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Designing for Prolonged Mastery. On involving old people in Participatory Design

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Abstract. In this paper, we report on a participatory design (PD) process with old users. We discuss how we organized and carried out the process so that our users could participate in the mutual learning and co-construction activities on their own terms. When organizing the process we had to take into account the limited capacity for design participation of our users but also build on the capacities they have. The paper describes our PD approach and what we did to facilitate participation from our old users, emphasizing recruiting, timing, continuity, representativity, and immediacy. The paper also discusses which design decisions the users participated in and how they influenced the design result. We analyse how they brought in design possibilities (choices), selected, concretized and evaluated them, and also how the final design result bears traces of their participation.

Key words: participatory design, old users, design decisions, mutual learning, co-construction.

1 Introduction

All over the globe people live longer, and many countries look for technologies that can assist old people in living independently longer in their homes. The European focus on assisted living and the Scandinavian commitment to welfare technology have resulted in large efforts to develop IT for people as they age. But what sort of support do old people really want? Do they get the chance to influence the design of such technologies? How could we arrange for their participation in design?

In this paper, we discuss how Participatory Design (PD) can be tailored to old people with limited capacities for participating as user representatives in organized PD activities due to physical or socio-cultural conditions accompanying aging, like reduced motor or cognitive capacities,

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fatigue and illness. We focus on old people who live independently at home with some assistance (what Östlund et al. (2015) call “the fourth age”). In the PD project reported in this paper, the participating old people produced results that are recognizable in the final design result. The paper discusses how the participation was organized and carried out along two dimensions: (1) how we organized the PD process to enable the old users to participate, and (2) what their participation consisted of. We analyze experiences from three years doing PD with old people and discuss how we redesigned the PD process in order to arrange for real participation for the old users. The paper builds on and expands earlier reports from the project (Joshi and Bratteteig 2015) by including detailed accounts of what and how the old participants contributed in the PD process, and an analysis of their influence. Our analysis of participation in PD contributes to the current debate about this by applying a general conceptual framework (from Bratteteig & Wagner 2014) on PD with old people. Our second contribution is our analysis of old people’s preconditions for active PD, and based on this our third contribution shows how PD can be organized and facilitated to meet the old people on their own terms.

The paper is structured as follows: Section 2 presents the main characteristics of PD emphasizing mutual learning and co-construction and describes our conceptual framework for analyzing participation in design. In Section 3 we give an overview of related work. In Section 4 we describe our empirical basis: a large PD project with old people, and we go into detail on the participation of five of our user participants. In Section 5 we discuss the analysis further to identify how and what our users contributed to through their participation in the design process. Section 6 presents the main changes to the PD process we made in order to make participation feasible for our old users. In Section 7 we discuss our approach and how it influenced the design results. Section 8 concludes the paper with a summary of the main principles for realizing PD with old users.

2 Some basics of Participatory Design

Before we discuss how we adjusted PD to our old user participants, we need to introduce the basic principles of PD. The origin of Participatory Design (PD) is the democratic ideal that those who will be using an artifact should be given the right to decide on its design: its functioning as well as its form, and through this gain more control over the use situation and achieve a larger space for action (Nygaard 1979; 1996; Simonsen and Robertson 2012; Bratteteig & Wagner 2014). Users are seen as experts on their own practices (Ehn 1989; Bjercknes and Bratteteig 1995; Bjercknes et al. 1987) and their expertise is needed in the design in order to arrive at a “participatory design result” (Bratteteig and Wagner 2016). The users should have a voice as well as a say in the design process (Kensing and Greenbaum 2012). Design in PD ideally becomes a collaborative process where expertise from both use and technology domains are necessary ingredients. This in turn affects how the design process is organized and carried out, making processes of mutual learning and co-construction essential (Bratteteig et al. 2012).

Seeing the design process as a collaboration between two expert groups with little knowledge about each other’s expertise suggests that they need to learn from each other. The first phase of PD is therefore mutual learning (Bratteteig et al. 2012; Bratteteig 1997): designers need to learn

about the use context and users' activities, and they need to observe and interview users in situ themselves. The users on their side need to learn about the technical possibilities so that they are able to imagine new solutions as well as the new practices that these solutions can bring about. The objective of mutual learning is to learn enough about each other to see the logic of the other domain: to recognize the logic and competence underlying all participants' reasoning about a design idea (Bratteteig et al. 2012).

A successful mutual learning process enables all participants to widen their imaginative capacity and to build on each other's ideas, increasing the possibility for designs that combines several imaginary sources. They need to spend time together: over time, their imagination about design possibilities, about needs and wishes for technology solutions changes as they learn more.

PD mixes analysis and design: understanding more of a problem area gives a better basis for imagining possible solutions. A prototyping workshop can therefore be used as a method of inquiry while a study tour to see a similar artifact in use in its real use context can be part of evaluation. In addition to mutual learning, PD emphasizes co-construction activities where users and designers work together on making concrete design representations and prototypes, and evaluate the design results together; e.g.; (Brandt et al. 2012). Co-construction is often intertwined with mutual learning: trying to concretize a design idea can spur a discussion not only about the problem solution but also about its definition (Bratteteig et al. 2012; Bødker and Grønbæk 1991).

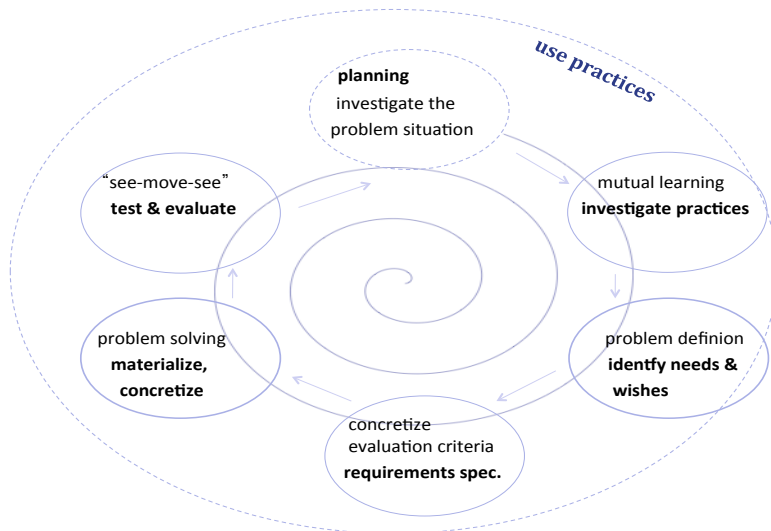


Figure 1. A model of the participatory design process (modified after (Bratteteig et al. 2012)).

In PD, the development of a problem definition and its solution goes hand in hand; they evolve together over time. Defining the problem typically involves fieldwork (interviews, observations on-site) and analysis of needs, their rationale and priority, while solving the problem typically involves various concretizing activities (design workshops, experiments, tests). A PD cycle typically involves getting to know the use context, identifying needs, specifying requirements,

concretizing design suggestions, testing, and evaluation in use—sometimes collapsed into the same activity (Figure 1). PD typically involves several iterations of these activities.

The view that problem setting and solving goes hand in hand is based on Schön (1983). Our analysis builds on Schön's conceptual framework on design and his notion of design as sequences of seeing-moving-seeing (Schön 1983; Schön and Wiggins 1992). Bratteteig and Wagner (2014; 2016) suggest a framework for analyzing participation based on Schön's concepts of seeing-moving-seeing combined with Schütz's (1951) concept of 'choice'. 'Seeing' involves considering the design possibilities: the choices in the situation; 'moving' includes selecting one of the choices and making a concrete design suggestion (concretizing it); the last 'seeing' refers to the evaluation of the move. If the move does not bring the design closer to the final design result, the move can be 'undone' and another move tried. Users can participate in all four activities: making choices, selecting one, concretizing it, and evaluating it. Hence, when describing participation in design we look at the decision-making in design: which choices have been made and who made them. Having 'a voice and a say' therefore means to be involved in such decisions in ways that influence the final design result in recognizable ways (Bratteteig and Wagner 2014; 2016).

3 Related work

Over the last decade, the PD community has discussed ways to organize PD processes with old people. Related work can also be found within more general research on PD with vulnerable users.

