotic dinosaur) shows that the participants were initially positive but that their engagement faded when the robot did not turn out to be as smart and engaging as it initially was perceived (Fernaeus, Håkansson, Jacobsson, & Ljungblad, 2010). It should be noted that none of the studies mentioned conducted "at home" were focused on older people in relation to robots. However, Forlizzi et al. interviewed and observed older people in their homes to gain an understanding of how robotic-products could assist older people in staying independent and active longer (Forlizzi et al., 2004). They concluded that future robotic products need to fit the ecology of older people as part of a system, that they must support the values of the actors involved in the ecology and

that the robotic products need to be adaptive. As you will see in the next chapter, their recommendations are very much in line with the concept of domestication of technologies.

One has to keep in mind the limited availability of commercialised robots and the above findings may be due to the novelty of the robots or biased by the willingness of people to take part in research projects. Imperative ethical concerns have also been raised about robots taking care of older people, such as putting them at risk, limiting their social interactions with others and providing low quality of care (Sharkey & Sharkey, 2012; Sparrow & Sparrow, 2006; Vallor, 2011). There is a need to study the long-term use of robots and how it shapes and is shaped by the users (Bauwens & Fink, 2012; Susanne Frennert & Östlund, 2014b; Hansen, Andersen, & Bak, 2010).

In this chapter, we saw that the research on older people in relation to technology is growing in different directions. These include concerns about ageism, the development of anti-age medicalisation, and the technocalisation of eldercare. The perspectives in the field of technology and aging are changing from the technical deterministic perspective, in which the dynamics of society are seen to be driven by technological developments, towards a perspective where technology and aging are seen through a constructivist lens, which is focused on older people as active technology users and co-producers. In the next chapter, I present the theoretical framework that forms the basis of my research.

4 THEORY

The research presented in this thesis is situated in the intersection of older people, robots, and the domestication process. This chapter provides selected theoretical perspectives on meaning making in relation to artefacts. It is structured as follows: It begins by describing meaning and meaning making as it is understood and used in this thesis. Thereafter issues of meanings and representations are described, followed by the notion of scripting, affordance and practice. The chapter ends by introducing and explaining the framework of domestication in which technology adaption is described as a process of meaning making. The domestication and practice-oriented approach has been employed to deepen the understanding of how older people construct meaning, use and make sense of three different kinds of robots. The selected theoretical perspectives presented have also been used to guide my thinking and actions (what to look and listen for as well of what to ignore) when collecting and analysing the empirical data (Forte, 2002).

4.1 ARTEFACTS AND MEANING MAKING

I will use Heidegger's classical example of the hammer to illustrate the concept of meaning making used in this thesis. A hammer is an artefact of wood and steel. It can be used to keep serviettes in place on a windy day. But its utility is relational in the sense that if we have a wall, nail and a picture frame, the hammer can be used to hammer the nail into the wall in order to hang the picture frame on the wall. A hammer is understood through hammering. In the example, the meaning of the hammer is found in relation to the nail, the wall and picture frame. If you were situated in a glass house and had a hammer, nail, a picture frame and double-sided adhesive tape, you would most likely use the adhesive tape and not the hammer to put up the frame. As such, the value of an artefact is understood through the situation and context of use. Similarly, if there was a group of small children in the glass house, the hammer might have been put away because the utility of the hammer is understood through experience and knowledge of what hammering on glass or other humans can result in. As such, the meaning of an artefact is relational to its use, the context, situation and our prior knowledge/experience. However, even though the artefact is not considered as

useful in a given situation or context, it can still hold meaning. The artefact can represent the owner's identity and accomplishments (the hammer can represent a profession or craftsmanship, for example); it can embody the owner's values and preferences (Csikszentmibalyi, 1993). An artefact can also signify the owner's past, aim for the future or belonging to a social group (Miller, 2007). In addition, both the usage and the physical properties of the artefact can change over time (Wiebe Bijker & Law, 1992).

The time factor is of significance for meaning making. The relationships between artefacts and everyday life are built up through a process where everyday practices evolve and transform, and in which tacit knowledge is acquired (Shove, Watson, Hand, & Ingram, 2007). These authors go on to state that society, people and artefacts co-evolve as a result of imaginaries, assumptions and expectations that are socially and historically constructed over time. New artefacts do not enter a context-free environment but one that is already filled with other artefacts (Turkle, 2012). These artefacts are already part of our everyday life and a new artefact has to fit into the network of other artefacts and everyday practices (Suchman & Bishop, 2000).

Society can be understood as socio-technical assemblages of humans and artefacts (Latour, 2005). We humans make artefacts as a result of our skills, competence, values and ideas. The meaning of an artefact evolves from cultural values and norms, which in turn shape and are shaped in conjunction with the technological developments (Bijker, Huges, & Pinch, 1989). A useful example is Bijker et al.'s (1989) illustration of the development of the bicycle. Bijker and Pinch describe how current practices affect the attributed meaning of different bicycles and how the meanings are constructed through a cyclic movement of the interactions and actions between different social groups (Bijker et al., 1989, pp. 27-40). They illustrate a range of different rival variations of bicycles in the past, which had different meanings for different social groups (social groups are actors who perceive the object in the same way). For example, young males valued the speed and excitement of the *penny-farthing* (a bicycle with a large front wheel and small rear wheel). Over time, the chain-driven safety bicycle was developed. It represented safety and enabled females (they could not use the penny-farthing due to their dresses and the clothing habits of the time) and older people to ride a bike. Over time, the meaning of the safety chain-driven bicycle came to dominate over the speed and excitements of the penny-farthing and the development of bicycles reached a level of closure and stabilisation. As such, the modern bicycle looks more or less as it did in 1890s.

As illustrated in the bicycle example, when a technology is new, social aspects play a crucial role in its development and acceptance. Once the technology is accepted and diffused in society, the social factors diminish; the technology

matures and becomes a part of the socio-technical assemblages of society (Hughes, 2004). The meaning of an artefact can also diminish when the artefact is replaced by another. An example is the radio that in the past was part of almost all households. It represented entertainment and a link to the outside world (through global and local news). As the public service industry has become digitalised, digital devices such as tablets and mobile phones are replacing the radio. Social patterns are changing due to the digital transformation and people have access to a wider spectrum of news and music to listen to whenever they want. The opportunity to personalised one's media consumption is increasing but also becoming more fragmented and polarised (Pariser, 2011).

In a similar vein, we need to consider the meaning of robots for older people in the space of their everyday lives and in the totality of artefacts and practices in their lives. We also need to consider how the meaning of old age is inscribed in emerging robots. Too often robots are seen as fixed and stable entities designed to achieve singular outcomes such as vacuuming. But another way of thinking would be to regard robots as artefacts capable of being experienced and used in different ways for multiple and equally valid purposes. In this regard, every older person is a unique individual, and each is capable of having a wide range of very different meanings in regards to robots. In this context it is interesting to explore if a group of older people construct the same meaning of a robot or if and why a robot has different meaning to different older people. I ask: What factors affects the meaning older people ascribe to a specific robot? The human-robot relationship can be mutual and what Latour called symmetry between humans and non-humans (Latour, 1999). Non-human entities like robots can influence the human and can be seen as mediators; as such, both the human and the robot translate, transform, distort and modify meaning, values and norms between each other (co-construction). In the book *Pandura's Hope* (1999), Latour illustrates the symmetry between humans and non-humans. He gives the example of a gun and a person who holds a gun. The person becomes another person with a gun in hand and the gun becomes another object in an angry person's hand compared to a gun that is on display in a museum. Even though a robot is quite different from a gun, there is a similarity: an older person might become another person with a robot.

In *The Semantic Turn* (2005), Krippendorff developed a sketch of a new discourse for a foundation for design. He describes and criticises a technology-centred approach and recommends a human-centred approach in which meaning is central. He describes how the usages of artefacts construct meanings. How we talk (narratives) about the artefacts we use with others also constructs meanings. Krippendorff highlights that designers and other stakeholders inscribe meanings into an artefact during its life cycle and how meanings are mutually constructed with ecologies of artefacts (Krippendorff, 2005).

4.2 MEANING MAKING AND AGING

Many theories of aging focus on how older people adjust and change while getting older. Example are disengagement theory, activity theory, continuity theory and the theory of gerotranscendence. Disengagement refers to a natural drive in individuals to decrease their involvement and reduce their activity level with age. According to this theory, aging involves a drive towards withdrawal and exclusion (Nussbaum, Pecchioni, Robinson, & Thompson, 2000). Activity theory, in contrast, advocates high social involvement and physical activity throughout one's lifespan (Nussbaum & Coupland, 2004). "Connect, be active, take notice, keep learning and give" (Brey, Briggle, & Spence, 2012, p. 104) is seen as a mantra for positive aging. Continuity theory is constituted of disengagement theory and activity theory. It emphasises a person-centred approach and an understanding that we are all individuals with different needs and wants (Nussbaum & Coupland, 2004). To age successfully according to continuity theory, we need to preserve our habits, lifestyles and wants during the aging process. In contrast, gerotranscendence theory focuses on positive aging and perceives aging as a shift of meta-perspective (Tornstam, 2005). Aging is viewed as a continuing process into old age, which can include decay and dependency, but can also lead to new qualitative perspectives of life. The individual redefines the notion of self and identity, relationships to others and acquires a new understanding of existential issues. Aging is seen as normal transition in an individual's lifespan where the older individual is constantly redefining and evolving his or her sense of time, space, life, death and self. The aging identity is characterised both by fluidity and fixity. Older people reach different levels of gerotranscendence: The higher the level of gerotranscendence, the higher the sense of connectedness with past and future generations, nature, the universe and the cosmos (Tornstam, 2005).

What is interesting with the theory of gerotranscendence is that it regards aging in relation to materiality. This is in contrast to many other aging theories in which materiality is often neglected. If we take the theory of gerotranscendence seriously, it has the following implication: When the individual develops a sense of gerotranscendence the focus moves from material things to spiritual freedom, which means that the individual is considering and revaluating their previous way of thinking and often results in a decrease interest in material things (Tornstam, 2005, p 67-68 & 187-193). In this regard, how older people construct meaning, use and make sense of robots cannot be constructed from the perspective of younger people but needs a shift to older people's perspective, which tends to prioritise fewer and more meaningful activities often associated with contemplation of the past (Tornstam, 2005).

4.3 ISSUES OF MEANING AND REPRESENTATIONS

The deployment of assistive robots and eHealth systems may affect how we view older people, their bodies and the self. It is interesting to reflect on how aging is inscribed in technologies aimed for older people as well as in symbols, language and identities used in the making of technologies for older people. Foucault has shown in his work that people are willing to subject themselves to a discourse or disciplinary regime and thereby become objectified to that discourse or regime (Foucault, 1982). For Foucault, institutions such as prisons, schools and hospitals use classifications, codes and languages to form practices. These practices generate languages of descriptions and explanations of the self as ill or healthy, able or disable, normal or abnormal, etc. In other words, discourses of innovations and older people configure how we perceive older people and what kind of innovations that are developed for older people (Aceros, Pols, & Domènech, 2015). How we talk about older people reproduces interpretations of need and entitlement as well as of normal and acceptable ways of being an older citizen and of aging at home (Milligan, Roberts, & Mort, 2011; Roberts & Mort, 2009). As a result, older people's identity, needs and priorities are configured together with innovations aimed for them (Neven, 2011). However, if the representation of robots for older people with its symbols, metaphors and values differs from the older people's values, wishes and needs, then the robot may be rejected (Copelton, 2010).

Studying robots in relation to older people from a constructivist perspective directs us to understand robot development and appropriation in terms of internalised control and externalised control. These two types of control are caused by discrimination, exploitation, and structural inequities as well as by the ambiguous role of meanings and perceptions of two or more actors (Bijker & Law, 1992; Donald & Wajcman, 1985; Latour, 2005). In this regard, technology is not just the hardware but the social values and norms inscribed in the technology and the social values that influences the development in certain directions (Donald & Wajcman, 1985). When outlining the field of constructivism and technology in relation to meaning making, it is useful to outline the notions of scripting, affordance and practice.

4.3.1 SCRIPTING

Scripting concerns how developers and designers configure their users. According to Akrich's terminology, designers develop "a script" (like an actor

using a script in a movie) to guide the user's usage and actions when interacting with a specific artefact (Akrich, 1992).

> Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science and economy will evolve in particular ways. A larger part of the work of innovators is that of inscribing this vision (or prediction) about the world in the technical content of the new object. I will call the end product of this work a 'script' or a 'scenario'.
>
> (Akrich, 1992, p. 208)

The notion of *age script* is useful when it comes to older people in relation to robots (Neven, 2011). The ideas designers and developers have about older people can result in them designing artefacts, such as robots, that restrain older people because of the presumptions that they are ill, fragile and sick. A useful example is provided by Neven who used actor-network theory to illuminate how different actors attribute different meanings to the same monitoring system intended for fragile older people to enable them to live at home longer (Neven, 2015). The assumption that older people like to age in their own home was never questioned in the project agenda, but taken for granted. The confinement older people experience from being housebound can be viewed as a discursive constraint in the development of technologies for them. In the Neven's study, the technology was seen as the answer for enabling older people to live at home longer. Neven notes that even though the system fulfilled this promise, it also had other negative effects on older people's homes and lives. Nevertheless, for the older users, the meaning of having the monitoring system was not related to the system per se or to living at home longer; the meaning came from the system enabling them to continuing living with their spouses (something they were unable to do if they moved into an eldercare facility where it was not allowed). Having the monitoring system in the home also offered them additional social contact with the engineers and researchers who installed, maintained and fixed problems with the system, as well as keeping their relatives happy because they knew the older person was being monitored the around the clock. The example illustrates that the relationship between technology and society is a seamless web (Hughes, 1986).

4.3.2 AFFORDANCE

The psychologist James J. Gibson coined the word *affordances*. The word describes how the meanings of things can be directly perceived. The meaning that is perceived is relative to the observer and the environment, which she is in. A fire, for example, can be perceived as hazardous or as a source that affords heath and warmth. However, in both cases, humans generally would not walk into the fire. We learn to perceive the affordance from other observers and from our own

experiences. Gibson uses a child as an example: children learn how to use different objects by observing how others do, but children also explore how to use different objects by themselves (Gibson, 2015).

Norman added the word *perceived*. He uses *perceived affordance* in the context of product design. In *The Design of Everyday Things* he illustrates how different interfaces and objects can be perceived by the observer and how they affect the observer's interactions with the object or interface (Norman, 2013). To paraphrase Norman, an interface or object affords certain actions such as a chair affords support and can be sat upon. A person may be able to lift the chair and as such, it affords lifting. However, some people may not be able to lift the chair and in that case it does not afford lifting to them. Designers can use different visual clues and physical properties to ease the intended users' understanding of what the artefact affords. When it comes to robots it has been proven that if a robot resembles a human in appearance, people expect it to behave like one; when the robot does not live up to these expectations, people tend to get very disappointed and distrustful of the robot (Walters, Syrdal, Dautenhahn, Te Boekhorst, & Koay, 2008). Mori (1970) studied human responses to non-human entities and concluded that if something looks real, but does not feel real, people develop unnerving feelings towards it (Mori, 1970). As such, if a robot resembles something familiar, but lacks the ability to behave as projected, people will lose interest in it or find it unappealing. It appears that the perceived affordance of a robot must correspond to its utility.

4.3.3 PRACTICE

Akrich and Latour (1992) provide a useful guide to how to talk about and understand users in relation to technology:

> **Script, description, inscription or transcription**: The aim of the academic written analysis of a setting is to put on paper the text of what the various actors in the setting are doing to each other; de-scription, usually by the analyst [user], is the opposite movement of the in-scription by the engineer, inventor, manufacturer or designer…
>
> **Prescription, proscription, affordance, allowances:** What a technology or device allows or forbids from the actors – humans and non-humans – that it anticipates; it is the morality of a setting both negative (what it prescribes) and positive (what it permits)
>
> **Subscription or the opposite, de-inscription**: the reaction of anticipated actants – human or non-humans – to what is prescribed or proscribed to them; according to

> their own antiprograms they either underwrite it or try to extract themselves out of it or adjust their behaviour or the setting through negotiations…
>
> **Re-inscription**: The same thing as inscription but seen as a movement, as a feedback mechanism; it is the redistribution of all the other variables in order for the setting to cope with contradictory demands of many antiprograms…
>
> (Akrich & Latour, 1992, pp. 259-262)

The vocabulary of the semiotics of human and non-human assemblies directs us to focus on the practice in which the older individual and the robot exist. A practice-oriented perspective can be used to help us shift our understanding of technology adoption as a product of subjective interests (goals and needs), to one of making sense of an ongoing practice as well as adapting to a new emerging practice. In other words, a robot or any other technology needs to become a part of an ongoing set of routines. As such, the meaning of a specific robot is not placed in the robot itself or its functionalities and neither in the physical properties attached to the robot (such as shape or form) but it emerges in its appropriation and use (i.e. in practice itself) (Shove, Watson, & Ingram, 2005). As Akrich et al. argue, "To adopt an innovation is to adapt" (Akrich, Callon, Latour, & Monaghan, 2002, p. 208).

A return to practice has been debated in the field of social science (Cetina, Schatzki, & von Savigny, 2001). Nonetheless, there is no unified practice-oriented theory but different perspectives to study and conceptualise practices (for a detailed account please see Nicolini, [2013] and Reckwitz [2002]). However, they all have common epistemological elements such as emphasising practices and placing meaning making as a result of actions, individuality and social order through everyday practices with a focus on what people do (Kuutti & Bannon, 2014; Reckwitz, 2002). Reckwitz describes:

> Practice is a routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, "things" and their use, a background knowledge in the form of understanding, know-how, states of emotions and motivational knowledge.
>
> (Reckwitz, 2002, p. 249)

Reckwitz argues that the thinking of Garfinkel (ethnomethodology), Foucault (association between power, meaning, discourse and knowledge), Latour (actor network theory), Bourdieu (habitus), Giddens (structuration) and Butler (performative gender) have had strong influences on social practice theory (Reckwitz, 2002, p. 249). In a practice-oriented perspective, meaning making is seen as negations between humans, context and artefacts, transforming current practices and giving birth to emerging practices. The focus is on practices, not just the human actor, the artefact or their interaction. As Kuutti and Bannon argue,

"Practices are where interactions take place in real life" (Kuutti & Bannon, 2014, p. 3549). I cite Reckwitz's (2002) example of playing football to give a clearer picture:

> A practice such as, say, playing football consists of a routinized set of bodily performances. Yet, within the practice these bodily performances are necessarily connected with certain know-how, particular ways of interpretation (of the other players' behaviour, for example), certain aims (most of all, of course, to win the game) and emotional levels (a particular tensions) which the agents, as carriers of the practice, make use of, and which are routinized as well. Without these mental and bodily activities, we could not imagine a practice of 'playing football'. For practice theory, a social practice consists of certain bodily and certain mental activities. If somebody 'carries' (and 'carries out') a practice, he or she must take over both the bodily and the mental patterns that constitute the practice.
>
> (Reckwitz, 2002, p. 252)

As seen in this example, in a practice-oriented perspective the unit of analysis can be neither the humans (the players) nor the artefact (the ball) but the network of mental and physical activities of the human body, the contexts, artefacts and their use, in a certain chronological time and space (Suchman, 2007). The intentional actions and interactions of individuals are understood to produce and alter the social system (Cetina et al., 2001) and social systems are seen as consisting of various elements that are continuously rearranged (Shove, 2003). The works of practice theorists have shown that innovations might transform and change existing practices into new routines/habits, produced by and generating new meanings (Shove, Pantzar, & Watson, 2012). Similarly, everyday technology adaption situations have been described as the "domestication of technology" (Silverstone & Hirsh, 2003).