Several researchers have discussed problems when redesigning for the home, with the residents. Ill and weak users are a challenge for PD, and Grönvall and Kyng (2011) point to the danger of the researcher dominating the PD process too much. Aarhus et al. (2010) discuss how to overcome the problems concerned with their user group, who "did not have the resources to fully engage in PD activities such as technology explorations, mock-ups, Wizard of Oz and different forms of creative workshops." Dickinson et al. (2003) advocate in-home requirements gathering to help identify more realistic needs for technology from old people. The selection of user participants when working with old people has been discussed (Aarhus et al. 2010; Lindsay et al. 2012; Uzor et al. 2012). The diversity of health conditions, contextual factors and daily activities of old people complicates the facilitation of PD. Grönvall and Kyng (2013) explain how moving the PD process into a home environment affects the organization, participation, and recruitment, especially when working with ill and fragile participants. Anderberg and Berglund (2010) paint a very realistic picture of the everyday lives of old persons in their description of thoughts and perspectives of inhabitants receiving care in nurse homes.

There is always a need to acknowledge and understand the context in PD (Robertson and Wagner 2002). Scandurra and Sjölander (2013) argue that contextual considerations are important when designing together with old people. Similarly, Ballegaard et al. (2008) discuss the design of the development process and how contextual considerations such as daily activities must be integrated as a part of the approach for the technology to sustain.

Ekdahl et al. (2010) discuss old patients' needs and preferences when making decisions about care and medical treatment, pointing at limitations involved when engaging old partic-

ipants. Aarhus et al. (2010) describe a variety of challenges and roles for participation in their study of old people suffering from vertigo, and argue for involving users despite their limited capacity to participate: their users contributed significantly to the end result. The work of Uzor et al. (2012) involved old users with limited possibilities to participate in the early stages of PD to achieve better results. Grönvall and Kyng (2013) report that half-day participation made their participant exhausted and affected her for days. They discuss how providing the participants with a meaningful engagement could help in recruiting: they argue that old people with a chronic illness need a purpose in order to spend their few ‘good days’ participating in a project. Kanstrup et al. (2014) describe how they have tailored their PD approach to their user group: a community trying out ‘transect walks’ as a start-up method for entering the area. The danger of overselling the outcome of PD activities to such participants is also stressed.

The research literature also includes discussions on how we involve various stakeholders such as proxy users to strengthen the design process. Hendriks et al. (2014) contribute to this discussion by demonstrating the value of bringing in trustworthy companions such as family members. They also stress the importance of being selective since many participants participate as a favor to the researcher rather than from a desire to contribute to the design process. Clemensen et al. (2007) make use of interdisciplinary teams to overcome practical challenges of involving old people in PD related to medical issues. Hultdtgren et al. (2013) present a concept for community-based co-creation with the goal to facilitate long-term collaboration with various stakeholders in a community environment, emphasizing mutual learning. Their discussion about commitment and how to engage participants is relevant for some of the topics experienced in our empirical context. Eisma et al. (2003) describe sessions where older people would build knowledge and experience with new and unfamiliar technology through hands-on activities.

Zhang and Wakkary (2014) emphasize how designers’ personal experiences influence design, relating this to the designers’ empathy with users. They claim that “the closer designers could get to their users’ lives and experiences, the more likely that their products and services could meet the users’ expectations and needs.” (p. 897). They refer to Koupric and Visser (2009), who discuss empathy as a process where the designers both become and stay beside the users. Yamauchi (2009) similarly suggests using empathic relations to better understand the participants. Also Wright and McCarthy (2008) advocate methods for getting to know the user, among them ‘empathy through narrative’, like in scenario-based design. Lindsay et al. (2012) argue for the importance of empathy when engaging old people, to make their engagement meaningful.

Finally, a part of the discussion about the organization of PD concerns the diversity of senior citizens. Seeing them as one homogeneous group of people can result in composing a user group with too diverse participants, which may not result in less than optimal group dynamics. Aarhus et al. (2010) and Grönvall and Kyng (2013) exemplify how equally old people have different attitudes and perspectives towards technology. This is supported by Vines et al. (2012) who use the term ‘eighty-something’ to describe the age group rather than characterizing them as old or oldest old. Hultdtgren et al. (2013) discuss how age is not bound to our biological age, but rather to the individual perception of age. Malmberg et al. (2010) confirm the difficulties finding characteristics for old participants that are not grounded in age and at the same time avoid stigmatizing their self-image. Their studies suggest different approaches and they suggest the concept of ‘situated elderliness’ as a way of addressing the old participants and simultaneously acknowledging context-specific challenges (Brandt et al. 2010).

Our study overlaps with many of the studies mentioned above as they report on how the bias and assumptions we have as researchers—and that are built into PD methods—get revealed when trying to make PD work for old users: the eighty-something people. Our approach has been to put a strong emphasis on what old people know and can do, hence tailoring the PD process to their competencies rather than their problems. Our empathy with our users has been necessary to tailor the process adequately, but insufficient for acting as representatives for their logic in the design process: this has required their participation. However, empathy helps for recognizing their competence. Our project facilitated PD by fragmentation of larger processes into sets of smaller processes and reassembling them into a whole. The heterogeneity of the fragments fitted the heterogeneity of the participants and enabled us to tailor the PD to each individual's competencies.

4 Our design approach

This section presents our project in more detail. We describe how we tailored the PD process to our participants, and present in detail five of the participants to illustrate the heterogeneity of the old users. This enables us to show that the fragmentation of the process took this heterogeneity into consideration. In addition to presenting our empirical material, this section includes an account of our methodology and the phenomenological basis for our work.

4.1 Practicing participatory design with old people

As part of a large research project¹, we had a long-term collaboration with Oslo Municipality and carried out a study of technology use in one of the several residences built for old people to live longer independently in their own homes. The building we studied contains 92 apartments (for rent), at the moment housing 104 persons with the average age 84 years (ranging from 74 to 101). The building is a residential building but includes some extra services like a reception desk with 24/7 staffing (three people every day, one person during the night), a café where the residents can buy dinner, a gym, an activity center open to the public etc.; a concept labeled Care+. The Care+ building has installed welfare technology for increased safety: stove guard, motion sensors in all rooms; e.g.; for a night light; video calling and door lock (RFID), electrical sockets with timers and automatic energy regulation (light, heating). The welfare technology solution also includes a tablet with an Internet connection for communication and information exchange; e.g.; telephone, calendar and bulletin board. The welfare technology was installed in December 2012, and at that time, it was the largest installation of its kind in Europe and made a good basis for studying use practices on a large scale. One fully-equipped apartment in the Care+ building was reserved for our project for us to evaluate the existing solution, enhance it and experiment with alternative designs.

The aim of the collaboration with Care+ has been to evaluate the practical application of the welfare technology solutions and suggest improvements and alternative solutions. Three faculty and three Ph.D. students with 10-15 graduate students and 16 undergraduate students have

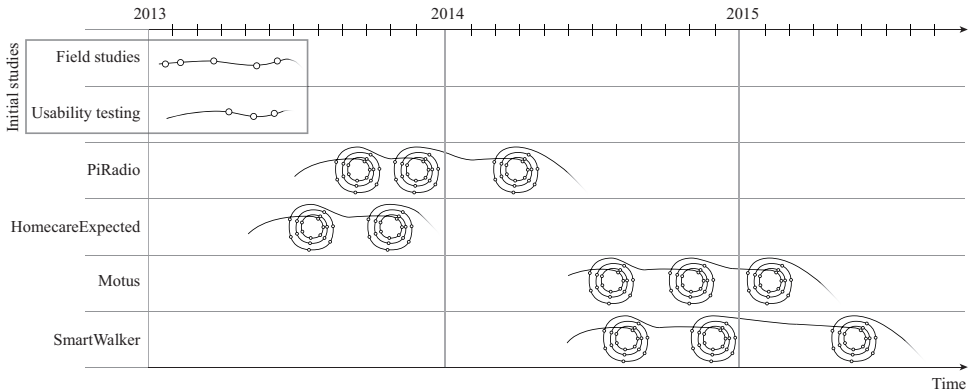


Figure 2. Overview of the four largest participatory design projects.

spent time in Care+ over the last three years. During these three years, we have organized ten small design processes with varying degrees of user participation. Initially, we started out with field work and usability testing (see Figure 2), but quickly discovered the need to facilitate more participatory activities in order for the residents to participate on their own terms. In some projects, the whole process was organized as PD, while in other projects, only one workshop activity could be considered to be participatory. Some of the projects spanned over several months with 2-3 design cycles, while others were organized as shorter processes. Table 1 presents an overview of the four largest PD projects with the corresponding number of residents from Care+ participating and the involved design activities. Each of these four projects involved 2-3 design cycles and lasted 4-12 months as illustrated in Figure 2. In total, 70 residents from Care+ (average age of 82 years) participated in these projects. The number of participants does not include other

<i>Project</i>	<i>Resident participants</i>	<i>PD activities</i>
PiRadio	20	Interview, observation, workshop, focus group, usability testing
Homecare Expected	10	Interview, home visit, coffee meetings, group observations, workshop, usability testing
Motus	17	Interview, home visit, physiotherapist walkthrough, workshop, usability testing, exhibition
SmartWalker	23	Interview, home visit, expert walkthrough, observation, workshop, usability testing

Table 1. Overview of the four largest PD projects with participants and activities.



Figure 3. Design results from the four PD projects (PiRadio, Homecare Expected, Motus, SmartWalker).

participants such as relatives, friends, volunteer workers, physiotherapists, and employees of the Care+ building.

The goal of these various projects was to design alternatives and improvements together with the residents. In the PiRadio project, the design process resulted in an alternative interface for a traditional radio. By recreating an interface that resembled traditional radio interfaces with similar feedback and modes of operation, the PiRadio was built around familiarity and habits. Homecare Expected yielded a mock-up for improved information about the delivery of health care services. The conceptual prototype allowed residents upon request to get a printed copy of the picture and name of the home care worker visiting on a given day before the visit. Normally, there are of different home care workers on duty to visit the care receiver, and the prototype attempted to support security and safety. In the Motus project rehabilitation and exercise was explored with the residents and an alternative exercise solution based on gesture detection was produced. An instruction video demonstrated a physical exercise that the resident would then have to recreate. With the help of Kinect-based movement analysis, the system would adapt to the performance and adjust the type and difficulty of exercises accordingly. Finally, SmartWalker explored alternative indoor navigation systems with the help of a Bluetooth-equipped walker and wall-mounted sensors in the building. By mounting the tracking system to the walker, residents who had problems navigating could be guided to their destination through a screen- and speech-based interface. The final prototypes produced in the four design processes are shown in Figure 3.

In the following we draw on experience from these four PD projects where the residents participated and influenced the process. These particular projects were carried out over the course of two years and with some overlaps. The projects were organized as a collection of separate but interdependent small projects on top of a small set of regular weekly activities for the residents: IT help workshop every Thursday evening, a local IT course every Monday at noon, regular visits involving workshops or interviews and observations.

Aging changes the body in many and non-linear ways, and vary enormously (Newell et al. 2007). Normal characteristics of the aging body, like declining sensing (eyesight, hearing, taste), loss of strength and balance, and changes in skin texture, fine motor skills and tremors make many appliances difficult to use. Also, a decline in memory, as well as the ability to understand abstractions (like maps), makes many standard interaction mechanisms and symbolic representations difficult or impossible to use. Designing for aging bodies, therefore, has to pay attention to what the design presupposes that the user is able to do, and to adjust these assumptions to the skills they have (Joshi 2015). PD helps us focus on what the users can do rather than

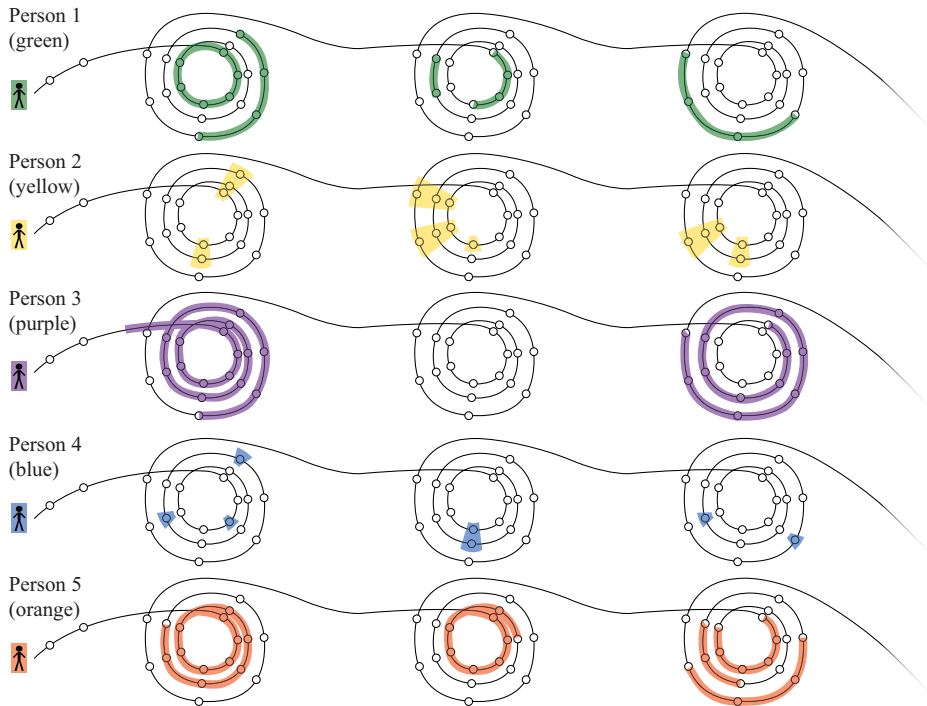


Figure 4. The participation activity for five of the participants throughout the project.

what they cannot (Newell et al. 2007), and base our design on the existing abilities—even if the loss of abilities tends to dominate the practical design challenges.

As explained above, our PD process can be described as a combination of several iterations of smaller projects (see Figure 2). The old users participated in some parts of some projects over a period and this long-term relationship enabled us to develop a coherent PD process (see Figure 4).

Figure 4 illustrates three iterative cycles where each cycle includes several smaller activities: interviews and observations, home visits, brainstorming sessions, group discussions, focus groups, coffee meetings, workshops, and prototype evaluations (cf. Figure 1). Different people participated in different activities depending on their abilities and interests. To demonstrate the different ways in which our participants influenced the design process, we present the participation stories of five of our user participants. These stories illustrate how their participation varied, and how focusing on shorter and more frequent activities allowed them to join even when they experienced that their capacity was limited.

4.2 Having a good day

Person 1 (green in Figure 4) was a man who depended on having “a good day” to participate. His health conditions prevented him from scheduling activities beforehand: he had to wait until the very same day to find out whether he was able to participate or not. His participation was a direct reflection of his daily capacity, introducing some unpredictability for us. The most important for him was not which activities he joined, but instead that he participated for as long as he could.

The green man was a former engineer and was very involved in the activities in which he participated. He was one of the very few participants able to formulate and introduce his own choices from the start. While others had to develop knowledge on technical possibilities throughout the whole design process, he already possessed a lot of the basic skills about protocols, frequencies and devices enabling him to imagine new technological solutions. In the second cycle he was more absent only participating in the initial stages of the first iteration, where he helped bridge the gap between us technicians and the old non-technical user experts. Due to his deep understanding of technology he was able to jump straight into the final stages of the second iteration and contribute to the concretization and evaluation of the various artifacts generated. Despite being absent from 12 of the 18 activities in the second cycle he still experienced the process as rewarding since he felt that he contributed to the design. His experience of influence and power—even through very limited presence—enabled him to join the third cycle at the very end. Due to health issues, he did not attempt to join any activities before the final stages of the last iteration in the third cycle. For him, participation was about influencing the design, not about hours spent.

4.3 No experience with technology

The second person (yellow) was very careful in picking the activities she would join. She did not want to participate in any activities involving tasks on devices such as testing of prototypes; she was very self-aware and aware of her limited experience with technology. She did not feel comfortable using devices for the first time in front of other people. She was only present for those activities that (she felt) enabled her to learn and contribute, but she participated consistently in the activities she liked. She is a very social person and seemed motivated by the social aspect of the participation: “It is nice to hear how I am not the only one struggling with this”.