4.4 DOMESTICATION – MEANING MAKING AS A PROCESS OF ADAPTING TECHNOLOGY

The domestication perspective originates from studies of the role and meaning of television in people's domestic lives in the disciplines of anthropology and consumption research, and deals with how technology becomes part of everyday routines (Berker, Punie and Ward, 2005; Lie & Sørensen, 1996; Silverstone & Hirsh, 2003). The processes of meaning making were explored and linked to the concept of domesticating animals by Silverstone et al. (1992, 1993, 1994, 1996). It mirrors the mutual taming of the technology in question and the user. In other words, the user and the technology in question are both the carriers of a social practice (in the user's mind and body, and in the specific technology's

"scripts") and they are also the ones who produce the practice (by the user's actions and the specific technology's capacity and limitations). In this regard, the users are active agents who make technologies their own (Lie & Sørensen, 1996). The key phases in the domestication process identified by Silverstone's and his team are: appropriation, objectification, incorporation and conversion (in Haddon, 2011). "Appropriation" involves the negotiations and considerations that are taken before and when a given technology enters the home of the user; "objectification" is the symbolic and spatial place given to the technology by the user in her home; "incorporation" is how technologies are fitted into daily routines and structures; "conversion" is the phase when the technology becomes a part of the user's identity and refers to how the user portrays the technology to others (Haddon, 2007, 2011a; Livingstone, 2007; Silverstone & Hirsh, 2003).

It has been shown that micro and macro level variables affect if and how technologies are domesticated (Lie & Sørensen, 1996). For instance, the economy and societal position of the individuals in the household (micro level) and their cultural habits, attitudes and expectations (macro level) affect the decision to integrate a technology into their everyday life or not. Different members of the same household can integrate the same technology differently into their life. Silverstone (2003) define this phenomenon as the "moral economies of the household". The concept highlights the negotiation of the meaning of a given technology within the household and between the household and the cultural context in which it exists. For example, having a car enables you to drive from A to B. All cars will get you from A to B but still there are a number of brands and sizes of cars to choose from. The choice on which brand of car you buy has to do with what you can afford, the purpose (for example if it is a family car for many or a car just for you), your family, etc., as well as on how you would like to be perceived (the car as a representation of your identity), what kinds of cars your neighbours and friends have, etc. Sørensen et al. (2000) who build their research on Science and Technology Studies (rather than Silverstone and Hirsh [2003] who build theirs on Media and Communication Studies) use domestication as an analytic tool to understand the multidimensional process of the cultural appropriation of technology (Sørensen et al., 2000). Sørenson et al. describe domestication as a process:

> "An artefact needs to be acquired (i.e. bought or in some way made accessible), placed (i.e. it is put in a mental and/or physical space), interpreted (i.e. to be given a meaning as well as a symbolic value to the outside world) and integrated into social practice of action"
>
> (Sørensen et al., 2000, p. 240)

They go on to describe how domestication strategies involve symbolic, cognitive and practical dimensions. The symbolic dimension includes how people construct meaning of the technology and the association between meaning and the user's representation of self and public identity. The practical dimension includes patterns of usage while the cognitive dimension refers to the processes of knowledge acquisition and how this knowledge is reshaped and transformed in relation to the technology. These three dimensions (cognitive, practical and symbolic) are closely interrelated.

By relating the theory of domestication to the research presented in this thesis, it can be concluded that for the older participant to domesticate the robot they are trying out at home:

> **(1)** They need to know how to use a robot in order to create a new practice (i.e. adopt and adapt the robot). Using Schatzki's words "knowing how to X, knowing how to identify X-ings, and knowing how to prompt as well as respond to X-ings" (Schatzki, 2010, p. 77). The participants need to be able to use their existing knowledge and transfer it through interaction with the robot to achieve their goals of the interaction. In some cases, the participants need to learn new skills or change their prior understandings to be able to use the robot.
>
> **(2)** The rules and procedures that prohibit or guide the participants into a certain pattern of usage must make sense to them.
>
> **(3)** They must feel that the robot corresponds to their individual abilities, needs, wants and desires, as well as the norms and values of the social system in which they exist.

This directs us to move on to the papers that are the foundation of this thesis. First, I will introduce the methods and then present a summary of the five appended papers.

5 METHODS

The research presented in this thesis focuses on how older people construct meaning, use and make sense of three kinds of robots – one current, and two emerging: a robotic vacuum cleaner (a current technology); an emerging eHealth system including a telepresence robot; and an emerging assistive robot. This multiple case study design provided depth and insights into older people: (1) in relation to one robot that is already on the market (robotic vacuum cleaners) that they tried out at home, (2) in relation to how older people construct meaning about two specific robotic innovations by participating in their making (an eHealth system and an assistive robot) by trying them out at home, and (3) in relation to their actual influence on the practice of developing robots intended for them. The methodological steps differed between the cases. The robotic vacuum cleaners were studied in the context of the participants' homes from the start, while the eHealth system and the assistive robot were part of a design process in which prospective users were involved from the beginning of the design process. Although the analytical concerns and methodological steps in all the home trials were similar, the emphasis differed due to the nature of the robot in question. In the homes where the robotic vacuum cleaners were introduced, the domestication process was central, while in the homes there the emerging technologies (eHealth system and assistive robot) were introduced, the emphasis was on how the situation, context and practice in which a robot is developed, tested and used, shape the role and meaning of the robot for the older participants, as well as the extent to which their "voices" were recognised and had an impact on the robot in the making.

This chapter presents an overview of the five appended papers, the methods used for the literature review and in the design process. Thereafter, the case study design method is described including the participants, data collection and the data analysis. Lastly, I describe methodological and ethical considerations.

5.1 OVERVIEW OF APPENDED PAPERS 1-5

This thesis consists of five papers: a literature review, a study of robotic vacuum cleaners, two studies of an eHealth system, and a study of an assistive

robot. Each study comprises separate sub-questions and provides stand-alone theoretical contributions. An overview of the research design in the papers is presented in Table 1.

Table 1: An overview of the research design of the 5 included papers.

	Research questions	Sample/ Participants	Methods	Analysis
Paper 1: Review: Seven Matters of Concern of Social Robots and Older People	How are older people and social robots currently portrayed in the literature?	31 key publications related to social robotics, older people and Science and Technology Studies (STS)	Reviewing scientific papers	Qualitative content analysis
Paper 2: Elderly People's Perceptions of a Telehealthcare System: Relative Advantage, Compatibility, Complexity and Observability	How do potential older users perceive an eHealth system in the making in a lab environment?	Eleven older people between the ages of 74 and 97	Interviews Observations of the participants exploring different user scenarios	Qualitative content analysis
Paper 3 The Domestication of Robotic Vacuum Cleaners Among Seniors	How do older people and their everyday practices shape the role and meaning of the robotic vacuum cleaner? How does the robotic vacuum cleaner form everyday practices among the older participants?	Ten older people between the ages of 74 and 90	Case study Interviews Observations Diaries Questionnaires	Qualitative content analysis
Paper 4 What Happens When Seniors Participate in New eHealth Schemes?	What motivates older people's participation in home trials of an eHealth system? What factors act as barriers in the participation in home trials of an eHealth system among older people?	20 participants including six older people, nine relatives and five caregivers	Case study Observations Interviews	Qualitative content analysis
Paper 5 Case Report – Implications of Doing Research on Socially Assistive Robots in Real Homes	What are the main implications of doing research on socially assistive robots in real homes?	Seven older women between the age of 76 to 90 years and five relatives	Case study Interviews Diaries Observations	Qualitative content analysis

5.2 LITERATURE REVIEW (Paper 1)

My research process started with a literature review. The literature on social robots and older people was reviewed based on publications and proceedings presented in peer-reviewed journals, conferences and books. The literature was retrieved from a search of databases, including *PubMed*, *Compendex* and *Google Scholar*. The search strategy involved multiple keyword searches. The following terms were used and applied in several different combinations: "social robotics", "STS" or "science, technology and society", "elderly", "old adults", "constructivism" and "mutual shaping". The search was carried out from September 2012 to January 2013. It was limited to the English language and excluded papers of technical description. The search initially yielded 345 publications. The titles and abstracts of all 345 were scanned and evaluated based on their relevance to the research question: How are older people and social robots currently portrayed in the literature? This resulted in 31 key publications and 5 books. The key publications were evaluated in regards to their STS application and if and how older people were involved in the studies. The objectives of the literature review were to identify a gap for further research, and to give a narrative review of social robots in relation to older people.

5.3 THE DESIGN PROCESS

As stated in 2.3.1 and 2.3.2, the fieldwork in the cases of the eHealth system and the assistive robot was part of a design process.

The development of the eHealth system was driven by a design approach that focused on collaboration with the intended users throughout the whole development cycle (Koskinen et al., 2011). Older people, relatives and caregivers were involved in determining the user requirements and functional specifications of the system by participating in focus groups, workshops and usability trials in a lab, as well as trying out the system in the older people's homes (Frennert, et al. 2013; Frennert & Östlund, 2015).

In the assistive robot project, the design approach also involved older people in focus groups and workshops, along with questionnaires and interviews to identify broad attitudes and preferences for assistive robots. They also tested a prototype in the lab and in their homes (home trials) (Frennert, 2012, 2013; Frennert, et al. 2013a; Frennert, et al. 2013b; Frennert, et al. 2013c).

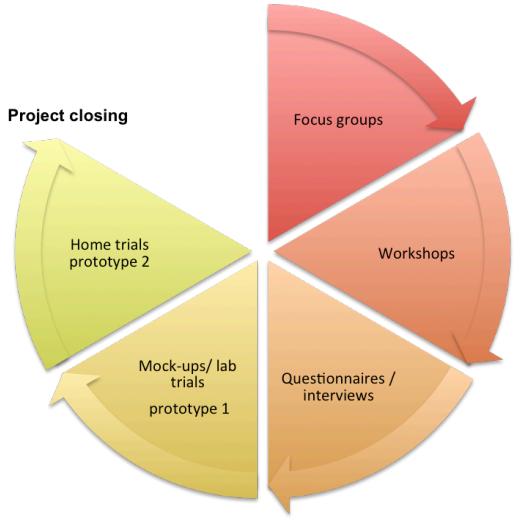


Figure 7: Illustration of the research process

A combination of several data collection methods was used (Fig. 7). Initially prospective user participated in focus groups and workshops. Design concepts and material were created to make the prospect of robots more tangible and to generate constructive discussions (Koskinen et al., 2011). Questionnaires were developed to verify the findings from the workshops and focus groups. In addition, semi-structured interviews were used to get a more in-depth understanding of older people's and secondary users' interpretations and expectations of the prospect of robots to enhance independent living (Susanne Frennert, 2014). First prototypes of the assistive robot and the eHealth system were developed and tested in a controlled environment (in the lab). The lab trials served as a ground to identify key usability problems and critical design problems (Lazar et al., 2010). The lab trials also enabled us to use wizard of OZ: "A wizard-of-Oz method is essentially a simulation of functionality that does not exist yet" (Lazar et al., 2010, p. 276) (in the case of the assistive robot, the robot was not autonomous but behaved as it was). During the lab trials the focus was on how novice users interacted with the robot prototypes. While acknowledging the need to study novice users' performance in a context-independent environment, it has to be problematised if such findings can be generalised to other settings and advanced level of users.

5.4 CASE STUDY DESIGN

The research conducted in the context of the participants' homes corresponds well with Yin's (2013) criteria for a case study design (Yin, 2014, p. 2): (a) the focus of the study is to answer "how" and "why" questions; (b) you cannot manipulate the behaviour of those involved in the study (in contrast to experimental studies); (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context (Yin, 2014). Yin defines a case study as: "…an empirical enquiry that investigates a contemporary phenomenon within its real-life context especially when the boundaries between the phenomenon and the context are not clearly evident" (Yin, 2014, p 2). Similarly, Swanborn (2010) defines a case study as a study of a social phenomenon:

> In one, or only a few, of its manifestations; in its natural surrounding; during a certain period; that focuses on detailed descriptions, interpretations and explanations that several participants in the system attach to the social process; in which the researcher starts with a broad research question on an ongoing social process and uses available theories, but abstains from pre-fixed procedures of data collection and data analysis, and always keeps an eye open to the newly gathered data in order to flexibly adjust subsequent research steps; that exploits several sources of data (informants, documents, observatory notes); in which sometimes the participants in the studied case are engaged in a process of confrontation with the explanations, views and behaviours of other participants and with the resulting preliminary results of the researcher.
>
> (Swanborn, 2010, p. 22)

Thus a case study design was chosen to investigate the domestication of a robot by older people because the case could not be considered outside of its context – the home – and more specifically, everyday life practices. It is in these settings that the domestication of a robot takes place and it would be impossible to gain a full understanding of what happens when older people domesticate robots without considering the context. A multiple case study design was also chosen to provide additional depth as well as insights into older people's domestication of robotics in three different situations: a robot already on the market that was not designed for them as the target group (robotic vacuum cleaners), and two specific innovations (an eHealth system and an assistive robot) tried out at home to see how older people construct meaning about a specific innovation by participating in its making, and to determine the actual influence they had on the practice of developing technologies intended for them.

5.4.1 THE PARTICIPANTS

5.4.1.1 THE ROBOTIC VACUUM CLEANERS (Paper 3)

The participants were selected for the robotic vacuum cleaner study based on purposive sampling. Purposive sampling is a method of identifying participants that provides maximum information (Charmaz, 2006). The criteria for purposive sampling used for this study included age, gender, technology experience, cleaning habits, living conditions, marital status, and health condition. Each individual in the study also shared features such as living in or around Lund (a small town in the south of Sweden), was over the age of 70, had expressed interest in participating in research on robots and older people, had significant health difficulties such as mobility, hearing and visual problems.

In Table 2, the year of birth, gender, household situation, and health condition and technology usage among the ten older participants in the robotic vacuum cleaner study are described. Aliases have been used to protect the privacy of the participants.

Table 2: Overview of the attributes of older participants

Participants	Gender	Born	Household	Health condition	Technology usage
Mrs G	Female	1941	Divorced, living with a female friend, service dog, large flat and summer house	Myasthenia gravis (muscle weakness disorder)	Laptop computer, mobile phone – **technophobe**
Mrs O	Female	1934	Widow, single, small flat	Glaucoma, cataracts, macular degeneration (poor vision) Hip replacement, back pain, arthrosis	Laptop computer, mobile phone – **technophobe**
Mrs H.H.	Female	1929	Widow, single, detached house	Inherited hearing impairment, hip replacement, depression	Laptop computer, mobile phone – **technophobe**
Mrs V	Female	1931	Widow, single, small flat and summer house	Back pain	Laptop computer – **technophobe**
Mrs H	Female	1929	Widow, single, large flat	Both hips are replaced, back surgery, depression, one breast removed due to breast cancer	Laptop computer, iPad, mobile phone – **technophile**

Mrs N	Female	1941	Married, living with her husband in a large house	Migraine, back pain	Laptop, computer, mobile phone – **technophobe**
Mrs D	Female	1924	Widow, single, living in a small flat	Hip replacement, depression	Stationary computer, mobile phone – **technophobe**
Mrs A	Female	1932	Divorced, single, living in a flat	Muscle pain, back pain, knee surgery	Laptop, mobile phone – **technophile**
Mr L	Male	1935	Widower, single, living in a flat	Heart problems, 7 heart surgeries, pacemaker, hip replacements, knee replacements	Lap top, mobile phone – **technophile**
Mr P	Male	1939	Widower, single, living in a flat	Prostate cancer	Laptop, mobile phone – **technophile**

The home trials of the robotic vacuum cleaners lasted for 24 months (autumn 2013 to late summer 2015).

5.4.1.2 THE eHEALTH SYSTEM (Papers 2 & 4)

Initial studies (focus groups and workshop) concentrated on many of the broad attitudes and preferences for eHealth monitoring and telepresence robots. The results from the studies were used to design a system that supports the intended users' existing beliefs, attitudes and behaviours (for more detailed information see my licentiate thesis, (Susanne Frennert, 2014)). A first prototype of the system was evaluated in a lab environment (Paper 2). A total of 11 (6 males and 5 females) participants took part in the lab tests, mean age 81 years (range 71-94). I interviewed the participants about the role and meaning they attributed to the eHealth system before they tested the system; thereafter, scenarios were demonstrated of specific situations in which the system could be used. Lastly, the participants were interviewed about the role and meaning they attributed to the system after they had participated in the user scenarios.

The prospective users, of course, lacked experiences of having an eHealth system at home since these are emerging technologies. We thus decided to install a functional prototype in five intended users' homes (data from six potential users are presented since one user had to withdraw after a couple of months and the system was moved into a sixth potential user's home). The eHealth "home" study was carried out in the municipality of Örebro, Sweden. Participants were selected according to the following criteria based on the Eurostat definition of older person

(Eruostat, retrieved 1 June 2013): 1) living in one's own home, 2) frailty when walking, 3) instability and risk of falling, 4) feelings of insecurity, 5) having at least one chronic condition, 6) receiving medical treatment. An additional two inclusion criteria were: 7) normal cognitive status, 8) not depressed. The last two were determined by screening potential participants at the pre-evaluations using the *Mini-Mental State Examination* (MMSE) for cognitive status, and the *Geriatric Depression Scale* (GDS15) for mood and depression. The senior participants were selected and recruited through primary healthcare in Örebro Country Council. The research project was reviewed and approved by the Regional Review Board (20 June 2012). Given the nature and complexity of implementing and running test sites with an eHealth system in the making, the selection of users in this project was not based on random sampling but on the person's representativeness and preparedness to participate in their homes as a test site.

The fieldwork involved 20 people (including the older participants in the home trials, their relatives and healthcare professionals). The healthcare professionals were a doctor, a nurse, two occupational therapists and a physiotherapist. All healthcare professionals, except the nurse, were members of the EU-funded project.

The home trials took place between June 2013 and November 2014.

5.4.1.3 THE ASSISTIVE ROBOT (Paper 5)

Initially, several studies were conducted with potential end users to identify criteria for the home trial evaluations and to provide feedback on form, function, ethical concerns and aesthetic. The studies show that the acceptance of assistive robots does not depend on a single variable but rather on multiple variables such as: 1) individual characteristics, including, personal evaluations of one's requirements in relation to a specific social robot, perceived needs, wants, desires, understanding and functional status; 2) environmental variables. including the social and physical characteristics of the context of use; and 3) features and functionalities of the given robot, including ease of use, the design of the robot and the person-task fit (for further findings please see (Frennert, et al., 2013a).