In a way this woman represents common challenges that end-users face with welfare technology: she did not have any prior experience with technology (IT that is). However, she was still willing to participate. She was unable to articulate her needs through abstract thinking. Instead, she used home visits to demonstrate challenges with her own devices and technologies. She used her own equipment as thinking tools, and she was able to use the limitations of her current technology as a basis for selecting choices. She was not able to verbally express the reasoning behind the selections if the new design inputs were not built on top of her existing technology, but this helped her articulating her requirements. Due to her positive experience of contributing to a technical process without any prior technical knowledge, she joined all the concretizing activities during the second and third cycle as she had experienced an alternative

way of expressing input to decisions about concretizing. She attempted to join the evaluation activity during the second cycle but did not feel enough progress or mastery between the three iterations to continue with this in the third cycle. She said that

“I don’t want to test in front of others as my learning curve does not evolve at the same pace as others [...] I want to test at my own pace alone [...] For me, the most important thing is for the technology to recognize my challenges during construction. As long as the technology has understood my needs properly, I will slowly learn to operate it, and I prefer that rather than using tests to determine suitability”.

For her, participation was mostly motivated by the opportunity to influence the requirement specifications that laid the foundation for the technology as she trusted her own abilities to learn how to use the device over time.

4.4 Active contributor

The third person (purple) was a very motivated and energetic participant during the first cycle and one of our main contributors. She was present in all activities and seemed less affected by fatigue than many other participants. However, she was hospitalized close to the end of the first cycle and stayed in the hospital during the whole second cycle; she did not return to the Care+ building until the third cycle. Once she had fully recovered, she jumped straight back into the process and continued as before. She ended up having one of the highest overall attendances as she participated frequently when she was able to.

This woman was by far the most active participant in our design process, and she expressed a strong desire to join the whole design process as she felt she needed time to “grasp everything”. Despite not having any technical background, she quickly learned about opportunities from others. Her motivation for participation was the ability to learn something new well enough to feel a sense of mastery. She said she would only continue her participation after the first cycle if she felt able to reapply her newly acquired knowledge in the later cycles of the design process. Thus, for her participation was focused on the process of (mutual) learning rather than the outcome. However, she was one of few participants present long enough to exhibit and to improve her ability to create choices over time. She is a very energetic woman, and her ability to articulate her opinions were easily reflected in her activity and even in her body language. During the first iteration, she was present but less active throughout the choice elicitation. She would later express unfamiliarity with options, terminology, and possibilities as her main obstacle preventing full participation in creating choices. Over time, she learned more about these issues from other stakeholders and us, and she participated more and more actively. In the second and third iteration, she was actively engaged in the design decisions until the accident that required hospitalization. After her recovery she rejoined the design process during the penultimate cycle and stayed until the very end. As she was cognitively proficient she had no problem building on knowledge and experience from the previous cycle. Her experience from the previous process made her able to participate fully in the decision-making during both concretizing and testing in the final cycle. Despite being away for more than half of the activities, her stable and continuous

engagement during the first cycle had given her enough confidence and positive reinforcement to join the final cycle even after a three-month break.

4.5 Sporadic participation

The fourth person (blue) was one of our most unpredictable participants. His participation was very sporadic and seemed to be independent of health condition. He was always invited but only showed up once in a while. He explained his absence with “it was not a good time due to other commitments”. However, he participated consistently throughout the three cycles. His general health condition was good but his endurance was limited. He would never participate in more than one activity, even if it only lasted half an hour.

Participation is not an absolute or binary term, and this participant demonstrated an alternative desire to participate. During the very first activity he joined he clearly stated that participation for him was not about the number of hours put into the process, but rather about the possibility and freedom to participate as he pleased. For him participation was being part of a team; he valued the sense of ownership to the process more than an equal level of participation. He used the analogy of a distant relative who would not be expected to show up at every family gathering, but instead occasionally—and pleasantly—showing up. To him participation was only positive, despite being limited and almost non-existing during some of the cycles. When first approached, where others would inquire about where and when activities would happen, his only requirement for participating was having the flexibility to opt out of participation whenever he wanted. As a person suffering from general fatigue, he was unavailable for many of the scheduled activities and knew before committing that his participation came with restrictions. He also did not want to disturb his other commitments, yet still wanted to join. Due to the very limited time to participate for this man, it was necessary for the design process to be facilitated in close vicinity; otherwise, he would not have been able to join. This participant was unable to develop the necessary knowledge for formulating his own choices, even though he was part of all three cycles. For him, to build the necessary understanding of technology to articulate opinions during the selection of choices, we had to arrange for him to live with prototypes of the technology, enabling him to understand the alternatives through experience rather than through terminology. Due to his health condition, he never experienced a full iteration as fatigue would wear him out between activities. His fragmented participation made all phases blend together: he evaluated choices and selected among them at the same time. Even though he did not experience the participation as separate activities, after the final cycle he expressed a satisfaction with his ability to influence all three cycles, especially given his condition and limited ability to participate.

4.6 Careful participation

The fifth person (orange) was very ambitious in the beginning and participated in all activities. However, in the middle of the first cycle, she suddenly became sick and was unable to participate for a long time. As she had little prior experience with such activities, she later said she

was caught by a surprise of how exhausting participation can be, even in good company. She returned for the second cycle, but only participated in half of the activities compared to the previous cycle, and managed to participate without any negative effects on her health. In the final round, she chose to participate in even shorter but multiple periods, as this allowed her to participate more throughout the cycle than if she was to do it all in one consecutive stretch.

Having no prior experience with a similar design process, she overestimated her own capacity—as did we. This led us to rethink her participation when she returned for the second cycle. As she was made aware of the forthcoming absences she required immediacy so that she quickly could learn about the impact of her contribution before having to leave the process. She considered it important for her sense of power and influence to join at least one whole iteration per cycle so that she could see how her opinions were visible in the design result. Her more fragmented participation later would then be an added bonus giving her an even stronger sense of participation. While she was too tired to bring any artifacts home with her during her scheduled absence, she was given the option of continuing her participation through artifacts. It was difficult for her—and for us—to evaluate her capacity before actual participation demonstrated an adverse effect on her health during the first cycle. For this participant our aim was to facilitate a scheduled on-off participation. One way of giving her (a sense of) decision-making power in the activities was to reorganize her participation schedule as she learned more about her capacity during the second and third cycle. In addition to joining one full iteration a secondary goal was to expose her to the same activity as many times as possible. During the third cycle, she would join two activities during all three iterations, and this would enable her to make decisions on equal terms with respect to certain parts of the design process (in this case the requirement specification) as well as in the concretizing activity.

4.7 Fragments into a whole

These five stories demonstrate how we adapted the overall design process to the capacities of the old participants in the large as well as in the small. As illustrated in Figure 4, we started out with traditional usability tests and discovered that we had to fit the activities to the participants rather than try to fit them to standard plans. For the rest of the period, the organization of the activities was flexible from our side as a way to recruit more participants and adapt the process to their ability to contribute.

The participants learned about their own capacity for participating in the design process. The PD experience was new to most of them, and they did not know how it would affect their health. Some were very careful and avoided over-committing and had to complete several activities before they took the chance to participate more. Others contributed so much that they became ill, and had to reduce their commitment level when they returned. All participants redesigned their participation pattern based on their experiences from the first cycle. Our organization of the design process gave them space to do that: we had an open attitude towards the duration and frequency of their participation and gave them several chances to rejoin even after long periods of absence. Some participants only wanted to participate together, and providing a high frequency of activities allowed them to coordinate their PD participation with their other commitments.

The design of small-enough work tasks for the participants' competencies and abilities resulted in a complex collection of small PD projects that each contributed with a PD result. The overall research aim still was to design technical support for old people to live independently longer in their homes. Participation in one large, long-term PD project would obviously have required more resources than the resident-participants had.

In Figure 5 we illustrate how the whole PD process looks when the various pieces are put together. In each of the three iterations, we have represented how our residents participated, providing an overview of the types and size of the activities. We see that many of the residents only participated in one type of activity; e.g.; workshops; but for several iterations and in several phases. We see that some participated in a full iteration, and we see that some occur in all phases but in different ways.

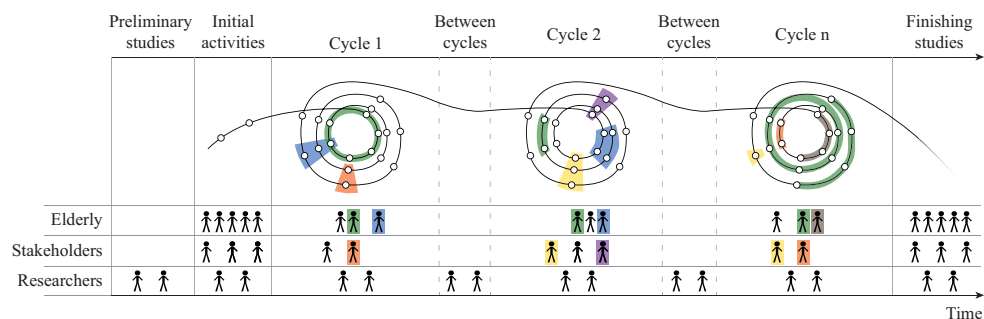


Figure 5. Illustration of the actual participation over time in the overall PD process.

The bigger picture also shows that the continuity of this PD process is provided by the use context: the everyday living at Care+ and that there is a community of voluntary resident-participants. The community as a whole has more resources and capacities than any individual participant. By utilizing the larger (use) context we can involve the community to participate in the overall PD project.

5 Analysis of participation in design

In this section, we analyze our empirical data concerning PD processes and results. We include here a more detailed analysis of the design decisions in order to understand how our old user-participants influenced the final design result. We use the framework described in Section 2, looking at (1) the choices the participants brought into the design, (2) if they could select a choice, (3) if they were part of concretizing the choice, and (4) if their evaluation of the choice was taken seriously in the design process. We also look at (5) the final design result and discuss how it may provide a larger space for action as well as how the participants have contributed to its design.

5.1 Creating choices

Most of our user participants were unable to introduce new choices without relying on their own lives and their own equipment as thinking tools. Figure 6 (left) shows how person 1 (yellow) used her home as a basis for introducing design suggestions based on her own equipment, things she found familiar. By using artifacts from her own life; e.g.; the safety alarm from Figure 6, middle; she articulated suggestions at home discovering opportunities by seeing the limitations of her existing equipment.



Figure 6. Residents using their own things as thinking tools.

Being able to build on familiar items allowed participants, who were not able to introduce new choices by imagination, to instead use recognition to suggest limitations and possibilities. Traditional equipment like radios and televisions, as well as newer technology, both used and unused, helped the participants articulate choices through explanation and demonstration.

Only a few of the old participants were able to develop enough familiarity with technology to independently suggest choices during the mutual learning process—in line with classic PD in workplaces (Bratteteig 1997). Person 3 (purple) developed the necessary technological competence through her long-term commitment and introduced new choices independent of existing equipment while person 1 (green) built on his professional experience as the basis for suggesting choices. Our participants brought in numerous choices, both independently and through using their own artifacts as thinking tools.

We also brought in choices, and our design suggestions built on what we had learned about our users as well as general knowledge about aging. We also tried to articulate choices we thought would address their needs. While this is not direct participation in creating choices, it generated choices that they later interpreted, concretized and evaluated independently of how the choice originated in the first place. The creation of choices would yield an array of alternatives that they could select from without expecting them to be able to formulate alternatives themselves. Several participants, for instance, person 2 (yellow) and person 4 (blue), did not show any particular concern with being the ones coming up with the idea, as long as they could influence the concretizing of the idea later in the process.

5.2 Selecting among choices

Selecting among choices was an important part of the decision-making for most participants as it gave a direct sense of participation: both excluding and keeping alternatives was experienced

as strong and clear indicators of influence. Being able to choose among the alternatives often required a thorough explanation as the ideas had originated from various participants and their opportunities and limitations were not obvious for participants, who did not have a technical understanding of the choice. Figure 7 shows two examples of workshops held for the participants to support their decision-making. In the workshops, they selected a choice based on walkthroughs of the various alternatives (neutral explanations independent of the originator). We also left behind prototypes of choices for the participants to continue the discussion after the workshops. Person 3 (purple) relied on the help and explanations from other participants when she returned from the hospital.



Figure 7. Workshops for selecting choices.

The processes of bringing in, selecting, concretizing and evaluating choices often collapsed into one activity by; e.g.; encouraging the participants to bring the artifacts home for evaluation in more familiar and everyday-like surroundings. Due to the general lack of familiarity with novel technology rushing the participants to make selections seemed counter-productive to the aims of PD. In the case of person 4 (blue), we spent time with various alternatives to properly understand the implications of use, hence, the selection of choices melted together with an evaluation of choices. Figure 8 shows two examples of participants going through independent testing (left) and discussion-based usability testing (right), respectively. Giving participants more time and space to explore alternatives before making their choices allowed them to make more qualified decisions.

5.3 Concretizing choices

While we found ways of dealing with absence during creation and selection of choices, decision-making in concretizing choices was much harder to achieve without participants' physical presence. Absence was one of the main reasons that some participants did not develop a sense of participating in the decision-making of the concretization of ideas. One example is person 4 (blue), who was absent for most concretizing activities—but also less interested in this part of the design process. The main challenge for our participants was to build enough knowledge about how the technologies could be concretized when starting with new and abstract concepts like induction charging. Building new alternatives based on or on top of their existing equip-

ment allowed several participants to articulate their opinions during creation and concretization of choices; e.g.; person 2 (yellow). In these cases, they understood where the idea underlying the alternatives came from (which was something they could relate to and understand). Hence it became easier for them to express opinions on how the various alternatives could be concretized.



Figure 8. Trying out things at home.

Another way of making the available options clearer to the participants was to present them with a wide array of choices. Figure 9 shows how an abstract concept like induction charging and RFID-based tangible blocks were concretized with different alternative materials so that the participants could explore the artifacts instead of building on imagination. To help participants make informed decisions about how induction chargers can be manifested, we provided a set of 10 off-the-shelf models in addition to some self-developed prototypes. The participants explored these before deciding on concretizing of choices. For the RFID-based tangible blocks, we gave them blocks of various sizes, materials and functionality to provide an empirical basis for their decisions.



Figure 9. Concretizing abstract technology solutions.

Another important feature was on site development of artifacts, where they could observe the construction of concretizing choices. Several choices were prototyped with 3D printers and laser cutters and the fact that we were able to carry out the prototyping in front of them helped them develop knowledge about the concretization of ideas. This helped us reduce the distance between doing and seeing and create a feeling of immediacy (see section 6.5). By presenting participants with tangible manifestations of their ideas on the same day as the workshop, we reduced the gap between expectations and results. It served two important purposes for the participants: (1) it demonstrated to them how their imagined ideas could be manifest by quickly producing artifacts, and (2) it gave them immediate feedback on their participation by visualizing how their opinions and decisions were represented in the artifacts. This process made the making of welfare technology more comprehensible and easy to relate to. One participant even commented that the technology seemed less cold when it was produced in-house. The close proximity to the residents homes also allowed participants with more sporadic and unpredictable participation, for instance Person 5 (orange), to easily jump into sessions when feeling well enough.

5.4 Evaluating choices

Most of the technology involved in our project was abstract: intangible and invisible, hence creating environments where users could imagine new design moves by seeing was challenging. Facilitating the evaluation of choices required us to rapidly prototype a large number of alternatives, however often collapsing the two types of decisions (concretization and evaluation) into one experience for the participants. Providing them with a large number of alternative designs for both organized testing and independent trying out was a key contributor for them to make informed decisions. When the participants could see through experiencing—learning by doing—both their understanding and decision-making were improved. We also introduced methods for evaluation that would give us feedback on the material choices; e.g.; material testing; through blindfold testing where they would try to understand how ideas materialized without using their eyes to see. To enrich their ability to develop informed comments to the design the long-term testing of design artifacts in their homes provided an understanding of use-in-context.

The way we organized the process also created the necessary flexibility in the participation schema. Both person 2 (yellow) and person 4 (blue) opted out of standard testing activities and instead chose to test artifacts in their homes between activities. For person 2 (yellow), it was a matter of preference: she wanted to experience the design in her own surroundings to properly evaluate. For her, evaluation was about gaining enough understanding of the artifact to properly see as many states of the system as possible. As she said: “when it works, we love it—when it does not work, we learn how strongly we love it”. For person 4 (blue), fatigue rather than active choice prevented him from participating in the design activities; he was not able to participate with the same precision as the others. He preferred to test artifacts on his own and return with comments. He appreciated the merging of selecting, concretizing and evaluating as it let him understand the concretizing of the design, evaluate his own influence, and finally help him make an informed decision on the selection. He never expressed a desire to create choices.