It quickly became apparent when testing the design that many of the potential users had hearing and visual problems. As a result, multimodal interaction (touch screen, speech and gestures) was required in the design of the first prototype. As a complement to speech, the potential users wanted subtitles of what the robot said on the touch screen. A first prototype was tested in a lab (21 older people). The robot prototype did not work fully autonomously and therefore we used the Wizard of Oz technique in order to let the users test various features of the prototype. Engineers made the robot respond to the users input (simulated what the

robot would do if it worked autonomously) while the researchers observed the user's reactions. Some of the key findings included the older participant's preconceptions (rather negative) of robots. They were sceptical in the beginning but became more interested and explorative during the trials. They provided examples of how the robot could become more useful such as picking up things from the floor, alerting for emergencies and carrying heavy bags. It was interesting to note that the older participants blamed themselves and not the robot when something did not turn out as they expected. We noticed that the older participants expressed feelings of self-conscious about interacting with the robot since the difficulties they experienced were perceived as their inadequacies rather than due to robot's incapacity. For example, they could say, "Maybe it doesn't like me," and move closer to the robot, repeating in a louder voice the command over and over again before giving up and using the touch screen instead. The results indicate that a new dialogue was needed where users are provided with more clues and feedback on the robots intended actions and output. It became apparent in the user trials that the users adapted to the robot by trying to adapt their behaviour so that the robot understood them. Questions were raised among the researchers about how potential users would react in the long term if they had to adapt their behaviour to the robot and not the other way around.

The older participants were recruited through advertisements and word of mouth for the home trials of the assistive robot study (Paper 5). The guiding principles for participant selection were to find older people who were: (1) living on their own, (2) over the age of 75 years, (3) who had fallen sometime during the last two years or were afraid of falling. Recruitment criteria also included (4) possibility of setting up an Internet connection, (5) not having a pacemaker, (6) no high thresholds or small hallways, (7) willingness to remove carpets and move furniture, and (8) no usage of a walking aid inside the flat. Requirements 4-8 were required because of the ability of the robot. Once a potential participant was identified, further information was given about the study. The research team visited the participant in his/her home to assess if the participant fulfilled the criteria and if the home was suitable for the trials. A consent form was signed and all the participants were reassured that they could change their minds at any time and the robot would be removed no questions asked. Relatives were recruited based on availability and willingness.

Aliases are used to protect the privacy of the participants (Table 3).

Table 3: The participants in the home trials of the assistive robot

Participants	Gender	Born	Household	Number of interviews	Number of observations	Relatives
Mrs 1	Female	1925	Widow, single, small flat	4	5	A friend
Mrs 2	Female	1937	Widow, single, small flat	4	4	A son
Mrs 3	Female	1937	Widow, single, small flat	4	3	None
Mrs 4	Female	1939	Widow, single, small flat	4	4	A grandchild
Mrs 5	Female	1937	Widow, single, two-storey house	4	3	A daughter
Mrs 6	Female	1933	Widow, single, large flat	4	5	A daughter
Mrs 7	Female	1930	Widow, single, small flat	4	2	None

Two robot prototypes were installed in the homes of seven women (average age 81). Each trial lasted three weeks.

5.4.2 THE METHODS USED IN THE HOME TRIALS

In all the three settings (the robotic vacuum cleaners, the eHealth system, and the assistive robot) the data collection involved interviews and direct observations. The research draws on empirical data collected at three different stages: before the given robot was introduced; during the time the robot was installed and used at the participants' homes; and after the robot had been removed (in the case of the eHealth system and the assistive robot) (Fig. 8). The participants in Paper 5 (the assistive robot) were asked to keep a diary. The diary was meant to elicit what was important and significant to the participants regarding the robot.

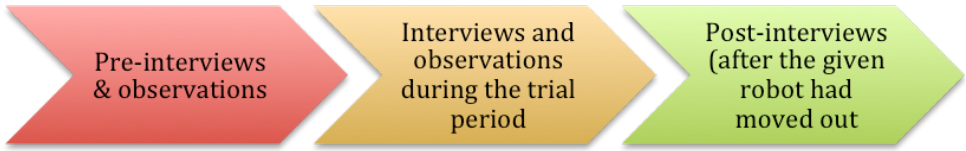


Figure 8: The three stages of data collection in the home trials

5.4.3 INTERVIEWS AND OBSERVATIONS

Interviews and field notes from the observations were the main tools, while the diaries were used as a supplement to validate the findings. Interviews and observations are dependent on the relationship between the researcher and the participant. Kiefer reports that communication skills are crucial when using qualitative methods such as interviews and participatory observations and that the individual researcher's communication skills are key to good research results. It is all about understanding the context from the participant's perspective, and to be able to interpret individual opinions and the individual's understanding of what is said (Eriksen, 2004; Helman, 2007; Kiefer, 2007; Lupton, 2012). Since the studies were conducted in the homes of older people, the interviews became a more informal meeting than if the person had been invited to the university for an interview or a laboratory experimental study. However, "a research interview is not a conversation between equal partners, because the researcher defines and controls the situation" (Kvale & Brinkmann, 2009, p. 3).

Research interviews are tools to gather research data, but Kiefer also highlights the importance of understanding the motivations and objectives older people have to participate in the research (Papers 3, 4 & 5) (Kiefer, 2007). Kiefer also highlights that it is important to let the older person be heard and to really listen to what he/she says and try to understand what he/she actually believes and wants to convey. Interviews were used to study how the selected older people explained their behaviour in relation to the domestication of a given type of robot. The observations, on the other hand, offered an opportunity to observe what the older people actually did with the robot. Roper and Shapira (1999) mention the following factors that should be considered in participant observation: time, place, social condition, language, proximity, transferability and distortion ("bias"). They highlight that carrying out participant observation requires that the researcher has enough time to capture what is happening. They also emphasise that there is a risk if the researcher spends too little time in the context that he/she might draw hasty conclusions to confirm his/her own preconceptions. In the home trials studies, the

participants were asked if the researcher's interpretations were correct and consistent with how the participants perceived their experiences.

5.4.3.1 DATA COLLECTION – INTERVIEWS (Papers 3, 4 & 5)

In the pre-interviews (before the robot was introduced) demographic data were gathered. The participants were also interviewed about their expectations of the given robot. The interviews were based on an interview protocol and were semi-structured allowing for new follow-up questions on what was said (Kvale & Brinkmann, 2009). Question such as, "Do you think there will be times when using the robot will be really useful for you? I would like you to tell me about that in as much detail as possible". In the follow-up questions the participant's own words were used to generate questions that elicited further information, such as, "You mentioned that you expect …; Could you tell me more about that? You mentioned that you expect…. Could you give me a specific example of that? You mentioned earlier that you ... Could you describe in detail what you expect?"

The subsequent interviews during the time the participants had the robot in their home were also modelled after ethnographic interviewing (Aspers, 2009) and followed predetermined topics such as the perceived usage and usefulness of the given robot, their views about how the given robot and other robots could be used in the future, other interest and activities related to everyday practices, technology usage and healthcare issues. The interpretations of what was said during the interviews were regularly summarised for the participants to enable them to clarify their responses and correct misconceptions.

The post-interviews (after the robot had been removed) focused on the participants' experience of partaking in the home trials, as well as on what was important and significant for them during the trials. The participants' diaries (in the case of the assistive robot and the robotic vacuum cleaners) were also a theme of discussion during the post-interview. Keeping a diary turned out to be a great means of eliciting what was important and significant to the participants about the given robot, as well as reminding them about specific events that they had documented in the diary but forgotten to mentioned during the interviews.

Relatives (in the cases of the assistive robot and eHealth system) and caregivers (caregivers were only involved in the case of the eHealth system) were interviewed regarding their perceptions of the usefulness of the given robot for the older person and their experience of the given robot (in the case of the eHealth system and the assistive robot). The older participants were interviewed up to six times (typically four times). Most of the interviews with the older participants lasted between 45 and 95 minutes while those with caregivers and relatives were shorter (30-45 minutes).

5.4.3.2 DATA COLLECTION – OBSERVATIONS (Papers 3, 4 & 5)

Observations were conducted 2 to 5 times at each test site. Observations were carried out before the given robot "moved" into the home of the older participant and several times after the it had moved in. The observations included walk-through tours in the older people's home modelled on an ethnographic method called *Technology Biography* (Blythe, Monk, & Park, 2002).

The participants were also observed during the course of their daily activities for a couple of hours each; notes were taken about the interaction with the robot and which functionalities were used. Occasionally, questions were asked to clarify what the participant was doing. The participants were asked to "walk through" with the robot and its interface to demonstrate the functionalities and explain how they responded to its feedback and how they used the robot. The case study design has been participatory in the sense that I partook in the instalment and set-up of the robots in the participant's homes. I was also involved and assisted in introducing the robot to the older participants and observed when the robot was used in the homes. Working with the set-up and instalment of the robots incorporated frequent discussions about the robot with the participant and their relatives, as well as observational work. As a result, the opportunity arose to observe how the usage of the robots evolved over time.

The observations lasted between 100 to 180 minutes each time.

5.4.4 DATA PROCESSING AND ANALYSIS

All the data were analysed using qualitative coding technics (Charmaz, 2006; Graneheim & Lundman, 2004). The data analysis moved between the details of specific events, situations and participants recorded in the data and the theoretical proposition of domestication and social practice theory. All the interviews were listened to repeatedly. The transcripts were read and re-read. Statements and field notes of relevance to the study aim were identified and sorted into meaning units (Graneheim & Lundman, 2004). The meaning unites were condensed to a descriptive level and the condensed meaning units were abstracted and coded. The codes were compared within each household and between households, searching for patterns and contradictions within one household and between all the households for each case (Graneheim & Lundman, 2004). *NVivo* was used as a tool to assist the qualitative analysis but "manual methods" was also used such as writing extracts from the field notes and interview transcripts on post-it notes and making large mind maps and flow charts of the post-it notes. Furthermore, chronological summaries were written close to the data for every participant, which included lengthy quotes from them and field notes. Photos, digital maps and audio files were also collected and stored. The summary for each participant was

analysed and patterns, themes and contradictions were searched for within the summary and thereafter between all the summaries for one given robot as well as between the summaries for all the three different robots. The analysis was iterative and involved a "bottom up" investigation from the coded data (from interviews, observations and diaries) and a "top down" comparison from research questions and the framework of domestication.

5.5 METHODOLOGICAL CONSIDERATIONS

As with any research strategy, numerous problems were encountered. When doing interviews and participatory observation, I as a researcher had to reflect on my role. By being in the participants' home, they might feel intimated or want to impress me. My presence could affect the outcome. The participants might alter their behaviour to match what they think I am looking for or how I want them to behave. Just by being "researched" or studied might alter the participant's behaviour. This phenomenon is usually referred to as the "Hawthorne effect" (Mayo, 1949). But as the research was anchored in real-life settings, loads of time were spent in other peoples' homes. As a consequence, I had to adapt to the participant's habits and routines. I met their friends and family, and I was involved in numerous discussions about robots. It has been very time consuming and I have gathered an enormous amount of data, which sometimes has felt too overwhelming to analyse. On my own I have been the instrument for collecting and analysing the data. It could thus be criticised that the interpretation of the data is based on my subjective perspective. However, the decisions on which methods to use and the findings were scrutinised in ongoing dialogues with my supervisors and anonymous reviewers (for the articles and conference proceedings). The participants have also been involved in an ongoing dialogue (member-checking) (Cresswell, 2003: 199) about the interpretations and if they found the findings recognisable. Moreover, some of the methods were used in other European countries, which had similar aims and findings.

Since the fieldwork was carried out in two EU-funded project, the research strategy had to be adapted to fit into the frame of these projects. The criteria for selecting the participants were decided within the projects. In addition, because the projects involved a complex eHealth system and an assistive robot, the participants were older people who wanted to take part in the home trials, not a randomised sample. The research strategy was chosen in order to collect real-world knowledge about how a number of older people domesticated three different kinds of robots. The findings should therefore not be judged as representative for all persons above 65 years of age.

5.6 ETHICAL CONSIDERATIONS

An ethical vetting board approved the three cases in which the fieldwork was conducted separately. All participants signed an informed consent form and on several occasions were reassured that they could change their mind at any time and that the robot would be removed without any questions or need for explanation. In the consent form, they were assured privacy and anonymity. Aliases have been used for the participants in the publications and in this thesis to protect their anonymity and privacy. They have also been assured that the robots would not cause any harm or danger to the participants.

There was one dropout in the eHealth project. The participant could not continue due to health issues. In the robotic vacuum cleaner project, eight out of ten participants asked if they could keep the vacuum cleaner after the study was over. The initial plan was not to let them do so. However, the robots had been incorporated into their everyday structures and routines and we thus decided that they could keep them.

6 SUMMARY OF INCLUDED RESEARCH PAPERS

This thesis builds on five research papers that provide insight into how older people construct meaning, use or reject robots in their everyday life (Fig. 9). This chapter provides a brief summary of each research paper.

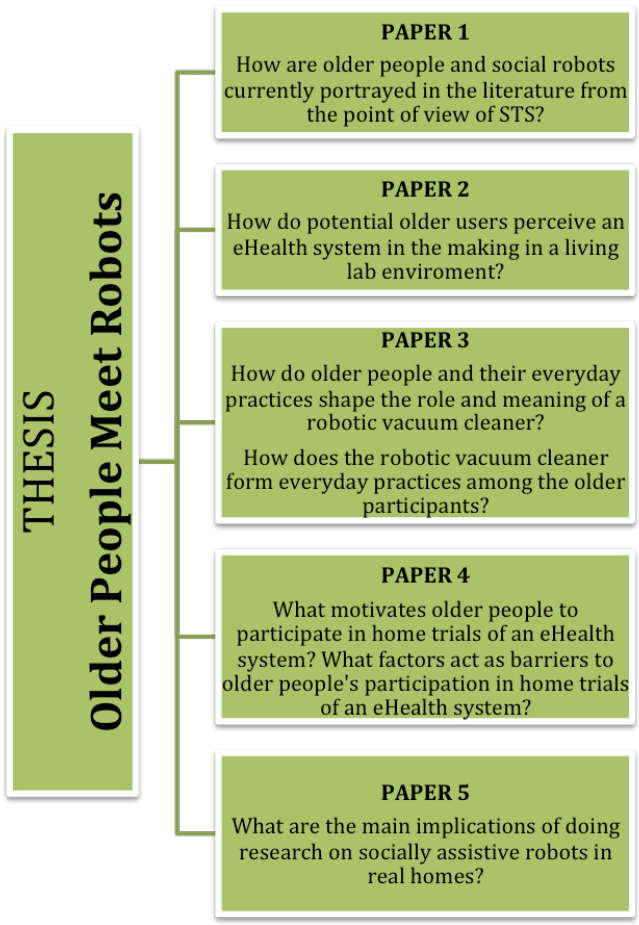


Figure 9: Overview of the research questions in the research Papers 1-5

6.1 PAPER I: Review: Seven Matters of Concern of Social Robots and Older People

Paper 1 presents a literature review in the area of social robots in relation to older people. It provides the context for the research. The literature review was guided by the framework of STS (Hackett et al., 2008) in which assumptions regarding technology and science as social constructions are dominant. The paper discusses the configuration of social robotics in regards to older people from a multidirectional view inspired by Bijker and co-workers (Bijker et al., 1989) and Latour (Latour, 2005). The findings of Paper 1 focus on seven matters of concern: (1) role of robots in older people's life, (2) factors affecting older people's acceptance of robots, (3) lack of mutual inspiration in the development of robots for older people, (4) robot aesthetics, (5) ethical implications of using robots in caring for older people, (6) robotic research methodology, (7) technical determinism versus social construction of social robots; as these 7 were most prevalent.

The review ended up being a call to challenge the technological-deterministic approach that characterises mainstream social robotic research. The paper argues that social robots in relationship to older people are a social construction. It raises five important questions: What will happen when social robots move out of the lab and into our lives? Can robots as companions be seen as a sign of dissatisfaction in the personal relationships we have today? Why are older people and children configured alike by roboticists? Can social robots or geminoids be used as "human probes"? How is the knowledge of robots translated, transformed and modified in the field of social robotics? What, if anything, should be done?

The results from the literature review revealed that there is a need to redefine stereotypes of older people in order to fairly represent who they are. We found a clear need for studies on how older people are configured and represented as technology users. There is also a need for participatory design that includes the users at the early stage of social robot design. By doing so, the identification of influencing technological changes and their social consequences will be more apparent early on for the engineers, the designers and the users. High-quality research, particularly longitudinal, is needed. More studies are needed of older people's perceptions of the positive and negative long-term effects of social robots. It is desirable to have an understanding of how the different types of social robots will inhibit or enhance older people's abilities or well-being

6.2 PAPER 2: Elderly People's Perceptions of a Telehealthcare System: Relative Advantage, Compatibility, Complexity and Observability

Paper 2 investigates older people's perceptions of the eHealth system in a lab setting. The study was guided by Rogers' theory of diffusion of innovations (Rogers, 1995). The methodology consisted of a pre-interview, the staging of scenarios of specific situations in which the system can be used, and a post-interview. The data analysis was deductive and guided by Rogers' framework of perceived attributes (relative advantage, compatibility, complexity and observability) of an innovation that influences the individual's decision to adopt or reject an innovation.

The findings from the evaluation of a telehealthcare system (GiraffPlus) demonstrate: 1) That elderly participants were in favour of face-to-face interaction with family and friends and they could imagine communicating with healthcare professionals via the telepresence robot. 2) The participants expressed preferences for as few devices as possible and the ability to integrate functions into devices they already have. 3) The non-intrusive sensors were perceived as safe and reassuring, while the self-monitoring equipment was perceived as a way to be in control of one's health. The participants mentioned, though, that such a system may cause anxiety and stress, especially if they worry about the results and cannot contact a healthcare professional immediately. 4) Confidence in their current healthcare was high when it came to storage of personal data, but the participants felt ambivalent about being monitored. They could imagine being monitored as a temporary solution to identify health-related problems or when de-hospitalised but not on a daily basis in their everyday lives. 5) A common opinion was that a telehealthcare system and social robots should be considered more of an addition rather than a substitute for the current healthcare system and other human help.

Our research implies that the relative advantage of the GiraffPlus system is dependent on how well integrated the system becomes in the current healthcare system. The potential relative advantage expressed by the participants is the wish for more contact with healthcare professionals.

6.3 PAPER 3: The Domestication of Robotic Vacuum Cleaners Among Seniors

Paper 3 explores how older people construct meaning, use and makes sense of an innovation that is already on the market (robotic vacuum cleaners). The aims of the paper were: (a) to explore how older people and their practices shape the role of the robotic vacuum cleaner, (b) to explore how the robotic vacuum cleaner forms everyday practice among older people.

The findings reveal that the older people used the robots in an effort to change their everyday life to suit them better through prioritisation and negotiation between activities. The robotic vacuum cleaners gave birth to new combinations and configurations of doing; for example, they transformed the practice of vacuum cleaning, and its symbolic value was constantly negotiated. The technology adoption process turned out to be filled with complexity and ambivalence. Through the analysis we identified three interrelating but noticeable themes: (1) Older people are enthusiastic about adopting the technology (robotic vacuum cleaner) because they perceive it as being beneficial in the prioritisation and negotiation of activities in everyday practices. (2) The adoption of robotic vacuum cleaners is a process characterised by complexity and ambivalence, which is affected by societal norms. These include activities older people consider to be normal in everyday practice: in this case, house hygiene. (3) Robotic vacuum cleaners transform everyday practice and their symbolic meaning is constantly negotiated. Robotic vacuum cleaners are adopted not just because they are functional and useful, but because they are a means by which older people can cope with everyday life and conserve physical energy for more meaningful activities, such as meeting friends and spending time on hobbies. We also use the conceptual framework of domestication (Silverstone & Hirsh, 2003) to describe the logic that binds the themes together in the process of robotic vacuum cleaners becoming part of everyday life among the participants. The study demonstrates that usage of robotic vacuum cleaners develops over time, to a certain extent fitting redefined expectations. It shows that initial attitudes to technology change over time as well, and that attitudes from others – externalisation – affect the domestication process. The results suggest that the autonomy of the robot made it possible for the older people to carry out other activities while the robot cleaned, but it also gave them a feeling of loss of control. Understanding the machine seemed to be of minor importance compared to the feedback from the machine that it was doing its job, in this case cleaning the home.