To facilitate participation for people absent from the evaluation activities, we arranged an exhibition of prototypes in the common area of Care+, where artifacts from the evaluation ac-

tivity were available for testing (assisted and independent). The artifacts were placed in the same area as the activities were normally held. This allowed the less frequent participants to catch up with the rest as they were able to test the same artifacts as them and by this partly compensate for their absence. If they had missed an activity with an interesting discussion the other participants would help summarize the discussion and contextualize the artifact. Figure 10 (right) shows an old participant having a prototype installed in her home for long-term testing, and on the left-hand side, we see a participant testing one of the exhibition prototypes available in the common area.



Figure 10. Long-term testing (right) and short-term prototype testing (left).

5.5 Influencing the design result

We have described some of the ways that the old user-residents participated in design decisions in our project. By facilitating a PD process tailored to their abilities—not insisting on doing PD in ways that they were not able to master—we succeeded in having their voice and their say in several design decisions. Table 2 summarizes the facilitations and decisions.

Our facilitation resulted in a PD process providing old people with an opportunity to participate and influence the decision-making throughout the design process. This way of facilitating the process also gave the participants the possibility to trace and recognize their choices in the final design result. One illustrating example is the development of the PiRadio (Figure 11): a more usable radio based on a new DAB-radio (Digital Audio Broadcast) equipped with the newest technology but with interaction mechanism and interface design based on older interfaces with traditional interaction mechanisms (Johnsson et al. 2012). The radio was co-constructed with some of the Care+ residents: in total 20 of the residents participated in the mutual learning and co-construction of the PiRadio.

The co-construction aimed at using rotary controls for operating the radio. In this way the interaction could make use of familiar gestures building on their habitual bodily skills (Johnsson et al. 2012; Merleau-Ponty 1962), the idea being that if they could not make sense of the interface intellectually, their ‘body would remember’ how to turn on the radio by recognizing the button as a device for rotary movement (the “maximum grip” (Merleau-Ponty 1962)).

<i>Category</i>	<i>Decision-making</i>	<i>Facilitation</i>
Create choices	All participants contributed numerous choices by 'discovering' choices by thinking through own artifacts Only participants with technical competence contributed with independent suggestions	Participants were encouraged to bring their own artifacts as thinking and 'discovering' tools
Select among choices	All participants made selections Few had prior experience to help inform the decision-making	Collapsing selecting with evaluation helped guide the selection Participants were walked through neutral explanations of various alternatives Numerous artifacts were created to demonstrate options and opportunities
Concretize choices	Few participants with technical interest made any decision Lack of interest and technical barriers prevented active decision-making from the majority of participants	'Immediacy' through rapid prototyping reduced the distance between doing and seeing Prototypes were developed 'on site' to visualize their influence
Evaluate choices	All participants actively made decisions regardless of participation pattern Decisions were assisted through activities or independently made through long-term testing	Blindfold and material testing, exhibition and long-term testing of artifacts in their own homes informed their decision-making Allowed to make decisions even when absent from evaluation activities

Table 2. Overview of design decisions.

The co-construction process involved designing a series of knobs and testing them as to how easy they were to turn when used by old fingers. Ageing often implies loss of strength in hands and fingers, and several of our participants struggled with getting a proper grip on some of the prototypes. A smooth plastic surface was, for instance, difficult to operate, in particular for fine-tuning the radio. The knob went through several iterations of redesign (co-construction) where our old user-participants tried out knobs of different shapes, sizes, and materials in the search for the best grip (see Figure 11 right). In the end, we arrived at a knob with a knurled and coarse surface that could compensate for reduced strength of their grip as well as reduced dexterity (reduced mobility and flexibility due to rheumatism or involuntary movements due to tremors). A second feature was the feedback of the knob when turned; its resistance and snap. The friction and snap into position were adjusted in cooperation with the participants in order to ensure that the feedback from the radio knob was familiar and immediately understood. The process made use of blindfold testing to investigate how the touch between the hand and



Figure 11. The PiRadio (left) and the prototypes for the knob (right).

the knob by itself, without visual stimuli, was able to trigger the habitual understanding of the interaction based on their experiences: “I understood when I touched it”. The result selected by all participants was confirmed by a one-tailed t-test used to compare the efficiency and effectiveness and the results showed that tasks were completed faster and with fewer errors when tested against two standard off-the-shelf radio models (Johnsson et al. 2012).

6 Tailoring PD to facilitate old participants

Our analysis of how we adjusted the PD process to facilitate real participation by our old users resulted in five topics: recruiting, timing, continuity, representativity and immediacy. Collaborating with the oldest people has been—and is—a pleasure. Their view on technology and quality of life differs from ours and represents a different logic that should be recognizable in the design result.

6.1 Recruiting

Recruiting participants for a particular activity proved to be easier than recruiting for a long-term commitment. In our consent form, we inform the participants that we will keep the recorded data for a year but several participants refused to sign—and to participate—because “I might not even be alive then. This is not for me!”. Many of the residents also did not want to engage in activities that were planned long time ahead. One reason is their determination to keep their promise while being uncertain about their health condition: they were reluctant to promise something that depended on them having a good day but agreed to participate if they could give the final answer in the morning on the day of the scheduled activity. If this was not an option, they often did not want to commit to participating. Some also tried to avoid thinking too much about the future: “I become sad when I think about how I will soon not be able to walk”. The future is a sensitive subject, and many old people do not see themselves as old and in need—they design to help others (Anderberg and Berglund 2010).

After some time, we managed to establish a group of eight committed participants and we asked them to find other people who could be interested in participating in the next couple of

weeks. This snowballing recruiting strategy proved more efficient than our direct one-to-one method. Old people are vulnerable to illness and injuries and two of our participants happened to get hospitalized during one of the iterations. They returned to the process when returning from the hospital. However, two of our participants died—we think they appreciated the fact that they could be active to their final moment.

Most residents at Care+ are women, and we also wanted to recruit some men to our workshops. Therefore, we went after the weekly football match on TV, where the men were gathered in the reception area and were in a good mood. In this situation, we easily recruited three men to a quick workshop. This more flexible strategy for recruiting people proved successful: it required spending more time with them and seizing the opportunity for recruiting people when the situation made it possible.

6.2 Timing

Linked to the previous theme is the duration of the participation. First of all, working with the people who inhabit the future use context means adjusting to that context. Working with old people in their homes means adjusting to their rhythms: their sleeping patterns (many sleep late) and regular appointments; e.g.; with home care services; their everyday practical-and-social routines, like the long meal together around lunch time, and the regular coffee at 5 PM, in addition to occasional appointments with the doctor or a physiotherapist. Also the Care+ staff organizes several activities during the week—all considered to be more important than our activities—and many of the old people had really full schedules. We had to look for open windows and opportunities for engagement in-between; hence, we always needed to keep ourselves oriented about activities and happenings at Care+.

This made us change our plans from doing a few long sessions to planning for several shorter ones. This organization enabled more people to participate in more sessions as our activities became easier to fit into their schedules. An additional reason for shortening the sessions was the fact that old people get tired from long sessions. Some of our old participants could only manage a half hour and some got a headache from looking at the screen for long.

More frequent and shorter sessions made our participants exposed to our themes more often. Most of the residents find technology difficult and strange, and they seldom meet IT in their everyday life. Having frequent discussions with us exposed them for the topics more often, reminding them about our topics and contributed to maintaining the continuity of the project. This was particularly helpful for those whose short-term memory is weak.

6.3 Continuity

A lesson from the two years spent at Care+ is the importance of creating continuity even though consistent commitment over time is not possible for most of the participants. We used several strategies for supporting the experience of continuity.

After some time, we moved our workshops and meetings to the library-meeting room right beside the reception area and with large windows facing the reception area. The reception area

is the meeting point for everyone at Care+. When our workshop participants leave the room, they are always encouraged to tell the curious spectators what happened; what they did, what we discussed, what they got to try out. The visibility of the project activities evoked curiosity and made recruitment easier. It also helped to establish continuity between the activities. The visible activities were positive reminders of our presence and the project topics. One of our colleagues, Rune Rosseland, has been arranging IT-workshops every Thursday afternoon for those who want to join. Seeing him every week was also a reminder and contributed to creating a feeling of continuity and confidence in our commitment. His regular presence gave him a different basis for contact than the less frequent visitors from our project.