6.4 PAPER 4: What Happens When Seniors Participate in New eHealth Schemes?

In this paper, we explore how older people construct meaning about an eHealth system through their interpretation of participating in eHealth system home trials (GiraffPlus). The aim of the paper was to describe and analyse: (a) What motivates older people to participate in home trials of an eHealth system? (b) What factors act as barriers to the participation in home trials of an eHealth system among older people?

During the analysis of the data it became apparent that the older participants would like to differentiate themselves from other "old people" and that their relatives often used "they" as if their older relative belonged to the "old people" group. Children and grandchildren often talked about their older relative as a technophobe with huge problems in handling innovations and new technologies. Older people were talked about as if they belonged to a normative convention. In this regard labels such as "technophobes", "backward" and "slow" were the norm. It is interesting to note that the older participants also used the same labelling when talking about "other older people". We identified three interrelated but analytically distinguishable themes related to what motivates the older participants to participate in the home trials of an eHealth system: (1) differentiating themselves from other older people, (2) something new/breaking routines, and (3) critique of the current welfare system/ belief that eHealth systems will be part of future care.

6.5 PAPER 5: Case report – Implications of Doing Research on Socially Assistive Robots in Real Homes

Paper 5 explores the main implications of doing research on socially assistive robots in real homes and pays particular attention to a specific empirical case in which seven older women tried out a robot in their own homes for three weeks. The specific aims of the paper were to explore older people's day-to-day experiences of having a robot at home and contrasting our findings with existing literature on socially assistive robots and home trials in order to understand research design challenges that need to be considered when planning and conducting home trials.

The findings revealed a discrepancy between the attributed abilities and actual abilities of the assistive robot. An imbalance was also noted in what the older participants perceived as useful to prolong independent living, versus the assistive robot's actual functionalities, which are geared toward entertainment and communication functions that are already accessible from an ordinary computer and other digital aids. The analysis also revealed that, similar to the developers, the participants cultivated an image of other older people as weaker and lonelier than themselves and in need of robots; they held a great belief in the promise of future robots. The participant drew on their experience of other technologies such as computers, televisions and mobile phones, which have all improved and become more user-friendly during their lifetime. The imaginings, expectations and visions of future robots affected what the participants said about the robot. A discrepancy could be seen between how they talked about the robot and their actual usage of the robot during the home trials. Initially the robot was used frequently. However, evidence from the observations shows clearly that over time, the participants went back to ordinary routines, which did not include the robot. As such, the robot did not become a part of everyday practice but was used because of the participants' sense of commitment to continue participating in the home trials. The findings also revealed that the results from the evaluation are dependent on the design of the robot, how the robot communicates its behaviour, the fit between the robot and the home, as well as the research design. The results of the evaluation could have been different if these factors were different. These are referred to as internal factors: Factors that are affected by the project and that can be influenced and changed by the researchers involved. The analysis also shows that factors such as other artefacts and the participants' motivation to participate affect the results of the evaluation and the meaning given to the robot. These factors are referred as external factors: Factors that are not easily influenced and changed by the researchers involved, but that have to be considered when developing and evaluating a robot.

6.6 SUMMARY AND MAIN RESULTS FOR EACH APPENDED PAPER

This section presents an overview of the appended research papers, highlighting the purpose, questions, methods and the main results for each (Table 4).

Table 4: Summary of the appended papers

	Purpose	Question/s	Methods	Main results
Paper 1	To reflect on how social robots and older people are portrayed and described in the field of social robotics from the point of view of STS.	How are older people and social robots currently portrayed in the literature from the point of view of STS?	Literature review	Findings indicate that older people are implicated but not present in the development of robots and that their matters of concern are not identified in the design process. Instead they are ascribed general needs of social robots due to societal changes such as aging demographics and demands from the healthcare industry.
Paper 2	To investigate older people's perceptions of a eHealth system in a lab setting.	How do potential older users perceive an eHealth system in the making?	Interviews Observations Scenarios	Results from the lab tests suggest that the system needs to be customised to the individual's need; the system has to be reliable, easy to use, and consisting of as few familiar parts as possible; training and educational support needs to be offered throughout the usage of the eHealth system. The results imply that the relative advantage of the GiraffPlus system is dependent on how well integrated the system becomes in the current healthcare system. The potential relative advantage expressed by the participants is the wish for more contact with healthcare professionals.
Paper 3	To explore how older people construct meaning, use and make sense of robotic vacuum cleaners in their own homes.	How do older people and their everyday practices shape the role and meaning of a robotic vacuum cleaner? How does the robotic vacuum cleaner form everyday practices among the older participants?	Case study Interviews Diaries Observations Questionnaires	The results show that the different dimensions in the process of domestication of robotic vacuum cleaners by seniors appeared concurrently with time. The results indicate that the process of domestication is characterised by fitting expectations and *redefining expectations* to practical and symbolic values. The older individuals' *self-perceived technology competence* had an initial effect on the appropriation of the robotic vacuum cleaners. However, after the older people had incorporated the robotic vacuum cleaners into their cleaning practice, no differences were perceived between "technophobes" and "technophiles". The domestication of the robotic vacuum cleaner emerged, in practice, when the older users formed a meaningful relationship with it.

Paper 4	To explore how older people construct meaning about an eHealth system through their interpretation of participating in home trials with an eHealth system (GiraffPlus).	What motivates older people to participate in home trials of an eHealth system? What factors act as barriers to older people's participation in home trials of an eHealth system?	Case study Interviews Observations	Findings indicate that although the older participants chose to participate in the home trials, the choice itself was configured by the stigmatisation of older people as technophobes, fear of "falling behind" and the association of technology with youth, the future and being up-to-date. Being a participant in home trials of an eHealth system became an identity of its own, representing a forward thinking and contemporary person who embraced changes and new technology.
Paper 5	To offer an insight into the experience of seven older users having a robot in the making in their homes for three weeks, and to offer insights into the main implications of doing home trials.	What are the main implications of doing research on socially assistive robots in real homes?	Case study Interviews Diaries Observations	The participants expected the robot to be like an artificial companion and butler. The actual abilities of the robot did not meet their high expectations. However, the participants still held a strong belief in future robots becoming more effective, cheaper and smaller. A discrepancy could be seen between how they talked about the given robot and their actual usages of the robot during the home trials. Initially the robot was used frequently. However, evidence from the observations shows clearly that over time, the participant went back to ordinary routines, which did not, include the robot. The main implication of doing home trials is that a single study will not produce conclusive findings. However, by converging and contrasting findings from multiple studies, conclusions can be reached. Internal factors such as the design of the robot, the feedback and visual clues provided by the robot to communicate its behaviour, the fit between the robot and the home, and the research design will affect the meaning the participants give to the robot. How people make sense of and use a robot is also dependent on other competing artefacts and their motivation to participate in trials (external factors). The internal factors are something researchers can influence and change while the external factors are harder to influence but should be considered when developing and evaluating a robot.

7 RESULTS AND COMMENTS

The development of robots does not exist in isolation. All three robots studied in the fieldwork have been developed with a certain aim and usage in mind (script); the participants have translated the script and negotiated the robots' meaning and potential usage in their everyday life (de-scription) (Akrich, 1992, p. 209). The process of constructing meaning, use and making sense of robots at home in the everyday life practices of the older participants was reciprocal (between the user and the robot) as well as technical and social. The main results of the five studies are presented in this chapter. The heading of each section is the paper's research question. The first part of the section provides a summary of the paper. The last part comments on what was learnt.

7.1 RQ 1: How are older people and social robots currently portrayed in the literature from the point of view of Science and Technology Studies?

The literature review in Paper 1 shows that the current developments of social robots are patterned with strong paternalistic values. They favour a reductionist approach, which reduces older people's full capabilities to their impairments. There appears to be an overestimation of the relationship between chronological age and ability with a tendency to treat older people as a homogenous group. Absences were noticed in the ability and understanding of the developers to include older people in the development of robots. Insufficient structures and knowledge for learning lessons from the user involvement were also noticed.

Two main configurations of robots for older people were identified: robots that were ascribed the role of taking care of older people, and robots that were ascribed the role of being taken care of by older people. In the first case older people were ascribed the role of being in need of care by robots because of their cognitive and physical limitations. The hypothesis was that older people would be less dependent on other people and thereby more independent and empowered. In the second case, older people were ascribed the role of being a caretaker of the

robot. The hypothesis here was that it would increase the older people's feeling of meaningfulness. Insufficient evidence was found to support the first hypothesis (robots as caretakers); some inconclusive evidence was found to support the second hypothesis (older people as caretakers). The results of the literature review highlight that robot developments can benefit from involving older people in the design process. By doing so, they can acquire knowledge and skills to articulate their views on robots, and the developers can acquire an increased understanding of older people as robot users. This in turn can help to ensure that the robotic solution better meets older people's needs, wants and desires (Susanne Frennert & Östlund, 2014b).

Paper 1 acknowledges and adds to our understanding that age stereotypes still flourish in the literature on older people in relation to robots. It confirms research results on technologies made for older people (Mort, Roberts, & Callen, 2013; Neven, 2010; Peine et al., 2015; Peine et al., 2014; Östlund, Olander, Jonsson, & Frennert, 2015). The stereotypes of older people associate old age with loneliness, illness, weakness, cognitive and physical limitations and situate older people as housebound.

7.2 RQ 2: How do potential older users perceive an eHealth system in the making?

Paper 2 presents findings from older people's involvement in evaluating an eHealth system in the making. The evaluations took place in a lab environment and involved eleven older people. The development team ascribed to the eHealth system the role of preventing isolation and increasing social interaction with relatives and caregivers. The eHealth system was configured to prevent health risks by early detection and to help the user self-manage her or his status of health and alert others in case of emergencies. The older participants subscribed to the role of the eHealth system as a system to monitor and control their health status if they were ill or had just came home from a hospital stay. However, half of the participants did not perceive the system as something for them, at that moment in time, but for other older people. As such, the system represents to them fragility and illness. The system was perceived as an addition to the current healthcare system. It was ascribed the role of being an around-the-clock opportunity to contact healthcare professionals, and an opportunity to receive reliable information about their health condition and treatment options. The participants stated that they would like reminders to do their daily exercise and to take their medication. There was ambivalence about what the system should be monitoring. The participants did not want it to micromanage how much time they spent in front the TV or in the shower. However, they would like the system to call for help in case of an

emergency. The paradox here lies in that the system needs to monitor all the time in order to identify normal activity patterns and when they change. Some of the participants raised fear of losing human contact because of the eHealth systems. They perceived the eHealth system as easy to use and emphasised that it should consist of as few devices as possible. The relative advantages were perceived to depend on how well integrated the eHealth system became into the current healthcare system (Susanne Frennert et al., 2013).

Paper 2, adds to our understanding that older people take on a role when trying out the system in a lab environment. Some participants evaluated the system based on their perception of who they are and on how they would like to be perceived by others. Others enrolled in the research project and ascribed to themselves the role of representing other older people who are more fragile and ill. As such, they evaluated the system on the basis of stereotypes of older people that are very similar to the ones identified in Paper 1.

7.3 RQ 3: How do older people and their everyday practices shape the role and meaning of a robotic vacuum cleaner? How does the robotic vacuum cleaner form everyday practices among the older participants?

Paper 3 revealed that the way older participants constructed meaning, used and made sense of the robotic vacuum cleaner initially involved negations and for one, resistance. The participants read the manuals, tested the robotic cleaners and evaluated them. Fears were raised about the vacuum cleaner harming the furniture and carpets. They disliked their lack of control over where the robotic cleaner vacuumed. But as the dustbins filled up and the carpets got clean, the robotic vacuum cleaner was used more and more. There was no evidence that the robot damaged the furniture and carpets; letting it vacuum one room at a time solved the issue of lack of control. The robotic vacuum cleaners were first regarded as a supplement to the ordinary vacuum cleaners, but after using the robots several times a week, the opposite occurred. Initially the robots were placed in the spotlight as a cognitive reminder to use them and as a focal point of discussions. But as they became part of everyday cleaning routines, the charging stations were moved to an easily accessible but less obvious location. The vacuum cleaning robot become a means of making everyday life easier by carrying out the tedious vacuuming while one was busy with other more valued activities or spending time outside the home. It freed up time and energy for more meaningful activities. This

was the role and meaning ascribed to the robotic vacuum cleaner for most of the participants. One of the participants returned the vacuum cleaner. He preferred doing the vacuuming himself with his ordinary vacuum cleaner because this was an important part of his daily physical exercise; doing the vacuuming himself had a symbolic dimension. Another participant domesticated the vacuum cleaner but de-domesticated it when the municipality offered her cleaning help. But for most, the robotic vacuum cleaner became domesticated and the participants did not want to return it when the study was over.

Another interesting finding was the way in which the participants' self-perceived technology competence initially affected the appropriation of the robotic vacuum cleaner. Those who considered themselves as technophobes needed more support and encouragement from friends and the research team, while those who considered themselves as technophiles explored and used the robotic vacuum cleaners more independently. However, after the robots had become integrated into the participants' everyday cleaning practices, no difference was noticed (Susanne Frennert & Östlund, 2014a).

Paper 3 adds to our understanding that older people do domesticate robots if the robots make sense to them. The observation of the reversal in the participants' view of the robot as a supplement confirms that the domestication of a robot is a gradual process in which the role of the robot is translated, negotiated and transformed, as well as how it modifies current practices (Lie & Sørensen, 1996; Shove et al., 2012; Sørensen et al., 2000). The robotic vacuum cleaners were intended for the general population. As such, they were not associated with old age.

The results from Paper 3 indicate that the development of robotic solutions needs to focus on fitting technology for older people so that it supports and maintains their current practices. The solutions should also contribute to transforming everyday practices in order to sustain everyday life as much as possible, and to fit the wants and desires of older people without being associated with stereotypic characteristics of older people.

7.4 RQ 4: What motivates older people to participate in home trials of an eHealth system? What factors act as barriers to older people's participation in home trials of an eHealth system?

The findings of Paper 4 reveal that the older participants' motivation to participate in the home trials was because the eHealth system represented something new. By partaking in the research project they differentiated themselves from other old people and had the chance to partake in something new and existing. As a result, everyday routines were changed and improved. The everyday routines were positively affected by the constant interaction with the research team and by friends and family. Being part of a research project on emerging technologies became valuable for the participants, was admired by relatives, friends and others and attracted a lot of attention. As a result, the social interactions with others increased during the time of the trials. The older participants ascribed the eHealth system the meaning of increased social interaction and the feeling of increased safety. Over time, it became apparent that the participants did not try out the system in their homes because they thought they needed an eHealth system but because they believed they could represent and add valuable input about other older people who they believed could be in need of such system. The findings were similar in Paper 5.

The domestication process of the eHealth system (Paper 4) shows a struggle and resistance between different practices such as in the professionals' everyday care practice, the relatives' current ways of communicating with their older relative, and the older people's everyday life. It was difficult for the relatives to incorporate the robot into their communication practices. This was because the robot could not be accessed from a smartphone or a tablet, which were the technologies they mainly used to communicate with their older relatives. As a result, the telepresence robot was rarely used. The prospective older users were configured as passive receivers. The older participants could only receive calls and call one predetermined number. They could not choose if they wanted to be visible to the caller or not. Nor did they have access to the data collected by the sensors. All these issues caused tensions and restricted the older participants' usage of the robot and caused barriers. The aim of the sensors was to collect objective measurements to prevent health deterioration; the caregivers, however, could not make sense of the data and did not know how to use it in their everyday care practice. The kind of data collected was not something they had had access to previously and they found it difficult to incorporate and interpret it in their care relationship with the older participants. The project participants were not their ordinary patients but older people with some health concerns who normally saw a

doctor a couple of times a year. Some of the older participants did have up to eight home visits a day from homecare staff who helped them get dressed, brought meals and did the cleaning. Unfortunately, the homecare staffs were not involved in the eHealth project and the ordinary care practice thus ran parallel with the eHealth practice. As a result, the older participants, the caregivers (who were also participants in the EU project) and the relatives were fitted into the practice of the eHealth system instead of the eHealth system being fitted into the everyday care practice of the older participants (Susanne Frennert & Östlund, 2015).

Paper 4 adds to our understanding that older peoples' motivations to participate in home trials of emerging solutions are related to an interest in breaking routines and being part of something new. They wish to differentiate themselves from "other old people" and/ or to criticise the current healthcare system and belief in technology as part of future care systems. Although the participants did not subscribe to the utility of the system for themselves, they were resolved to ascribe to themselves the role of representing other older people who they believed were in need of such a robotic solution. As such, they took part in cultivating the stereotypes of old age. The findings in Paper 4 confirm past research that the success or failure of a robotic solution is dependent on the network of other people and the technology in which the eHealth system and the older person are situated (Forlizzi, 2008; Sung, Grinter, & Christensen, 2010). A robotic solution cannot be considered as an isolated artefact but as part of a socio-technical system. The robotic solution needs to be integrated and compatible with the technology cluster (in this case smartphones and tablets) and the care practices that are currently used. Under the guise of good intention, the telepresence robot was designed to be easy to use by limiting the older users' interaction with the system by allowing they to only press a red or green button (the green button to make a pre-programmed number call or to take a call; the red button to disengage the caller). However, although the robot was perceived as being easy to use, the limited utility options were perceived as a barrier and restricted the older participants' domestication of the eHealth system. Further findings from the paper indicate that valuable insights can be gained by involving older people in home trials, but that the strict structures of funding agreements and project time frames can hinder the assimilation of the users' input. These findings are also confirmed in Paper 5.

7.5 RQ 5: What are the main implications of doing research on socially assistive robots in real homes?

Paper 5 illustrates that there are a lot of issues to consider when evaluating robots in real homes. Robots exist in all shapes and forms, and with different kind

of behaviours. The choices made regarding the design of the robot, how the robot communicates its behaviour, the fit between the home and the robot, and the methods used for the evaluation will have a major impact on the findings. People will react differently to a robot depending on its behaviour and its appearance. Different methods will address different issues: in questionnaires researchers can decide which questions to ask and which not to ask; during observations, researchers can observe how the participant uses the robot but the researcher's presence might affect the participant's behaviour; data logs can be used to measure how often and for how long robot functionalities are used but the data log will not show why a participant uses a robot. Participants can have competing artefacts that they prefer to use and compare the robot functionalities to. Their individual motivations to participate in the home trials also have an impact on the meaning they assign a robot.

The findings indicate a discrepancy between the actual abilities and the attributed abilities of the robot. The actual abilities of the robot had shortcomings. For example, the robot had an arm that could pick objects up from the floor so the older people would not have to bend over and risk falling. However, the pick-up procedure required the participant to stand two metres in front of the robot and execute a special pointing gesture. The robot had to notice and recognise the gesture and arduously position itself before picking the object up. The object had to be placed in a special position in an open space for the robot to be able to "see" it (Fig. 10) and the object also had to be of a specific size. The whole procedure was tedious and often failed. As such, the "pick up function" did not fit into the older participants' everyday routines and was too failure prone and challenging compared to using a manual gripper, which most of the participants were already familiar with. They also mentioned in the initial interviews and focus groups that they often dropped small things like earrings, hearing aids and cutlery, which the robot could not pick up anyway. The participants in the home trials reported that the objects that were problematic to pick up often disappeared under furniture. In such instances, the robot could not assist them at all. The aim of the robot, to prevent falls, was not realised since the "pick-up function" did not correspond to the daily "drop-objects-and-pick-up" practice of older people.

Figure 10: The assistive robot picking up an object from the floor

The robot had sensors to detect if someone had fallen. When this happened, the robot would make an emergency call. However, the robot had to detect the person, and to do so, the person had to fall about two metres in front of it. This procedure did not fit into the "reality" of older people. The probability of an older person falling in front of the robot is low, making its ability to detect falls highly questionable. In this regard, technical determinism was noted. There was a fascination among the participants in regards to the robot's ability to pick things up and detect human bodies. But in the everyday practices of the older participants, these functionalities were not practical and helpful in the current, primitive technological state of the robot. Even so, when they talked about the robot, most of them still attributed to it the ability to detect falls and pick up objects from the floor. This could be the result of their belief and trust in future robots being intertwined in how they talked about the robot and its functionalities, or it could be the result of them wanting to please us by telling us what they thought we wanted to hear. The observations, though, revealed that for a majority of the participants the robot was merely a distraction in everyday routines; they initially had high hopes for the robot to be an aid in everyday life but after a couple of days the engagement and enthusiasm faded (novelty effect) and they went back into their everyday structures and routines. They dutifully used the robot once in a while but it did not, for the most part, become domesticated. Instead it ran parallel with their everyday practice and was used occasionally because of their perceived obligation to test the robot at home. Similar results can be seen in Paper 4.

Paper 5 adds to our understanding of the complexity of user involvement. As in Paper 4, the older participants ascribed to themselves the role of trying out the robot at home. The meaning they ascribed to their role as participants affected the domestication process. For example, one participant (Mrs 3, 78 years old), who is a retired engineer, ascribed to herself the role of an "expert" and an evaluator. Mrs 3 made it her task to systematically test the robot in all possible kinds of scenarios and came up with detailed protocols on the strengths and weaknesses of the robot's functionality. As such, she did not ascribe to the robot the meaning of becoming part of her everyday practices and routines. Instead she evaluated the robot based on her understanding of mechanical engineering and of "other old people" who she thought might need a robot. During the time she had the robot, a new practice emerged that was grounded in her expertise and former work as an engineer: that of evaluating and testing a robot in the making. The findings from Paper 5 also illustrate that what the participants said and what they did differed. When they talked about the robot they often repeated the grand visions of robots as being configured as artificial helpers and companions. Even though the observations and diaries revealed that the robots in the making did not become integrated into everyday life for most of them, the participants still held a great belief in future robots and attributed abilities to the robot they tried out that were associated with efficiency and companionship.

Our results show that even though potential older users were involved in the evaluation of a socially assistive robot, the older participants cultivated the image of other older, weaker and lonelier people than themselves as being in need of robots and held a great belief in the promise of future robots. Crucially, people's motivation for participating and their imaginings, expectations and visions of future robots affect how participants talk about robots. These factors have vital implications for how data from home trials can be interpreted.

8 DISCUSSION

This thesis presents my research on how older people construct meaning, use and makes sense of robots. Such research calls for an "interpretive flexibility" of robots in relationship to older people. It also calls for recognising the relationship between the social context in which both the older participants and the emerging robotic solutions exist and the consequences thereof. Previous chapters show that the construction of meaning and the practical efforts to integrate a robot into everyday practices need to be studied in real-life contexts. The previous chapters also show that an understanding of the domestication process is of great importance and can contribute to a given robot's eventual success or failure. Knowledge about the tensions and contradictions surrounding the domestication of a robot is also useful in future design processes as well, and can offer new ways of thinking in developing and evaluating robots.

8.1 THE CONFIGURATION OF "THE USER" AND OLDER PEOPLE

The first and most apparent difficulty is the matter of involvement of older people and their impact on the development. Over the years, several ISO standards (ISO 26000:2010; ISO 26800:2011; ISO 27500) have been developed to ensure the involvement of users and that consideration be taken of the situations and tasks at hand (ISO, 2010, 2011, 2016). However, as can been seen in the results from the appended Papers (2, 4 & 5), older people's involvement per se does not equal the demise of old age related stereotypes. On the contrary, the participants in the research projects on emerging robotic solutions subscribed to the traditional configuration of the user (as in the case of the two independent living robotic solutions) as representing older more fragile people than themselves. The underlying hypothesis in the two research projects (the eHealth system and the assistive robot) was that new technologies need to be introduced before an older individual is too "sick or fragile" to be able to learn how to use it. But in the research presented here, introducing a new technology that does not fit into any current practices turned out to be difficult. Thus, the findings reported in this thesis indicate that a technology needs to make sense for the participants in their everyday life practices.

Tornstam (2005) argues:

> . . . many of us have a tendency to define the present time of life as the best one and as normative for how the rest of life should be. We can understand otherwise in retrospect, but have difficulty doing so in prospect.
>
> (Tornstam, 2005, p. 1)

Tornstam's quote sums up the tendency of people to be in the moment and the difficulties of imagining how life can change as one gets older. It is thus very easy to resolve to stereotypes of old age as they spread across the media, through stories and hearsay. The older participants in the case studies found it hard to imagine how to use a robotic solution that they did not need or desire at the moment but might need in the future. They thus resolved to ascribe to themselves the role of representing other older people who they believed were in need of such robotic solutions. In that regard they cultivated the stereotype of older people as lonely, ill, fragile and weak. As a consequence, the domestication of the robotic independent living solutions encountered barriers because the solutions were not superior or did not support the older people testing them, and so could not sustain or transform their current practices. However, the older participants supported the narrative of the robotic solutions as independent living technologies and could easily interpret the benefits of the robotic solutions, although not for themselves but for other older people.

There is a gap between the scenarios of use and the older participants' actual circumstances. In the case of the robotic vacuum cleaners, it was of interesting to note that the potential users were not configured as older people and that the older participants did not subscribe to the role of representing other older people but instead they represented themselves and their own wants, desires and needs. This highlights the impact on the initial configuration of the user. The results from the case studies indicate that if a robot already has a prescribed meaning, the participants will subscribe to the configuration of the intended user during home trials, at least in how they talk about the robot. However, observations of the context of use can give valuable insights into how a robot is used (the users' subscription or de-inscription) and how the robot should be re-designed to become better integrated into the older person's everyday life. If the participants are testing a robot in the making, the materiality and physical properties of the robot affect how the potential user perceives a robot (affordance) and his/her framing of the robot. Similar effects have their inscriptions: the meaning the developers ascribe to the robot.

The optimal solution would be to make rapid changes based on the user's input in order to match the robot's inscription with the potential user's everyday practices,

desires, needs and wants. However, the difficulty here is both of a technical and social nature: (1) Of a technical nature in that the development of a functional robotic solution takes time. Making major changes, such as changing physical properties or the robot's utility in response to the users' input, is time-consuming. (2) Of a social nature in that the practice of developing robotic solutions for older people in the project context where I did my fieldwork, a technological deterministic approach was favoured in which the intervention was developed and studied according to fixed criteria and quantitative measurements at baseline, midway and post-intervention (a major problem in my fieldwork in the two EU projects). In this context, the innovation ideally is studied without any interference or adaption to local settings. The context of use is seen as stable and fixed. The simplicity of this model is that the predefined variables can be measured at baseline, compared midway and post-intervention. This can give a clear picture of the efficiency and impact of the intervention.

This is in contrast to a practice-oriented design approach in which the innovation is seen as a construction that needs to be adapted until the desired outcome and results have been achieved (Koskinen et al., 2011; Pols, 2012). Under such circumstances, the desired outcome has to be negotiated locally in real-life settings and involving the people that are supposed to integrate the innovation into their everyday practices. Ideally, to avoid having the "script" and stereotypes verified without critical reflection, potential users should be involved in the problematisation and problem identification before any solution is considered. The development of robots for older people must move away from considering them as a problem that needs to be fixed and instead to consider situations in older people's everyday practices that can be supported or enhanced by robots. As such, older people themselves initially need to partake in defining the role and meaning of the prospective robotic solution based on their own everyday practices, desires, needs and wants. Thereafter they should be involved in making and testing the robotic solutions both in the lab to verify reliability, safety and usability and in their everyday life to verify suitability. In other words, older people's needs, wants and desires must be seen within the context of their everyday practices. The robotic solution ought to be constantly improved and changed until the solution has achieved its intended aim in real-life settings. The above suggested approach is in line with what has been called "the third wave of HCI" in which the focus is on technology as experience in our homes and everyday life (Bødker, 2015). Bødker highlighted that we cannot just "dump technology on people" to find out what happens; instead we need to involve potential users, ask the right questions and be willing to listen to, try to understand and respect the answers (Bødker, 2006, p. 6).

Based on my understanding from partaking in two robotic solutions projects, I would argue that robots in today's development are often considered as isolated technical solutions and that more development is desirable to consider robots as

part of a techno-social system. Furthermore, strict funding agreements often hinder a dynamic assimilation of user participation and input since the aims, objectives, target groups and feasible technical solutions have to be defined a priori in the research proposal.

8.2 DOMESTICATION OF ROBOTS IN EVERYDAY LIFE

I became aware during my fieldwork that it is not enough to listen to what people say they want to do. Nor is it enough to rely on what they answer in questionnaires because this does not reflect why and how they actually use the robots. What the participants said and did very much depended on the meaning they ascribed to their role as participants in a research project. Most of them wanted to show their commitment to participating by praising the assistive robot or the eHealth system (this was evident in both cases). Initially they emphasised their engagement and usage of the robot or eHealth system. However, when I probed deeper with questions during the observations, significant design challenges and development opportunities emerged. The complex pattern of how older people construct meaning, use and make sense of robots in everyday life is not easily describable. I would argue that using the domestication framework would broaden our understanding of this. The strategies of the domestication of an artefact take form in the three main dimensions (cognitive, practical and symbolic) identified by Sørenson et al. (Sørensen et al., 2000) (Fig. 11).

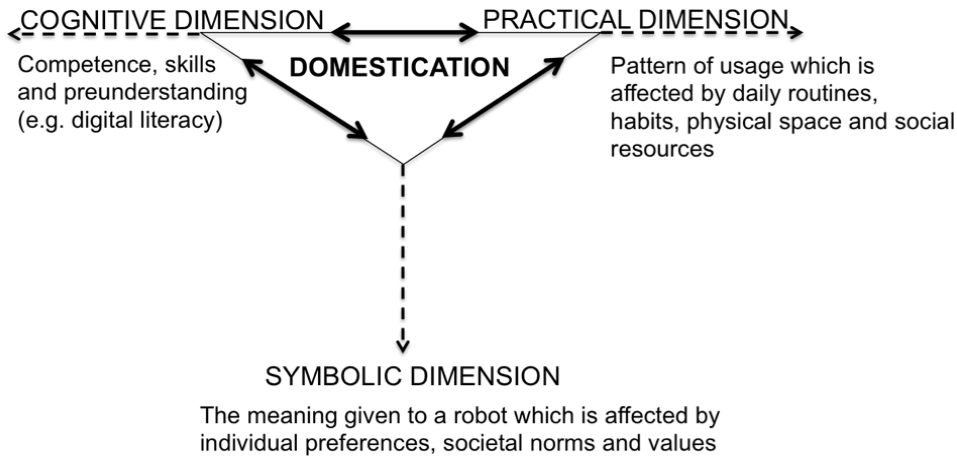


Figure 11: The domestication framework of a robot (my interpretation based on (Sørensen et al., 2000, p. 240)[1]

The appended Papers 3, 4 & 5 describe how the older people/robot relationship develops in and through everyday life in a particular setting (the home) with a particular type of robot (robotic vacuum cleaner, a telepresence robot and an assistive robot). The domestication of a robot is a process, which takes place over time and is open to further unanticipated changes. Domestication must be understood as processual, situated and longitudinal. One stable configuration or routine might give rise to another that we may not have anticipated. The domestication of a particular robot takes place at particular times in particular places and in relation to social and technological circumstances (i.e. the dimensions are related and affected by each other). In this section I attempt to develop a theoretical construct that can deepen our understanding of how older people construct meaning, use and make sense of robots across different types of robots in older people's everyday practices at home. The recurring themes from the three case studies have been mapped to the Sørenson et al.'s three dimensions of the strategies of domestication of an artefact (cognitive, practical and symbolic) (Sørensen et al., 2000) to demonstrate crucial aspects that can either hinder or support the domestication of a robot (in sections 8.2.1, 8.2.2 and 8.2.3).

[1] Sørensen et al. (2005) did not put the domestication framework into a graphical model but I believe that the model in Fig. 11 can serve as a guide for understanding their and my findings.

8.2.1 COGNITIVE DIMENSION

The domestication process involves a cognitive dimension such as the competence and skills (digital literacy and preunderstanding) on how to use a robot. The observations, interviews and diaries show that older peoples' former experiences and expectations affected how they interpreted and understood a robot's utility. At the outset, there was a difference between older people who perceived themselves as technophobes versus those who considered themselves technophiles (self-perceived technology competence). The self-named "technophiles" explored the robots more independently while the self-named "technophobes" initially needed more support and assurance. However, the difference disappeared in the cases where the robot became domesticated. In all three case studies the robots were perceived as easy to use but issues arose about being in control and perceived maintenance.

8.2.1.1 BEING IN CONTROL VERSUS AUTOMATION AND LOSS OF CONTROL

One of the main advantages with robots is that they autonomously can do things that people normally do such as vacuum cleaning. However, observations from the case studies showed that the automation caused concerns among the participants about loss of control. For example, when the robot (in the case of the assistive robot) approached the user, it stopped at a pre-programmed distance and the participant could choose if she wanted it to come closer. It then came closer but sometimes too close and sometimes it stopped too far away (Fig. 12). The participants found it hard to direct the robot to do exactly what they wanted and as a result they felt that they had to adapt more to the robot than the robot to them (perceived affordance). Similarly, in the case of the robotic vacuum cleaners the participants wanted to know where the robot had cleaned and where it had not. So they moved the robot from room to room to gain control over this. Likewise, the telepresence robot (the eHealth system) could have been integrated into the everyday routines of the older participants if they had been able to make calls to whomever they wanted (as on a normal phone), to see who was calling and choose if they wanted to be visible to the caller or not (none of these functions were available). Other ways the robot could have been integrated would have been if the participants had access to the data collected by the sensors on the robot screen, if the data had been easy to interpret, and if they were given recommendations on how and if they should change their daily routines (such as doing physical exercise or spending less time spent in front of the TV). Based on these observations, I would argue that a person's feeling of being in control of the robot is crucial for the domestication process. Being in control involves understanding what one can and cannot do (know-how and affordance). However, making the robot easy to use by limiting its functionalities can lead to domestication failure e.g. in the case of the telepresence robot.

Figure 12: Loss of control was a major concern. The pictures show that the robot was either too far away or too close. It was hard for the robot to adapt to the user's preferences.

8.2.1.2 PERCEIVED MAINTENANCE

Another crucial factor for successful domestication of a robot is how the person perceives its maintenance. In the case of the assistive robots, the constant software updates were a cause of concern for the participants. It was difficult for them to comprehend the software update messages on the screen, which made them wary about what to do. Some of the participants found the brushes of the robotic vacuum cleaners hard to clean. Many stated that they just wanted the robots to work without them having to deal with maintenance. If maintenance is needed, it has to be easy to understand what is expected of the users and why.

8.2.2 PRACTICAL DIMENSION

The practical dimension of the domestication process of a given robot is affected by the context of use and the rules and procedures that prohibit or guide the user into a given pattern of usage ("script"). The home was the main context of use for the robots studied and their adaptability to the home practices turned out to be significant: It lead to resistance or non-use if the robot or/and the user and the home practices failed to adjust and adapt to each other. The importance of considering a robot to be part of a complex socio-technical system confirms the findings of other studies on robots (Forlizzi, 2008; Suchman, 2007; Sung et al., 2010). The everyday life of older people is often filled with other technologies, other people and different kinds of practices (e.g. resting, cooking, socialising); the use of a robot is only one element in the complex everyday routines and habits of older people. Neglecting the context in which the robot is to be used can lead to non-use. This is why the design process/development of robots must start in the everyday practices of older people. The adjustments or failure to adapt are particularly interesting from a design process point of view. Highlighting these tensions and contradictions are an added advantage that with the designers' or

developers' focus might be solved. As a result, the robot might become domesticated.

8.2.2.1 ROBOTS IMPACT ON HOME PRACTICES AND HOME PRACTICES IMPACT ON ROBOTS

In the case of the domestic vacuum cleaners, the participants worried about the robot damaging their furniture and carpets. In the cases of the eHealth system's telepresence robot and the assistive robot, there were tensions between what the robots' capability allowed and prohibited in the homes. In Paper 4, for example, the actions the relatives and caregivers could take, and the interactions with the eHealth system were predetermined and limited by technical issues such as: the robot's inability to receive calls from smartphones and other mobile phones; the need for a web camera; a software program only compatible with Windows and not Mac OS. The system required that the relatives and caregivers interact with the older participant while seated in front of a PC, while the relatives preferred to use their mobile phones when they had the time (pattern of usage by other people and current technology cluster).

A study by Wiles et al. shows that the meaning of home is related to the older person's identity and that the person's home offered a feeling of security and familiarity (Wiles et al., 2011). In the cases of the assistive robot and the telepresence robot (part of the eHealth system), the robots violated both the practical and symbolic dimensions of the home practice. The participants wanted to have the robot docking station (the place where the robot charges its battery) in an out-of-the-way place such as the bedroom. This desire was not based on safety or accessibility issues but because they wanted the robot to be out of sight when it was not in use. The constraints inscribed in the robot, though, were that it made sounds (from the fan), emitted light and generated heat. As a result, it had to be placed in any other room than the bedroom since it disturbed the participants' sleep. The participants thus had to place the docking station in the kitchen or living room (none of them had any other room where the robot charging station could be placed), which was not appreciated and met some resistance. For the most part, they appreciated having the robot around when they used it but when they did not use it they preferred to have it out of sight.

Another limitation inscribed in the robot was that it could not navigate the high thresholds, narrow corridors or areas covered with carpets (the physical space of the home). These limitations were justified in both projects as something good for the older people since high thresholds and carpets can cause falls. However, the participants were not happy about removing their treasured carpets since this affected their feeling of warmth and familiarity. This points to the need for a deep understanding that the robot has to be "placed" (using Sørensen et al.'s [2000] terminology). That is, robots need to correspond to the user values in an already

constructed home setting. The ability of the robot to fit the home practice turned out to be crucial for the domestication process. The participants were prepared to make minor adjustments to the robot such as keeping the floor clean from clutter so that the robot could move unhindered in their homes, but they were not willing to make major adjustments such as changing communication practice with relatives (using the robots to contact relatives instead of mobile phones or land line), removing carpets, furniture and changing the layout.

8.2.3 SYMBOLIC DIMENSION

How robots are given meaning is affected both by individual aspects and social structures. The individual's abilities, habits, routines, needs, desires and wants are affected by the norms and values in the social system in which they exist, such as participating in research projects. The robotic solutions as they are today turned out to encourage attachment, social inclusion and to free up time for more meaningful activities (in the case of the robotic vacuum cleaners). Observations from the case studies confirm past research that people tend to project human attributes onto robots (Reeves & Nass, 1996; Sung et al., 2007; Turkle, 2012). For example, the participants tended to give the robots names and projected human feelings and behaviours onto the robots when they talked about them. However, the older participants did not perceive them as supporting independent living but as entertainment and amusement to past time. Although, many did not consider themselves to be similar to a wider representation of vulnerable "older people" for which they thought the eHealth system and assistive robot were designed, the key findings indicate that participating in research projects on emerging robotic solutions became an end in itself, and that the robots nourished the participants' desires for freedom, control and independence.