Other PD projects have suggested leaving things after our activities to enhance the learning and attention without our presence (Yamamauchi 2009). The active residents made use of papers, photos, prototypes etc. that we left behind. This after learning also helped recruiting new participants as the continuing discussion encouraged a wider engagement. Above all, the discussions felt less strange and not threatening.

The old residents took their appointments very seriously, and not keeping appointments threatened the trust we had built throughout the project. Sometimes the home care nurses were too busy and did not show up to scheduled design activities with the residents. This made us more determined to control the appointments ourselves—trust is a fragile relation that can easily be destroyed by only a few examples of breaking the contract (Joshi 2014).

6.4 Representativity

Old people are as different as everyone else—maybe even more. Ageing meets us in very different ways, hence, the diversity is not easily represented through a few participants (see also (Fuglerud 2014)). Including employees and health care professionals in the project provides information about the variety and frequency of abilities and problems, hence we have invited all the daytime employees to be part of workshops and interviews. This has increased the feeling of trust and has made the participants relax because of their good personal relationships (Joshi 2014). We have taken the participants to represent themselves rather than (pre-defined) groups of people.

Our strategy of ad hoc recruiting people present in the reception area also resulted in recruiting people from the friends-of-Care+ community. This proved very useful as they are close to the residents; they know them and their problems very well. They also add to the discussion with experiences from living in their own homes rather than in Care+ apartments. We have also included relatives in our workshops. They often participate as observers, but sometimes comment on challenges that the residents forget to mention. They definitively contribute to a richer picture of the problem area. We also find that not distinguishing between the people in the reception area, including guests and visitors, makes the project more socially acceptable and interesting. The residents do not miss out of a social possibility, and including more people makes the project activity a part of the social community hence adding to the reasons for joining in.

6.5 Immediacy

Reducing the threshold and seriousness of participating in project activities makes it easier for everyone to participate. The division of activities into smaller units and addressing smaller elements of the project contributes to making participation in the project more accessible. A second strategy has been to demonstrate that the project aims to address problems that they experience in their everyday lives and that we are interested in hearing about their technology problems. Also, we offer help in solving (some of) them (Joshi 2015). Their problems are often not difficult to solve, and the concrete offers to help; e.g.; in the weekly Thursday evening workshop; have acted as a door opener for the project as a whole. More people become curious about participating. The difficult part was to have them understand the mutuality of the process; that they learn something and that we do as well. The aha moment demonstrating that learning has happened, often occurs when some concrete problem is solved: just talking about a technical feature does normally not result in increased understanding (Newell et al. 2007). Problems and solutions need to be concretized to contribute to the mutual learning.

As a way of increasing the old residents' understanding of technology design we arranged testing of materials. An example is the co-construction of the radio buttons: we brought buttons with very different properties; form, size, material, color etc. and had them look and feel their way to a decision about the best solution. The pedagogic principle of show, not tell was useful for understanding the interaction mechanisms as well as the possibilities for design options.

6.6 Facilitating a participatory design process

PD is first and foremost characterized by its organization of work, distributing design work to users and learning to the designers (Bratteteig et al. 2012). Organization of PD—like all organization of work—is concerned with the division of the work into tasks suitable for the available work resources as well as the coordination of these tasks to a coherent whole. PD with old people puts particular requirements to what kind of tasks can be carried out by the participating old people, and how the performance of the tasks is organized.

When collaborating with old people time is crucial: the scope of the project, the planning horizon, the stamina of the participants, the maintenance of dialogue over time, and the everyday rhythms that structure the days at home. All the topics discussed in Section 6: recruiting, timing, continuity, representativity and immediacy, refer to how old people experience time differently—and as having less time. The commonly experienced loss of short-term memory makes the immediate concrete activity more important: abstractions and representations beyond oneself in the here-and-now-communication are often not engaging or even understandable. The topics of representativity and immediacy both concern the reluctance to deal with issues outside of the present context or situation. Hence, the transferability of the PD results needs to build on more general knowledge about old bodies and old people's habits, needs, and quality of life.

7 Shaping the process to facilitate participation

The previous three sections have described in detail how (some of) our old user-participants participated in the design process, how they influenced the choices and decisions during the design, and how we organized and facilitated their participation in the design process. In this section, we reflect on our experiences and what they can add to the PD field.

7.1 Empowering marginalized user groups

Marginalized groups are people who under normal circumstances are excluded from decision-making (Bratteteig and Wagner 2014). Old and frail people are often not included in design processes as their ability to participate is limited. However, the ability to participate is only limited—not absent—and with proper facilitation old people are able to participate and contribute to PD processes. Our participants can be considered marginalized by developers and vendors since they never participated in any design activities before our process, despite living in apartments stocked and surrounded with welfare technology. The marginalization was induced upon them by society rather than by themselves, but society’s assessment of their ability to participate did not fit their own self-perception. One participant commented that “by participating in this process I want to debunk the myth that all elderly people are afraid of new technology”. He expressed that the residents felt more marginalized by society’s portrayal of them as weak, sick and troubled than by the limitations their own health condition would induce, see; e.g.; (López and Doménech 2009). There are other examples of PD processes facilitated for people marginalized by society, yet still possessing a strong desire to participate; e.g.; (Björgvinsson et al. 2010; Kanstrup et al. 2014). Our participants considered themselves excluded because they had to live with welfare technology that they had not been able to influence rather than excluded based on a political perspective grounded in social and economic conditions for influence (Guijt and Shah 1998).

Therefore, an important issue for us has been to ensure that the participants felt that they were more than token participants: we wanted them to experience participation on equal terms in collaborative decision-making processes. One way of expressing this attitude was to invite representatives of real policy and decision-makers in the municipality into the design process, so that the users’ opinions were shared directly with the important people. The voice they got in our fragmented PD processes was heard by the municipality—and got closer to having a say. This exchange of experiences represented a second arena for mutual learning, opening up a dialogue based on more than the collection of artifacts developed in the design process. Making alliances with representatives from different societal arenas may enhance the influence of the project (Gärtner and Wagner 1996; Bjerknes and Bratteteig 1995).

Another major value in our PD process was to set the right expectations for the participation and the process; the participants should experience participation as we advertised it. This is important for giving the users a sense of sharing power in the process and not being just a token of participation (Arnstein 1969). Our ambition to give the users a say, not just a voice had methodological implications and involved designing a process that was open enough for the participants to contribute where they preferred but also clear on our expectations from them.

Not communicating realistic objectives sufficiently clear may end up with people having very different expectations and perceptions, possibly leading to disengagement (Sanoff 2006).

7.2 Dealing with absence

In our project, we experienced people with very irregular patterns of participation. The absence of participation during the design process required facilitation in such a way that participants did not lose touch with the process and their influence in the decision-making. We strived for an organization with multiple short iterations where the effects of not participating in all activities were reduced. A high frequency of iterations is a way to make people with limited memory capacity more aware of their contributions to a PD process; e.g.; suffering from dementia (Lindsay, p. 525). This way of facilitating PD demonstrates that regular presentations of artifacts from the design process to the participants can make visible how their contributions are present in a particular design, and thereby help clarify how their input to the process has been interpreted (Bratteteig and Wagner 2014). Another argument for a high frequency and repetition of activities is that collaborative design requires time to mature, especially for people with little understanding of the technical aspects. Use of technology is an area of competence that requires first-hand experience, hence, the presence of users in design is needed. If the users have little technology experience and their capacity for imagining future use experiences is limited, time and space for frequent exposure to technology can compensate.

Rapid iterations with clearly defined objectives were also important for achieving a design result. It is important for the participants to see how they influence the process itself, but they also need to see the outcome of the process and how the design result influences the contextual conditions they started out with (Bratteteig and Wagner 2014). Since most of the participants in our project had limited time for participation due to old age, it was important that they got frequent chances to experience the design results so that they could see the traces of their influence. However, the outcome of the process extended the artifacts themselves: it also influenced the local authorities responsible for future procurement of welfare technology. In addition to the primary target group for PD research, policy makers have always been an important group of recipients of PD results (Kensing and Blomberg 1998; Bjercknes and Bratteteig 1995). Having the decision makers at the municipal level join the process served two purposes: they contributed to the design process especially considering the legal perspective, and, secondly, they served to help reflect on the process as their legislative actions would be directly influenced by the process.