8.2.3.1 PARTICIPATING IN RESEARCH PROJECTS AS AN END IN ITSELF

Participating in the research projects had an impact on the participants' perceptions of self. In this case, the participants identified themselves as being forward thinking and contemporary and people who embraced changes and new technology. They perceived the home trials as being very meaningful and beneficial.

One of the participants describes this very well:

> The robot has had a positive impact on my daily life…. partly because I have had a lot of visits from you [the author], friends and family. Many have been very interested and it has been fun to show the robot to others. The robot has really cheered me up and I got on with things that I normally put off such as inviting friends to my house. Mostly I get into a routine and become stuck in the pattern and I do not feel motivated to do new things. By having the robot at home, I started doing things that I have been planning to do but never got around to. It has been

> very easy to invite friends over when I have the robot here because then the focus was not on food or how my home looks, instead the robot become the main focus. The robot became the topic of discussion. I like to show off the robot. It broadens my horizons and I'm interested in knowing what others think. I am very interested in social development and binge able to influence the future.

The extract exemplifies that participation was not just a private affair but something discussed with friends and family. The motivation for participating in the home trials appeared to be personal satisfaction that also resulted from a process of engagement with the research team. The making of emerging robots and the involvement of older participants can be seen as a "community of practice" (Wenger, 1998). Wegner define communities of practice as:

> Being alive as human beings means that we are constantly engaged in the pursuit of enterprises of all kinds, from ensuring our physical survival to seeking the most lofty pleasures. As we define these enterprises and engage in their pursuit together, we interact with each other and with the world and we tune our relations with each other and with the world accordingly. In other words we learn.
>
> Over time, this collective learning results in practices that reflect both the pursuit of our enterprises and the attendant social relations. These practices are thus the property of a kind of community created over time by the sustained pursuit of a shared enterprise. It makes sense, therefore to call these kinds of communities "communities of practice."
>
> (Wenger, 1998, p. 45)

Participating in home trials can result in a socialisation process. For the older participants, being part of the research team gave them additional value and purpose in life. Participating in the research projects on emerging technologies was perceived as a "welcomed break" from everyday routines and as a means to help us (the researchers) to develop useful robots (Susanne Frennert & Östlund, 2015).

8.2.3.2 ROBOTS NOURISHING THE DESIRES FOR FREEDOM, CONTROL AND INDEPENDENCE

During the studies it became apparent that robots nourished the desires for freedom, control and independence. Although the participants did not consider themselves in need of a robot or eHealth system at the moment, they still held a belief that eHealth systems and assistive robots will become a part of future care. This was one of the reasons why they wanted to participate in the first place. Their appropriation or the meaning they described for trying out a given robot at home was based on curiosity and interest in new technology. For Mrs 1 (who participated in the assistive robot study), the appropriation of the robot expressed qualities of self, such as being independent and forward thinking. The robot was compared to other forms of help and care and in terms of differences and likeness:

> I would much rather have a robot than human help because the robot does what I tell it to do, while what the homecare staff does is based on a list of what to do and when[2]. If I have robot help then I will not have to instruct a new person each time[3]. A robot does not gossip and I do not like to have strangers in my home. I trust the robot and a robot does not steal. You cannot control another person as I can control the robot. Many fear that a robot will replace human contact, but a robot does not exclude human contact instead the robot will be my servant. If I was bedridden, I would like to have a robot that would help me. It could fetch medicine and read aloud to me. I strongly believe that for those of us who want to take care of ourselves, we would rather have a robot than another person to do so. When you have a robot, you can decide when, what and how.

Mrs 1 portrayed the robot as an undemanding companion and an aid that could enable her to be more in control than if she had human help. She was the participant who was the most enthusiastic about the robot. As she said:

> I would like to keep the robot forever. It keeps me active. It always has time for me. It can play games with me when the neighbours have no time. Other people are always busy with other things but the robot always has time to play games with me. If I like to do something, then I can get it to come and it has time to play games with me.

From a constructivist approach it can be argued that Mrs 1's beliefs and hopes in future robots affected her perception of the robot. From this point of view, the perception of an artefact reflects reciprocity between cultural values, the individual and non-human actors (Latour, 1999). However, it could as easily be argued that Mrs 1 is being seduced by the promises of new technologies and as Lehoux puts it:

> Technology sounds modern. It also evokes time. Technology must be about the latest. It is also supposed to be better."
>
> (Lehoux, 2006 ,p. xii)

In other words, this is a technological deterministic perspective that assumes that technology is always beneficial and "a good thing" (Selwyn, 2003). Indeed, indications were found in the fieldwork that there is a "seductive power" or force of technology, making older people feel that they have to keep up to date, fearing

---

[2] In Sweden the homecare providers are restricted in the kinds of help they are allowed to give, for how long and when to do it.

[3] The staff turnover in some places is huge and the person could receive assistance from over 20 different people a week.

that they will be otherwise left behind. They also attributed abilities to the robotic solutions that did not correspond to the actual usage. Robots represented the future and something that has to be considered and explored.

To summarise, the process of constructing meaning, using and making sense of robots at home in everyday life among older people is reciprocal – to and from the robot – as well as technical and social. The holistic aspects of the domestication perspective can contribute a nuanced view of the meaning making of a given robot since the analysis involves multidimensional (cognitive, practical and symbolic) dimensions of the domestication process of a specific robot. As such, the domestication of a robot is a three-way process between the individual, other people and everyday practices. The structures, norms and values of robots in society are interrelated with the individual's perception, competence and understanding of a specific robot, as well as everyday routines, pattern of usage and physical space. The success or failure of a given robot is dependent on how well the robot corresponds to the user's values in an already constructed home practice. This includes how the robot corresponds to the social context of the user (other activities, other people and the technology cluster in which she is situated) and the physical space of the home, as well as the user's feeling of control and the level of maintenance required.

8.3 DOMESTICATION OF ROBOTS IN RELATION TO AGING

It was observed among the participants that aging was perceived as a gradual, slow process that changes over time, a process that they adapt to along the way. They made changes in their daily routines (like more time for resting) and they adapted their homes (furniture arrangement and placement of things to remind them to take medications, etc.) to suit their everyday life. As such, the assistive robots and eHealth systems did not seem to be what they themselves perceived as the solution to prolonging their independence. However, this might also change over time depending on what technology is available and as a consequence of sociotechnical changes, such as an infrastructure to support eHealth systems and assistive robots in the national social and healthcare system. However, in the cases of the given eHealth system and the assistive robot, it is obvious from the studies that these technologies, as they are today, do not support independent living for the older participants.

Aging and gerotranscendence involve a shift in perspectives that changes the perception of time and reflections on life according to gerotranscendence theory (Tornstam, 2005). In the case studies of the assistive robot and the eHealth system,

it was observed that the older participants were drawing upon their experiences of other technologies such as computers, televisions and mobile phones when talking about the robots. All of these have improved, become smaller, cheaper and more user-friendly during their lifetime. The perceived attributed abilities and actual abilities of the robot often became intertwined with their imaginaries, visions and expectations of future robots. When the participants were asked if they could imagine buying the robot they were testing at home (eHealth system, the assistive robot or the vacuum cleaning robot), the most common answer was "no". Often they explained this by saying that they did not need the robot (in the cases of the eHealth system and the assistive robot) or that they thought that the technology would improve in the following years. Even the participants who tested and domesticated the robotic vacuum cleaners said that they would not buy one since they still had their ordinary vacuum cleaner or they would get cleaning help. There seemed to be a low interest in investing in a new robotic vacuum cleaner. However, most of them wanted to keep it after the study finished but seemed unwilling to pay for the robot. An internal ambivalence about getting a robot was noticed during the observations and interviews. They could see the benefits of having a vacuum-cleaning robot, but they did not want to buy one now because they expected them to get better and cheaper in the near future. Similarly, ambivalence was noted in the cases of the eHealth system and the assistive robot. The participants were eager to try them out but they could not imagine paying for such innovations themselves. Gerotranscedence might explain this ambivalence but it might also be a course of life such as Ranada & Hagberg (2014) argue that some older people are averse to taking in new objects, technical or non-technical because they feel no need of possessing new things and are aiming for the dissolution of the home when they die (Ranada & Hagberg, 2014).

Older people's meaning of life and priorities shift through gerotranscendence (Tornstam, 2005). The observations from the case studies indicate that urges to acquire or to own new artefacts seem to decrease with age. However, there were no indications in the case studies that the older participants were averse to the idea of acquiring new artefacts if they fitted into the their worldview. The results of the case studies indicate that older people do not passively accept technology aimed for them but that they make informed choices on which technology to domesticate and which to reject. They do this as technogenarians, to use Joyce & Loe's concept: ". . . individuals who create, use, and adapt technologies to negotiate health and illness in daily life" (Joyce & Loe, 2010, p. 172). During the many hours of observations it became apparent that the participants domesticated technologies that both transformed and fitted into their everyday structures and routines such as computers and social networks (i.e. Facebook) as a means to keep up to date with family and friends; they used mobile phones as safety devices when out and about and as a means to talk to and text message family and friends; they used microwave ovens for quick and easy meals; they used the television and

radio to keep up with what was happening in society and for pastime; they used the robotic vacuum cleaners to have time and energy for more valuable activities. None of the participants used technology for the sake of technology; instead its usage was dependant on how it fitted into their everyday life practices. When it came to the eHealth system and the assistive robots, most of the participants were just not interested in possessing these innovations or similar ones after they had tried them out. This was because at that moment in time, they did not ascribe their perceptions of self to the technologies and so they resisted incorporating the configurations of the users that were built into the technology. In this way, the older participants could be viewed as active users or refusers who engaged with the practical, symbolic and cognitive dimensions of the robots.

8.4 METHODOLOGICAL ISSUES

Important lessons learnt are:

- It takes time for a robot to become domesticated.
- The domestication process is dynamic.
- Tools for rapid changes and improvements can support the domestication process.
- It takes time to understand the social nature of potential users' practices or activities with emerging robots.
- It takes time to implement desired changes and needs into a new prototype, to test the revised prototype, and collect feedback from the users.
- Methods for identifying and analysing the users' everyday practices with a robot need to be dynamic and adaptable.
- The transformation of everyday practice evolves over time (Shove et al., 2012).
- When conducting experimental studies in a research laboratory the variables are known but in an innovation process piloted in potential users' homes, the variables are unknown and the methods used need to be able to identify and recognise the "unknown" (Östlund, 2011).
- In other words, it is almost impossible to identify all variables before the robot has been introduced and used at home.

Consequently, researchers, developers and the project as a whole have to be open to the fact that variables can change along the way.

Studies similar to the ones in this thesis are often criticised for being observational, lacking critical conditions and involving a small sample (Burton, 2013). It is also argued that they fail to consider placebo effects, novelty effects, experimenter expectancy effects and information bias (Burton, 2013). It is claimed that randomised control trials (RCT) are needed to provide "good science" (Burton, 2013). However, the problem with the RCT approach is that even if the randomised control sample involves older people who all have the same diagnosis, they are not a mutually unified, exclusive group who domesticate a given technology in exactly the same way. RCTs do not take into account unforeseen effects or variables. To paraphrase Pols (2012), RCTs were designed to ensure that patients receive the right medical treatment because of its effectiveness and not because the doctors like a given treatment. As such, RCTs are useful for simple innovations but not for complex ones that are under construction. An innovation process needs to be open to redefine and reframe goals along the way in order to adapt and improve the innovation to ease its domestication (Pols, 2012). When developing robots, experimental studies are needed to assure the safety, usability and reliability of robots. However, experimental studies are not adequate for understanding how, if and why (or why not) the intended users will "make a given robot their own". An important question is: Since the participants know that the robot will be removed at the end of the trials, how does this affect their motivation to domesticate the robot while they have it at home?

8.4.1 CARRYING OUT A PROJECT-BASED PHD

When I started my PhD studies in 2012, the proposals for the projects in which I would conduct my fieldwork were already written and approved by the European Commission. As a result, the kind of robot and eHealth system to be developed was already decided. The proposals were based on the competencies (skills and knowledge) of the partners in the projects. As a consequence, the functionalities of the robot and eHealth system were more or less already decided. As "user partners" our task was to involve the users and to gather their experiences and requirements through workshops, lab trials and trials in the home (Susanne Frennert, 2014). Input from the users, however, was seldom considered since the technological development was already fixed in the project proposal. Minor changes were possible but no major ones. One of the major ones that was revealed in the lab trials was that the users did not want their activities in the home to be micro managed by the sensors of the eHealth system. Another was that the users were not interested in learning sign language gestures to communicate with the assistive robot. In some regards, the EU projects created a space where people

from different disciplines worked in parallel instead of one where they mixed, interacted and learnt from each other. All the disciplines had their own agendas and research interests. This meant that the end product was not the main emphasis, but a means to acquire funding for doing research on challenges in each research partner's field. Some interests were marginalised by other more powerful interests. In the eHealth system and assistive robot projects, pragmatic technical solutions had to meet deadlines and research interests that overrode the interests of the potential users and the "user partners" who were not present or involved in the decisions made. As such, we as user partners and the users were held "hostage" to prove that the pre-decided design and functionalities met the needs of the users. My own research interest in technology adoption and adaption as a social process was to embrace the complex, manifold and contradictory domestication process while the engineers, developers and project reviewers were more interested in a need-based bullet list on how to develop a robot and an eHealth system that fit all old people.

I am still struggling to realize what I could have done differently in order to get all the valuable insights from the user studies to have greater impact on the development. So far, I have come to the conclusion that the set-up of EU-funded projects with its linear model may not support emerging designs. The process needs to be more open-ended and iterative. All technological decisions and partners cannot be determined in advance. Partners need to be decided upon, recruited and involved based on the outcomes of the user involvement. This points to the need to combine disciplinary perspectives and focus on developing technologies such as robots that fit older people's needs, wants, values, daily practices, and that embody a desired human-robot relationship. The challenge here is to design a sufficient range of transdisciplinary methods to enable a holistic "co-production" among all actors (i.e. users, engineers, scientists, healthcare providers, designers, manufacturers, etc.) where different perspectives and worldviews meet and are combined. Although the project politics were frustrating, carrying out a project-based PhD had its advantages. I was able to work with researchers from all over Europe; I gained insight into how EU-funded projects are controlled; I was given the opportunity to do very interesting fieldwork with two emerging technologies; and I had to follow a structure, with deadlines, milestones and deliverables.

8.5 ETHICAL ISSUES

Doing home trials raises ethical considerations. When targeting potentially fragile and vulnerable older users, the research team has to ensure that the participants understand what their participation involves. Emerging robots are

seldom plug-and-play installations but often involve technical breakdowns and everyday managing. This normally involves frequent visits from the set-up team to the homes where the robot is being tested. One has to consider what kind of user support is needed. Around the clock phone support was provided in both the EU projects. The participants could call us any time and any day of the week, and they did (technical breakdowns often occurred at night or on weekends).

Projects are temporary – being part of developing emerging robots can be exciting for the potential users but as with all projects they have to an end and the robot has to move out. An exit strategy is crucial. The users need to understand that their involvement is only temporary and that they cannot keep the robot after the project is finished. If we target fragile and vulnerable people, there is a risk that they may become attached to the robot or the robot may increase their feeling of safety at home. It is also possible that the user involvement could evoke a need that the older people did not know they had but that became evident as a result of their user involvement: They realised that the robot is vital for their wellbeing. An exit strategy should be designed to ease the removal of the robot from the home in those cases where the participants have become attached to it.

8.6 KNOWLEDGE CONTRIBUTION

The contributions of this thesis are the insights and understanding generated by applying the domestication framework to three case studies involving older people and three different kinds of robots. The older participants are experts in their everyday life at home and in their social interactions with familiar technologies, friends and family. Everyday actions at home often flowed effortlessly and unhindered by analytic deliberations. The older participants did not to have goals or plans for their everyday actions at home. They already had an established set of "home" practices, which either hindered or supported the domestication of a given robot at home. By studying the robots-in-use in their natural context (the home) the robot/older people relation could be understood. The robots encouraged attachment, social inclusion and freed time for more meaningful activities, but the empirical findings showed that there were factors that hindered the robots from becoming a part of the older person's everyday life. The practice-oriented research approached revealed design challenges and development opportunities which if addressed can support a successful domestication.

For robots to be meaningfully and seamlessly integrated into older people' everyday lives:

- They need to be easy to use.
- They need to be desirable.
- They need to correspond to the participant's home practices.
- They need to respond appropriately to the older person's household activities, hobbies, interests, the network of people and the technology cluster in which the older person is situated.

The usage of the robot needs to make sense to the older person – she needs to feel that she is in control of the robot and that the perceived level of maintenance is reasonable. If the usage of the robot makes sense to the older person then she will be willing to alter stable practices and routines. The findings illustrate how the older participants during the domestication process modified the robot to suit their needs, wants and desires, along with their attitudes, behaviours, motives and feelings. The participants chose how, when and which functionalities they used and which they did not. But at the same time, the robot defined and constrained the ways in which it was possible and likely to transform the participants' "practice of usage". It was a mutual and gradual process that evolved over time. In the case of the vacuum cleaner, the participants first regarded them to be a supplement to the ordinary vacuum cleaners, but over time, the roles reversed: The robotic ones were used several times a week and the ordinary ones became a supplement and were used once in a while. The findings also illustrate that limiting the functionalities as a means of making the robot easy to use can result in domestication failure since the older person then experiences the robot as too restricted and inferior to the technologies he or she is currently using.

The empirical findings in this thesis indicate that valuable insights can be gained by applying a practice-oriented design approach and by involving the potential users. The main challenges, though, lie in the power struggle of who initiates and makes the technical decisions; who defines the potential users and the intended meaning of the robot. In addition, when interpreting the users' input, an understanding of their motivation for participating is crucial. The meaning the participants ascribe to their role as participants and how they situate themselves and others in relation to robots has an impact on what they say and how they construct meaning, use and make sense of the robots.

9 CONCLUSIONS

The aim of this thesis has been to explore how older people construct meaning, use and make sense of three kinds of robots in their homes. It is a research endeavour that encompasses a review of the research literature about older people and robots, and three projects at four different research sites. An important insight gained is that "older people in need of robots to support independent living" is a "construct" of developers, funding agencies, society, and the older participants (who do not consider themselves to be in need of a robot). All of these actors have a misconception based on the prevailing image of older people being more fragile, ill and weaker than they are in reality. Increasing their awareness and understanding of this misconception, can increase the exploration of alternatives to current robotic developments. If the aim is to incorporate a robot into the everyday life of an older individual in order to support independent living, the robot is an imperfect product that needs rapid, ongoing changes until the user perceives it as being perfect or near perfect in supporting them to live independently.

Aging is not a standardised process. No two older people age exactly in the same way. Their experiences of aging differ. This differs between individuals but also for the same individual depending on the time of day, time of year, situation and context, and on their experiences of illness or wellness. This raises complex challenges for a robot's ability to provide independence, security and empowerment for older people. In these circumstances the research methods need to be tailored to suit a design process and allow research variables to change during the iterative process in order to find the optimum solution. This thesis shows that a robot that supports and maintains everyday practices (such as vacuum cleaning, rest, social activities and hobbies) rather than emphasising the users' decline, risks or illness is far more likely to become domesticated by them.

The main conclusions are:

- Robotic developments aimed for older people have much to gain by involving older people in the design process.

- If a robot already has a prescribed meaning, then older people will subscribe to the configuration of the intended user during lab trials and home trials. During the trials, older participants became actors who are resolved to act according to the prescribed meaning of the robot in the way that they talked about it. As such, they take part in cultivating the stereotype of old age. To avoid having the "script" and "stereotypes" verified without critical reflection, potential users ought to be involved in the problematisation and problem identification before any solution is considered.

- The development of robots for older people must move away from viewing them as a problem that needs to be fixed. Instead the development process should take into consideration the situations in older peoples' everyday practice that can be supported or enhanced by robots.

- Robotic developments have much to gain by longitudinal observations of robots in real-life contexts. Longitudinal observations reveal what happens when a robot interplays with real-life settings and goes through the domestication process. By identifying the actual usage of a robot, its ability in real-life settings, and what causes tensions, designers and developers can understand and prioritise what needs to be done or changed for a robot to become domesticated. Older people make informed choices on which technology they are going to domesticate and which they will reject; consequently, an understanding of the meaning-making (domestication) process is crucial.

- Participation in the development of emerging robotic solutions can be beneficial for older people. Our older participants treasured and cherished being part of the research projects, being listened to, and having the opportunity to contribute to future developments. A welcome side effect was increased social interaction and increased energy to break everyday routines.

- The success or failure of a given robot is dependent on its domestication, that is to say, how well the robot corresponds to the user's values in a home practice that is already constructed. This includes how the robot fits into the social context of the user (e.g. activities, other people and the technology cluster in which she is situated), the practical properties of the home, the user's feeling of control, and the level of maintenance required.

9.1 FUTURE RESEARCH

Sometimes I feel that it would have been easier to write the thesis before I started the fieldwork. This is because the more I learn about older people in relation to robots, the more I realise how little I know, and how much more I would like to explore and learn. Every new finding or insight has led to new questions and hidden phenomena that I would like to uncover.

Several questions were highlighted in the literature review. Some of these are addressed by the research in this thesis while others remain. The findings that are presented contribute to reflections on different stakeholders' perspectives, such as who initiates, directs and benefits from the projects and the form in which user participation occurred. However, these reflections raise questions on what kind of future research would be beneficial. One example may be to examine the ramifications of the overwhelming masculine and "young adult" predominance in robotic development teams. Efforts are also needed to uncover how robots embody the perspectives that their creators have of older people. These include how older people are represented and incorporated in advertisements, marketing, and media or instruction manuals. Another aspect is how governments, expert bodies and other influential actors in techno-scientific policymaking and development define, frame and understand the needs, solidarity, temporality, competiveness, risks and benefits of different robots.

I argue that there is a need to combine disciplinary perspectives and to design a sufficient range of transdisciplinary methods. The focus should be on developing robots that fit older people's needs, wants, values, daily practices and that embody a desired human-robot relationship, that can be achieved by a holistic "co-production" among all actors (i.e. users, engineers, scientists, healthcare providers, designers, manufacturers, etc.) where different perspectives and worldviews meet and are combined. In this regard, it would be of great interest to be involved in a user-led innovation process in which older people are the lead innovators who

define the concepts, needs, wants and what kind of artefact to developed, and who lead the product development process with support and input from experts.

10 REFERENCES

Aceros, J. C., Pols, J., & Domènech, M. (2015). Where is grandma? Home telecare, good aging and the domestication of later life. *Technological Forecasting and Social Change, 93*, 102-111.

Akrich, M. (1992). The de-scription of technical objects. In W. Bijker & J. Law (Eds.), *Shaping Technology / Building Society: Studies in Sociotechnical Change* (pp. 205-224). Cambridge, Mass: MIT Press.

Akrich, M., Callon, M., Latour, B., & Monaghan, A. (2002). The key to success in innovation part II: the art of choosing good spokespersons. *International Journal of Innovation Management, 6*(02), 207-225.

Akrich, M., & Latour, B. (1992). A summary of a convenient vocabulary for the semiotics of human and nonhuman assemblies. In W. Bijker & J. Law (Eds.), *Shaping Technology/Building Society Studies in Sociotecnical Change* (pp. 259-264). Cambridge: The MIT Press.

Aspers, P. (2009). Empirical phenomenology: a qualitative research approach (The Cologne seminars). *Indo-Pacific Journal of Phenomenology, 9*(2).

Baars, J., Dohmen, J., Grenier, A., & Phillipson, C. (2013). *Ageing, meaning and social structure: Connecting critical and humanistic gerontology*. Bristol: Policy Press.

Bannon, L. (1986). From human factors to human actors: The role of psychology and human-computer interaction studies in system design. In J. Greenbaum & M. Kyng (Eds.), *Design at work: Cooperative design of computer systems* (pp. 25-44). Hillsdale: Lawrence Erlbaum Associates.

Battarbee, K., Mattelmäki, T., Ylirisku, S., Koskinen, H., Soosalu, M., Allén, M., & Salo, H. (2005). *Looking beyond the product: design research in industrial and academic collaboration.* Paper presented at the Proc. of Joining forces conference.

Bauwens, V., & Fink, J. (2012). Will your household adopt your new robot? *interactions, 19*(2), 60-64. doi:10.1145/2090150.2090165

Bedaf, S., Gelderblom, G. J., & De Witte, L. (2015). Overview and Categorization of Robots Supporting Independent Living of Elderly People: What Activities Do They Support and How Far Have They Developed. *Assistive Technology, 27*(2), 88-100.

Belk, R. (1988). Possessions and the Extended Self. *Journal of consumer research, 15*(2), 139-168.

Bemelmans, R., Gelderblom, G. J., Jonker, P., & de Witte, L. (2012). Socially assistive robots in elderly care: A systematic review into effects and effectiveness. *Journal of the American Medical Directors Association, 13*(2), 114-120. e111.

Berker, T, Hartmann, M., Punie, Y and Ward, K. (eds) (2005) *Domestication of Media and Technologies*, Open University Press, Maidenhead

Biggs, S., Lowenstein, A., & Hendricks, J. (2003). *The need for theory: Critical approaches to social gerontology*. Amityville, N.Y: Baywood Publishing Company.

Bijker, W., Huges, T., & Pinch, T. (1989). *The social construction of technological systems*. Cambridge, Mass: MIT Press.

Bijker, W., & Law, J. (1992). *Shaping technology/building society: Studies in sociotechnical change*. Cambridge, Mass: MIT press.

Blythe, M., Monk, A., & Park, J. (2002). *Technology biographies: field study techinques for home use product development.* Paper presented at the CHI'02 Extended Abstracts on Human Factors in Computing Systems.

Bouma, H. (2001). Creating adaptive technological environments. *Gerontechnology, 1*(1), 1-3.

Bouma, H., Fozard, J. L., Bouwhuis, D. G., & Taipale, V. (2007). Gerontechnology in perspective. *Gerontechnology, 6*(4), 190-216.

Brey, P., Briggle, A., & Spence, E. (2012). *The good life in a technological age*. London: Routledge.

Broadbent, E., Stafford, R., & MacDonald, B. (2009). Acceptance of healthcare robots for the older population: Review and future directions. *International Journal of Social Robotics, 1*(4), 319-330.

Broadbent, E., Tamagawa, R., Patience, A., Knock, B., Kerse, N., Day, K., & MacDonald, B. A. (2012). Attitudes towards health-care robots in a retirement village. *Australasian journal on ageing, 31*(2), 115-120.

Broekens, J., Heerink, M., & Rosendal, H. (2009). Assistive social robots in elderly care: a review. *Gerontechnology, 8*(2), 94-103.

Brooks, R. (2004). Technology's Elder Boom-An aging populace will look increasingly to technology to enhance its quality of life. *Technology review - Manchester NH, 107*(3), 32-32.

Brown, N., & Webster, A. (2004). *New medical technologies and society: reordering life*. Cambridge: Polity.

Brundell, S. (2014). *Äldrestatistik 2013/2014*. Retrieved from Hjälpmedelinstitutet: http://www.hi.se/Global/dokument/publikationer/2014/14309-pdf-aldrestatistik-2013-2014.pdf

Burton, A. (2013). Dolphins, dogs, and robot seals for the treatment of neurological disease. *The Lancet Neurology, 12*(9), 851-852.

Bødker, S. (2006). *When second wave HCI meets third wave challenges.* Paper presented at the Proceedings of the 4th Nordic conference on Human-computer interaction: changing roles. Keynote Paper, 1-10.

Bødker, S. (2015). Third-wave HCI, 10 years later---participation and sharing. *interactions, 22*(5), 24-31.

Carstensen, L. L., Fung, H. H., & Charles, S. T. (2003). Socioemotional selectivity theory and the regulation of emotion in the second half of life. *Motivation and emotion, 27*(2), 103-123.

Cetina, K. K., Schatzki, T. R., & von Savigny, E. (2001). *The practice turn in contemporary theory*. London: Routledge.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis (Introducing Qualitative Methods Series)*. London: Sage Publication.

Charness, N., & Boot, W. R. (2009). Aging and information technology use potential and barriers. *Current Directions in Psychological Science, 18*(5), 253-258.

Charness, N., & Bosman, E. A. (1990). Human factors and design for older adults. In J. E. Birren & K. W. Schaide (Eds.), *Handbook of the psychology of aging* (Vol. 3, pp. 446-464). New York: Academic Press.

Cockburn, C., & Ormrod, S. (1993). *Gender and Technology in the Making*. London: Sage Publications.

Copelton, D. A. (2010). Output that counts: pedometers, sociability and the contested terrain of older adult fitness walking. *Sociology of health & illness, 32*(2), 304-318.

Coradeschi, S., Cesta, A., Cortellessa, G., Coraci, L., Galindo, C., Gonzalez, J., . . . Furfari, F. (2014). GiraffPlus: A System for Monitoring Activities and Physiological Parameters and Promoting Social Interaction for Elderly *Human-Computer Systems Interaction: Backgrounds and Applications 3* (pp. 261-271): Springer.

Cresswell, J. W. (2003). *Research design: Qualitative and Quantitative approaches*. Thousands Oaks, CA: Sage Publication.

Csikszentmibalyi, M. (1993). Why we need things. In S. Lubar & D. Kingery (Eds.), *History from Things: Essays on Material Culture*. Washington / London: Smithsonian Institution Press.

Czaja, S., J, & Lee, C., C. (2007). The impact of aging on access to technology. *Universal Access in the Information Society, 5*(4), 341-349.

Czaja, S., Sharit, J., Charness, N., Fisk, A., & Rogers, W. (2001). The Center for Research and Education on Aging and Technology Enhancement (CREATE): A program to enhance technology for older adults. *Gerontechnology, 1*(1), 50-59.

Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A., & Sharit, J. (2006). Factors predicting the use of technology: findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and aging, 21*(2), 333.

Dahlin-Ivanoff, S., Haak, M., Fänge, A., & Iwarsson, S. (2007). The multiple meaning of home as experienced by very old Swedish people. *Scandinavian journal of occupational therapy, 14*(1), 25-32.

Dautenhahn, K., Woods, S., Kaouri, C., Walters, M. L., Koay, K. L., & Werry, I. (2005). *What is a robot companion-friend, assistant or butler?* Paper presented at the Intelligent Robots and Systems, 2005.(IROS 2005). 2005 IEEE/RSJ International Conference on.

Dijkstra, K., Charness, N., Yordon, R., & Price, J. (2015). The role of coping, relaxation, and age on stress and task performance with new technology. *Gerontechnology, 13*(4), 388-395.

Donald, M., & Wajcman, J. (1985). *The social shaping of technology*. Milton Keynes Open University Press.

EC.europa.eu. (2015a). Digital Agenda for Europe. Retrieved from http://ec.europa.eu/digital-agenda/en/node/72886 - EU Investments

EC.europa.eu. (2015b). Overview: EU funded projects in ICT for Ageing well. Retrieved from https://ec.europa.eu/digital-single-market/en/news/overview-eu-funded-running-projects-area-ict-ageing-well

Eriksen, T. H. (2004). *What is anthropology?* London: Pluto Press

Essén, A., & Östlund, B. (2011). Laggards as innovators? Old users as designers of new services & service systems. *International Journal of Design, 5*(3), 89-98.

Eurobarometer. (2012). *"Public Attitudes towards Robots"*. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_382_en.pdf:

Eurostat. (1st of July 2013). Population structure and ageing. Retrieved from http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Population_structure_and_ageing

Fatehi, F., & Wootton, R. (2012). Telemedicine, telehealth or e-health? A bibliometric analysis of the trends in the use of these terms. *Journal of Telemedicine and Telecare, 18*(8), 460-464.

Fernaeus, Y., Håkansson, M., Jacobsson, M., & Ljungblad, S. (2010). *How do you play with a robotic toy animal?: a long-term study of pleo.* Paper presented at the Proceedings of the 9th international Conference on interaction Design and Children.

Findahl, O. (2014). *Pensionärerna och internet 2014*. Retrieved from https://www.iis.se/docs/Pensionarerna_och_internet_2014.pdf:

Fisk, A., Rogers, W., Charness, N., Czaja, S. J., & Sharit, J. (2004). *Designing for older adults: Principles and creative human factors approaches*. Boca Raton, USA: CRC press.

Forlizzi, J. (2008). The product ecology: Understanding social product use and supporting design culture. *International Journal of Design, 2*(1), 11 - 20.

Forlizzi, J., & DiSalvo, C. (2006). *Service robots in the domestic environment: a study of the roomba vacuum in the home.* Paper presented at the Proceedings of the 1st ACM SIGCHI/SIGART conference on Human-robot interaction.

Forlizzi, J., DiSalvo, C., & Gemperle, F. (2004). Assistive robotics and an ecology of elders living independently in their homes. *Human-Computer Interaction, 19*(1), 25-59.

Forte, J. A. (2002). Mead, contemporary metatheory, and twenty-first-century interdisciplinary team work. *Sociological Practice, 4*(4), 315-334.

Foucault, M. (1982). The subject and power. *Critical inquiry, 8*(4), 777-795.

Frennert, S. (2012). *I want one too! Domestication of Assistive Robots.* Paper presented at the Participatory Design Conference, Denmark.

Frennert, S. (2013). *Social companion robots in eldercare–who gains and who loses?* Paper presented at the ICSR2013, Bristol, UK.

Frennert, S. (2014). *Older people and the adoption of innovations.* (Licenciate Thesis), Lund University, Lund.

Frennert, S., Eftring, H., & Östlund, B. (2013a). Older people's involvement in the development of a social assistive robot *Social Robotics* (p. 8-18): Springer.

Frennert, S., Eftring, H., & Östlund, B. (2013b). *Using attention cards to facilitate active participation in eliciting old adults' requirements for assistive robots.* Paper presented at the RO-MAN, 2013 IEEE, Korea.

Frennert, S., Eftring, H., & Östlund, B. (2013c). What older people expect of robots: A mixed methods approach *Social Robotics* (p. 19-29): Springer.

Frennert, S., Forsberg, A., & Östlund, B. (2013). Elderly People's Perceptions of a Telehealthcare System: Relative Advantage, Compatibility, Complexity and Observability. *Journal of Technology in Human Services, 31*(3), 218-237.

Frennert, S., & Östlund, B. (2014a). The domestication of robotic vacuum cleaners among seniors. *Gerontechnology, 12*(3), 159-168.

Frennert, S., & Östlund, B. (2014b). Review: seven matters of concern of social robots and older people. *International Journal of Social Robotics, 6*(2), 299-310.

Frennert, S., & Östlund, B. (2015). What happens when seniors participate in new eHealth schemes? *Disability and Rehabilitation: Assistive Technology*, 1-9. doi:10.3109/17483107.2015.1063016

Friedan, B. (1993). *Fountain of age*. New York; Toronto: Simon & Schuster.

Fuglsang, L. (2001). Three perspectives in STS in the policy context. *Visions of STS: Counterpoints in Science, Technology and Society Studies. SUNY Series in Science, Technology and Society*, 35-55.

Fukuda, R. (2011). *Gerontechnology for a Super-Aged Society*. Heidelberg: Springer.

Gelderblom, G. J., De Wilt, M., Cremers, G., & Rensma, A. (2009). *Rehabilitation robotics in robotics for healthcare; a roadmap study for the European Commission.* Paper presented at the Rehabilitation Robotics, 2009. ICORR 2009. IEEE International Conference on.

Gibson, J. J. (2015). *The ecological approach to visual perception: classic edition*. New York, N.Y: Psychology Press.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105-112.

Gustafsson, C., Svanberg, C., & Müllersdorf, M. (2015). Using a Robotic Cat in Dementia Care: A Pilot Study. *Journal of Gerontological Nursing, 41*(10), 46-56.

Hackett, E. J., Amsterdamska, O., Lynch, M., & Wajcman, J. (2008). *The handbook of Science and Technology Studies*. Cambridge, Mass: The MIT Press.

Haddon, L. (2007). Roger Silverstone's legacies: domestication. *New media & society, 9*(1), 25-32.

Haddon, L. (2011). Domestication analysis, objects of study, and the centrality of technologies in everyday life. *Canadian Journal of Communication, 36*(2).

Halskov, K., & Hansen, N. B. (2015). The diversity of participatory design research practice at PDC 2002–2012. *International Journal of Human-Computer Studies, 74*, 81-92.

Hansen, S. T., Andersen, H. J., & Bak, T. (2010). *Practical evaluation of robots for elderly in denmark: an overview.* Paper presented at the Proceedings of the 5th ACM/IEEE international conference on Human-robot interaction.

Hanson, J., Percival, J., Aldred, H., Brownsell, S., & Hawley, M. (2007). Attitudes to telecare among older people, professional care workers and informal carers: a preventative strategy or crisis management? *Universal Access in the Information Society, 6*(2), 193-205.

Hanson, V. L. (2010). Influencing technology adoption by older adults. *Interacting with Computers, 22*(6), 502-509.

Haraway, D. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist studies, 14*(3), 575-599.

Harnett, T., & Larsson, B. (2011). Äldre människors rättigheter *Äldre och Åldrande. En grundbok i gerontologi* (p. 243-260). Stockholm: Gothia Förlag.

Harrington, T. L., & Harrington, M. K. (2000). *Gerontechnology: Why and how*. Maastricht: Shaker.

Hedvall, P.-O. (2009). *The Activity Diamond-Modeling an Enhanced Accessibility.* (PhD thesis), Lund University.

Hedvall, P.-O., & Jönsson, B. (2015). *Att så vidare 25*. Lund, Sweden: CERTEC, LTH nummer 1:2015.

Helman, C. (2007). *Culture, health and illness*. London: Hodder Arnold.

Hickman, J. M., Rogers, W. A., & Fisk, A. D. (2007). Training older adults to use new technology. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 62*(Special Issue 1), 77-84.

Hughes, T. P. (1986). The seamless web: technology, science, etcetera, etcetera. *Social studies of science, 16*(2), 281-292.

Hughes, T. P. (2004). *Human-built world: How to think about technology and culture*. Chicago: University of Chicago Press.

ISO, I. (2010). 26000, 2010. Guidance on social responsibility *The International Organization for Standardization*.

ISO, I. (2011). 26800, 2011. Ergonomics - General approach, principles and concepts *The International Organization for Standardization*.

ISO, I. (2016). 27500, 2016. The human-centered organization - Rationale and general principles *The International Organisations for Standarization*.

Jiménez Villarreal, J., & Ljungblad, S. (2011). *Experience centred design for a robotic eating aid.* Paper presented at the Proceedings of the 6th international conference on Human-robot interaction (HRI2016), Lausanne.

Joyce, K., & Loe, M. (2010). A sociological approach to ageing, technology and health. *Sociology of health & illness, 32*(2), 171-180.

Joyce, K., & Loe, M. (2011). *Technogenarians: Studying health and illness through an ageing, science, and technology lens*. Chichester: Wiley-Black.

Joyce K, W. J., Mamo, L. (2008). *Studying Aging through a Science and Technology Lens*. Paper presented at the American Sociological Association Annual Meeting, Boston.

Kaplan, D. M. (2009). *Readings in the Philosophy of Technology*. Lanham: Rowman & Littlefield Publishers.

Kaufman, S. R. (2010). Time, clinic technologies, and the making of reflexive longevity: the cultural work of time left in an ageing society. *Sociology of health & illness, 32*(2), 225-237.

Khan, Z. (1998). *Attitudes towards intelligent service robots*. Retrieved from Stockholm:

Kidd, C. D., & Breazeal, C. (2008). *Robots at home: Understanding long-term human-robot interaction.* Paper presented at the Intelligent Robots and Systems, 2008. IROS 2008. IEEE/RSJ International Conference on.

Kiefer, C. W. (2007). *Doing health anthropology: Research methods for community assessment and change*. New York: Springer.

Kluge, F., Zagheni, E., Loichinger, E., & Vogt, T. (2014). The advantages of demographic change after the wave: fewer and older, but healthier, greener, and more productive? *Plos ONE, 9*(9). doi:10.1371/journal.pone.0108501

Kohlbacher, F., & Herstatt, C. (2008). *The silver market phenomenon: Business opportunities in an era of demographic change*. Berlin: Springer Verlag.

Koskinen, I., Zimmerman, J., Binder, T., Redstrom, J., & Wensveen, S. (2011). *Design Research Through Practice: From the Lab, Field, and Showroom*: Morgan Kaufmann.

Krippendorff, K. (2005). *The semantic turn: A new foundation for design*. Boca Raton: CRC/Taylor & Francis.

Kuutti, K. (2001). *Hunting for the lost user: From sources of errors to active actors–and beyond.* Paper presented at the Cultural Usability Seminar.

Kuutti, K., & Bannon, L. J. (2014). *The turn to practice in HCI: Towards a research agenda.* Paper presented at the Proceedings of the 32nd annual ACM conference on Human factors in computing systems.

Kvale, S., & Brinkmann, S. (2009). *Interviews: Learning the craft of qualitative research interviewing*. Los Angeles: Sage Publications.

Lagergren, M., Johnell, K., Schön, P., & Danielsson, M. (2015). Healthy life years in old age: Swedish development 1980–2010 according to different health indicators. *Scandinavian journal of public health, 44*(1), 55-61.

Lammer, L., Huber, A., Zagler, W., & Vincze, M. (2011). *Mutual-Care: Users will love their imperfect social assistive robots.* Paper presented at the Work-In-Progress Proceedings of the International Conference on Social Robotics.

Landström, C. (1998). National strategies: the gendered appropriation of household technology. In M. J. Hård, A (Ed.), *The Intellectual Appropriation of Technology: Discourses on Modernity, 1900-1939* (p. 163). Cambridge: MIT Press.

Latour, B. (1999). *Pandora's hope: essays on the reality of science studies*. Cambridge, Mass: Harvard University Press.

Latour, B. (2005). *Reassembling the social - an introduction to actor-network-theory*. Oxford: Oxford University Press.

Latour, B. (2005). Reassembling the social-an introduction to actor-network-theory. *Reassembling the Social-An Introduction to Actor-Network-Theory, by Bruno Latour, p. 316. Foreword by Bruno Latour. Oxford University Press, Sep 2005. ISBN-10: 0199256047. ISBN-13: 9780199256044, 1*.

Laviolette, P., & Hanson, J. (2007). Home is where the heart stopped: panopticism, chronic disease, and the domestication of assistive technology. *Home Cultures, 4*(1), 25-44.

Lazar, J., Feng, J. H., & Hochheiser, H. (2010). *Research methods in human-computer interaction*. Chichester, West Sussex, UK: John Wiley & Sons.

Leason, C. A.-P., & Neven, L. (2015). Beyond determinism In D. Prendergast & C. Gabelich (Eds.), *Aging and the Digital Life Course* (Vol. 3, p. 84-106). New York

London: Berghan books.

Lehoux, P. (2006). *The problem of health technology: policy implications for modern health care systems*. New York: Routledge.

Lesnoff-Caravaglia, G. (2007). *Gerontechnology: Growing old in a technological society*. Srpingfield: Charles C Thomas Publisher, Limited.

Lewis, T., Langdon, P., & Clarkson, P. (2006). Investigating the role of experience in the use of consumer products. *Designing accessible technology, 9*(3), 209 - 225.

Lie, M., & Sørensen, K. H. (1996). *Making technology our own?: Domesticating technology into everyday life*. Oslo, Norway: Scandinavian University Press.

Lin, P., Abney, K., & Bekey, G. A. (2011). *Robot Ethics: The Ethical and Social Implications of Robotics*: MIT Press (MA).

Livingstone, S. (2007). On the material and the symbolic: Silverstone's double articulation of research traditions in new media studies. *New media & society, 9*(1), 16-24.

Loe, M. (2010). Doing it my way: old women, technology and wellbeing. *Sociology of health & illness, 32*(2), 319-334.

López, D., & Sánchez-Criado, T. (2015). Analysing hands-on-tech care wark in telecare installations. In D. Prendergast & C. Garattini (Eds.), *Aging and the Digital Life Course* (p. 179-197). New York / London: Berghan books.

Lupton, D. (2012). *Medicine as culture: illness, disease and the body*. London: Sage Publications.

MacKenzie, D., & Wajcman, J. (1999). *The social shaping of technology*. Buckingham and Philadelphia: Open University Press.

Mataric, M. J. (2015). *Socially assistive robotics: Personalized machines that (Provide) care.* Paper presented at the Pervasive Computing and Communications (PerCom).

Mayo, E. (1949). Hawthorne and the western electric company. 161 - 170.

McCarthy, J., & Wright, P. (2004). Technology as experience. *interactions, 11*(5), 42-43.

Miller, D. (2007). Artefacts and the meaning of things. In S. Knell (Ed.), *Museums in the Material World* (p. 166 - 186).

Milligan, C., Roberts, C., & Mort, M. (2011). Telecare and older people: who cares where? *Social Science & Medicine, 72*(3), 347-354.

Mol, A., Moser, I., & Pols, J. (2010). *Care in practice: On tinkering in clinics, homes and farms*. Bielefeld: transcript Verlag.

Mori, M. (1970). The uncanny valley. *Energy, 7*(4), 33-35.

Mort, M., Roberts, C., & Callen, B. (2013). Ageing with telecare: care or coercion in austerity? *Sociology of health & illness, 35*(6), 799-812.

Mort, M., Roberts, C., & Milligan, C. (2009). Ageing, technology and the home: A critical project. *ALTER-European Journal of Disability Research/Revue Européenne de Recherche sur le Handicap, 3*(2), 85-89.

Mort, M., Roberts, C., Pols, J., Domenech, M., & Moser, I. (2013). Ethical implications of home telecare for older people: a framework derived from a multisited participative study. *Health Expectations, 18*(3). doi:10.1111/hex.12109

Motion 1998/99: So436 Ädelreformen.

Neven, L. (2010). 'But obviously not for me': robots, laboratories and the defiant identity of elder test users. *Sociology of health & illness, 32*(2), 335-347.

Neven, L. (2011). *Representations of the old and ageing in the design of the new and emerging: assessing the design of ambient intelligence technologies for older people.* (PhD thesis PhD thesis), University of Twente, Enschede.

Neven, L. (2015). By any means? Questioning the link between gerontechnological innovation and older people's wish to live at home. *Technological Forecasting and Social Change, 93*, 32-43.

Neven, L. (2011). *Representations of the old and ageing in the design of the new and emerging: assessing the design of ambient intelligence technologies for older people*: University of Twente.

Nicolini, D. (2013). *Practice theory, work, and organization: An introduction*. Oxford: Oxford university press.

Norman, D. A. (2013). *The design of everyday things: Revised and expanded edition*. New York: Basic books.

Nussbaum, J. F., & Coupland, J. (2004). *Handbook of communication and aging research*. Mahwah, N.J: Lawrence Erlbaum Associates.

Nussbaum, J. F., Pecchioni, L. L., Robinson, J. D., & Thompson, T. L. (2000). *Communication and aging*. Mahwah, NJ: Routledge.

Nylander, S., Ljungblad, S., & Villareal, J. J. (2012). *A complementing approach for identifying ethical issues in care robotics-grounding ethics in practical use.* Paper presented at the RO-MAN, 2012.

Pariser, E. (2011). *The filter bubble: What the Internet is hiding from you*. UK: Penguin

Peine, A., Faulkner, A., Jæger, B., & Moors, E. (2015). Science, technology and the 'grand challenge'of ageing—Understanding the socio-material constitution of later life. *Technological Forecasting and Social Change, 93*, 1-9.

Peine, A., & Herrmann, A. M. (2012). The sources of use knowledge: Towards integrating the dynamics of technology use and design in the articulation of societal challenges. *Technological Forecasting and Social Change, 79*(8), 1495-1512.

Peine, A., Rollwagen, I., & Neven, L. (2014). The rise of the "innosumer"—rethinking older technology users. *Technological Forecasting and Social Change, 82*, 199-214.

Plowman, T., Prendergast, D., & Roberts, S. (2009). "From people to prototypes and products: ethnographic liquity and the INTEL global aging experience study". *Intel Technology Journal, 13*(3).

Pols, J. (2012). *Care at a Distance*. Amsterdam: Amsterdam University Press.

Pols, J., & Willems, D. (2011). Innovation and evaluation: taming and unleashing telecare technology. *Sociology of health & illness, 33*(3), 484-498.

Prendergast, D., & Garattini, C. (2015). *Aging and the Digital Life Course* (Vol. 3). New York / London: Berghahn Books.

Pritchard, G. W., & Brittain, K. (2015). Alarm pendants and the technological shaping of older people's care: between (intentional) help and (irrational) nuisance. *Technological Forecasting and Social Change, 93*, 124-132.

Ranada, Å. L., & Hagberg, J.-E. (2014). All the things I have—Handling one's material room in old age. *Journal of Aging Studies, 31*, 110-118.

Reckwitz, A. (2002). Toward a Theory of Social Practices A development in culturalist theorizing. *European journal of social theory, 5*(2), 243-263.

Reeves, B., & Nass, C. (1996). *How people treat computers, television, and new media like real people and places*. Stanford: CSLI Publications and Cambridge university press.

Reinharz, S. (1986). Friends or foes: Gerontological and feminist theory. *Women's Studies International Forum, 9*(5), 503-514.

Roberts, C., & Mort, M. (2009). Reshaping what counts as care: Older people, work and new technologies. *ALTER-European Journal of Disability Research/Revue Européenne de Recherche sur le Handicap, 3*(2), 138-158.

Rogers, E. M. (1995). *Diffusion of innovations*. New York: Free Press.

Rogers, W. A., & Fisk, A. D. (2010). Toward a psychological science of advanced technology design for older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 65*(6), 645-653.

Rogers, Y. (2012). *HCI theory: classical, modern, and contemporary* (Vol. 5). London: Morgan & Claypool publishers.

Ryan, E. B., Szechtman, B., & Bodkin, J. (1992). Attitudes toward younger and older adults learning to use computers. *Journal of Gerontology, 47*(2), 96 - 101.

Sanders, E. B.-N. (1999). *Postdesign and participatory culture.* Paper presented at the Proceedings of the International Conference 'Useful and critical'-The position of research in design. University of Art and Design, Helsinki.

Sanderson, W., & Scherbov, S. (2008). *Rethinking age and aging*. Washingthon, DC: Population Reference Bureau.

Schatzki, T. R. (2010). *Site of the social: A philosophical account of the constitution of social life and change*. University Park: Pennsylvania State University Press.

Schulz, R. (2012). *Quality of life technology handbook*. Boca Raton: CRC Press.

Scopelliti, M., Giuliani, M. V., & Fornara, F. (2005). Robots in a domestic setting: a psychological approach. *Universal Access in the Information Society, 4*(2), 146-155.

Selwyn, N. (2003). Apart from technology: understanding people's non-use of information and communication technologies in everyday life. *Technology in society, 25*(1), 99-116.

Sharkey, A., & Sharkey, N. (2012). Granny and the robots: ethical issues in robot care for the elderly. *Ethics and Information Technology, 14*(1), 27-40.

Shove, E. (2003). *Comfort, cleanliness and convenience: The social organization of normality*: Berg Oxford.

Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: everyday life and how it changes*. Los Angeles: Sage Publications.

Shove, E., Watson, M., Hand, M., & Ingram, J. (2007). *The design of everyday life*: Berg Oxford.

Shove, E., Watson, M., & Ingram, J. (2005). The value of design and the design of value. Paper presented at the Joining Force International Conference on Design Research, Helsinki.

Silverstone, R., Hirsch, E. and Morley, D. (1992) Information and Communication Technologies and the Moral Economy of the Household, in Silverstone, R. and Hirsch, E. (eds) Consuming Technologies: Media and Information in Domestic Spaces. London: Routledge

Silverstone, R. (1994) Future Imperfect - Media, Information and the Millenium, PICT Policy Research Paper No.27, Brunel University. Silverstone, R. (1995) Media, communication, information and the 'revolution' of everyday life, in Emmott, S. (ed.) Information Superhighways: Multimedia Users and Futures. London: Academic Press.

Silverstone, R. and Haddon, L. (1993) Future Compatible? Information and Communications Technologies in the Home: A Methodology and Case Study. A report prepared for the Commission of the European Communities Socio-Economic and Technical Impact Assessments and Forecasts, RACE Project 2086, SPRU/CICT, University of Sussex.

Silverstone, R. (1994). Television and everyday life. London / New York: Routledge.

Silverstone, R., & Haddon, L. (1996). Design and the domestication of ICTs: technical change and everyday life. In R. a. M. Silverstone, R (Ed.), Communication by design. The politics of information and communication technologies (p. 44-74). Oxford: Oxford University Press.

Silverstone, R., & Hirsh, E. (2003). Consuming technologies - media and information in domestic spaces. London / New York: Routledge.

Socialdepartementet. (2010). Nationell eHälsa – strategin för tillgänglig och säker information inom vård och om- sorg. Diarienummer: S2010.020.

Sparrow, R., & Sparrow, L. (2006). In the hands of machines? The future of aged care. *Minds and Machines, 16*(2), 141-161.

Suchman, L. (2007). *Human-machine reconfigurations: Plans and situated actions*. Cambridge: Cambridge University Press.

Suchman, L., & Bishop, L. (2000). Problematizing'innovation'as a critical project. *Technology Analysis & Strategic Management, 12*(3), 327-333.

Sung, J., Grinter, R. E., & Christensen, H. I. (2010). Domestic robot ecology. *International Journal of Social Robotics, 2*(4), 417-429.

Sung, J.-Y., Guo, L., Grinter, R. E., & Christensen, H. I. (2007). *"My Roomba Is Rambo": Intimate Home Appliances.* Paper presented at the Ubiquitous computing, Austria.

Swanborn, P. (2010). *Case study research: what, why and how?* Los Angeles: Sage.

Szebehely, M., & Trydegård, G.-B. (2007). Omsorgstjänster för äldre och funktionshindrade: skilda villkor, skilda trender? *Socialvetenskaplig tidskrift, 14*(2-3), 197-219.

Szebehely, M., & Trydegård, G. B. (2012). Home care for older people in Sweden: a universal model in transition. *Health & social care in the community, 20*(3), 300-309.

Sørensen, K. H., Aune, M., & Hatling, M. (2000). Against linearity on the cultural appropiation of science and technologydomestication. In D. Dierkes & C. Grote (Eds.), *Between understanding and trust: The public, science and technology* (pp. 237-257). Amsterdam: Harwood Academic

Tornstam, L. (2005). *Gerotranscendence: A developmental theory of positive aging*. New York: Springer Publishing Company.

Turkle, S. (2012). *Alone together: Why we expect more from technology and less from each other*. New York: Basic books.

Vallor, S. (2011). Carebots and caregivers: Sustaining the ethical ideal of care in the twenty-first century. *Philosophy & Technology, 24*(3), 251-268.

van Wynsberghe, A. (2013). Designing robots for care: Care centered value-sensitive design. *Science and engineering ethics, 19*(2), 407-433.

Vines, J., Clarke, R., Wright, P., McCarthy, J., & Olivier, P. (2013). *Configuring participation: on how we involve people in design.* Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.

Wajcman, J. (1991). *Feminism confronts technology*. University Park, Pennsylvania: Pennsylvania State University Press.

Walters, M. L., Syrdal, D. S., Dautenhahn, K., Te Boekhorst, R., & Koay, K. L. (2008). Avoiding the uncanny valley: robot appearance, personality and consistency of behavior in an attention-seeking home scenario for a robot companion. *Autonomous Robots, 24*(2), 159-178.

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambidge, UK: Cambridge University Press.

Wherton, J., Sugarhood, P., Procter, R. N., & Greenhalgh, T. (2015). Designing technologies for social connection with older people. In D. Prendergast & G. Chiara (Eds.), *Aging and the Digital Life Course* (pp. 107-124). New York / London: Berghan books.

WHO, W. H. O. (2015). *World report on ageing and health*. http://www.who.int/ageing/events/world-report-2015-launch/en/ Retrieved from http://www.who.int/ageing/events/world-report-2015-launch/en/.

Wigg, J. M. (2010). Liberating the wanderers: using technology to unlock doors for those living with dementia. *Sociology of health & illness, 32*(2), 288-303.

Wiklund Axelsson, S., Melander Wikman, A., Näslund, A., & Nyberg, L. (2013). Older people's health-related ICT-use in Sweden. *gerontechnology, 12*(1), 36-43.

Wiles, J. L., Leibing, A., Guberman, N., Reeve, J., & Allen, R. E. (2011). The meaning of "ageing in place" to older people. *The gerontologist, 52*(3), 357 - 366.

Winfield, A. (2012). *Robotics: A Very Short Introduction*. Oxford, UK: Oxford University Press.

Wyatt, S. (2008a). Feminism, technology and the information society - Learning from the past, imagining the future. *Information, Community & Society, 11*(1), 111-130.

Wyatt, S. (2008b). Technological determinism is dead; long live technological determinism. In E. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *The handbook of science and technology studies* (pp. 165-180). Cambridge, USA: MIT Press.

Yin, R. K. (2014). *Case study research: Design and methods*. Los Angeles: Sage publications.

Östlund, B. (1995). *Gammal är äldst: en studie om teknik i äldre människors liv.* (PhD Thesis), Linköping University, Linköping: Tema.

Östlund, B. (2011). Silver age innovators: a new approach to old users. In F. Kohlbacher & C. Hertstatt (Eds.), *The silver market phenomenon* (pp. 15 - 26). Heidelberg: Springer.

Östlund, B., Olander, E., Jonsson, O., & Frennert, S. (2015). STS-inspired design to meet the challenges of modern aging. Welfare technology as a tool to promote user driven innovations or another way to keep older users hostage? *Technological Forecasting and Social Change, 93*, 82-90.