On a more practical level, it was important that participants were able to keep each other updated on the design process without us being physically present. This was particularly important when their absence from an activity required some catching up activities for them to be able to participate in the next step. We wanted to avoid that participants fell behind in the process and felt distanced and unfamiliar with the development of the process so that they no longer felt the necessary commitment to continue their participation.

One of the motivations for selecting the reception area: a familiar, yet open public space as the venue for the design process was that it served as a meeting place for the residents (and participants). Several of our participants met in this space daily regardless of our scheduled activities. Thus, the meeting point was a natural place for the residents to keep each other updated on

the process (in the case of absence). To further strengthen these dialogues we intentionally left behind artifacts from the design activities so that they would remind the participants (and other residents) about the outcome of the last process. Examples of artifacts left behind were: notes, sketches and charts from the process; physical objects that were prototyped during the activity; e.g.; 3D-printed or laser-cut objects; photos of participants and artifacts. The participants meeting in this open space used the artifacts as tools to think with when reiterating and summarizing the design process to those who had been unable to participate.

7.3 Mastery: building on their competence

In addition to the irregular pattern of participation, the second main challenge with involving our participants on equal terms was their lack of technical experience. Development of welfare technology is an unknown domain for most old people. New and almost invisible technology such as sensor-based systems introduces a challenge where the design concerns intangible and invisible properties. To reduce the complexity of this kind of abstract technology it was important for us that our participants brought their own lives and experiences into the design process. By encouraging participants to express their opinions of the technology by bringing in their own personal experiences and challenges we reduced the level of abstraction in the discussion, see; e.g.; (Lindsay et al. 2012). One example of this approach is a workshop where we built induction chargers into all sort of everyday, well-known objects like the lacework tablemats shown in Figure 12.

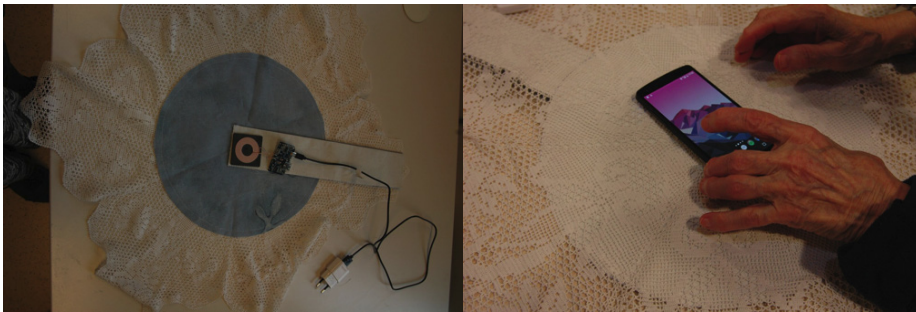


Figure 12. New technology (induction chargers) embedded in everyday objects.

We tailored the PD process to the capacity of the old participants. We facilitated bringing in their voices in the design process by hunting for things they like and master, and used these things as a basis for bringing in choices in design. In this way, their voices depended on our interpretation of what they know and like. This also goes for their role in selecting choices: this activity depended on us providing a large number of alternatives to select from but it limited their selection process to the examples we provided. However, sometime this sparked new ideas or comments beyond the physical reality of the present selection. Their participation in concretizing choices similarly depended on us arranging for immediate physical participation (like

the PiRadio described in 5.5). Like many other PD projects, our participants participated most easily in the evaluation of selected choices (Iversen and Joshi 2015). The importance of making a large number of concrete choices cannot be stressed too much: our old participants have limited capacity for generating more examples themselves and many choices offers some compensation for this. A large number of choices opens up space for reflection (Bratteteig 1997), hence collapsing the processes of bringing in, selecting, concretizing and evaluating choices.

Mastery is an important criterion for old people to be able to live with welfare technology (Joshi 2015). In our PD project, we find that we need a definition that not only focuses on losing capacities but also on the positive and development side of human life—present also in old age. Our approach to mastery resonates with educational approaches to mastery, although not taken to be a systematic training program (Bloom 1984; Dewey 1997). By building on existing capacities, knowledge and skill, we can open up the design space, and simultaneously form a process where participants are released from the shortcomings that marginalized them out of decision-making in the first place. PD is about fostering an open dialogue and enabling mutual learning; using a confrontational and sensitive issue like stressful and difficult situations people no longer master as the starting point challenges the emancipatory goal as well as both recruiting and participation.

There are two sides of participants' mastery that we want to emphasize. One is the mastery of technology: the degree of which a person is comfortable with and effortlessly uses a piece of technology. In a design process where new technical solutions are developed mastery of these will be important for selecting and evaluating the choices. Our strategy of lending prototypes to the user-participants for them to learn and familiarize themselves with the current design suggestions was a way to build mastery and confidence necessary for real participation in the design decision-making.

The second side of mastery is exactly this: the mastery of participation in PD. Participation on equal terms requires a certain level of competence. Hence, understanding and mastery of technical suggestions and choices are crucial to master the decision-making part of participation. As the purpose of our PD was to develop solutions with old people as end-users, a prerequisite for a successful outcome is that the participants master participation in the process. This is, however, closely linked to their mastery of the solution-to-be, of the ability to operate the artifact generated in the design process. We contend that successful mastery of the process opens up an extended design space that can generate results that can create mastery in use. The ultimate goal of PD is to shape a better future for the participants (van der Velden and Mörtberg 2014; Bratteteig and Wagner 2016), in our case: improved possibilities for living independently in their own homes. We have previously presented a phenomenological perspective on the process of aging (Joshi and Bratteteig 2015) applying phenomenology as a basis for arguing for using existing experiences and skills as a foundation for the design of durable welfare technology compensating as aging introduces challenges to independent living.

8 Tailoring PD to old people

Our aim in this paper has been to discuss how PD can be tailored to users such as the old residents at Care+, and how they can be part of designing their own future welfare technologies. We have argued that our project needed to divide the PD-work into smaller pieces to fit the capacities of our resident-participants. Moreover, by utilizing the use context as a frame for the larger PD project, we made it possible for our users to influence the bigger picture emerging from the puzzle of smaller pieces. Cooperation in PD is based on mutual respect and trust, which in turn is based on knowledge about each other's perspectives and competencies. The careful timing of PD activities as well as the utilization of the use context to support the continuity in and between activities contributed to establishing the necessary common ground. Our mutual learning process involved resident-participants learning from small activity chunks supported by reminders happening in regular patterns of activities (like the Thursday IT workshops) while our own learning happened as we discovered the practical and rather mundane problems that the old residents experienced, some very easily solved and some easily solvable with a better design (Sustar 2008).

PD emphasizes co-constructing the solutions hand-in-hand with defining the problems they solve. Our project has shown that old user-participants can participate in PD and contribute to bringing in choices, selecting choices, concretizing choices and evaluating choices if this is facilitated well. The detailed co-construction of the radio button (the PiRadio project) illustrated that a concrete design task was experienced as engaging while more abstract developments (navigation in the SmartWalker project) needed concretization to facilitate active participation. The radio buttons clearly show the influence of the participants (from the design process) in the final design result. The many prototypes co-constructed in the project contributed to concretizing what technology can do and acted as a basis for the resident-participants' imagination and evaluation in the design process.

The most difficult part of the project was supporting our resident-participants in reflection to develop their own choices and wishes—resisting the urge to drive the process too fast and with a too dominant technology focus. A process where their worldview to a larger degree decided the moves may have led to different designs and priorities in the design. Old peoples' lives are both more fragmented and have more continuity than the average (younger) designer's life. Assembling the pieces of PD into a larger context of mastery of technology hence resonates differently for the two groups. The patience to build a continuous account from smaller snippets of stories is crucial for creating alternative designs for old people.

We started the paper asking what sort of support old people really want, and have based our answer on phenomenology as well as on the analysis of actual design results made in collaboration with old people. In Section 5 we discussed how they can influence the design of technology support and in Sections 6 and 7 we described how we arranged for their participation in design. PD is about participation, and working with the oldest old sets limits to the forms and level of participation in design. Getting to know the old residents over time certainly improved our abilities to facilitate their participation, but we also needed the supplement of others who sometimes represented the interests of the residents better than they could do themselves. Our experience is that redesigning PD methods to fit the capacities of the users, enabling them to participate,

can result in really novel and innovative solutions. In this paper, we only report from a few of our fragment-projects, and we will work on analyzing the rest of the projects and hopefully learn new things. We also would like to carry out similar PD projects in other contexts to study the transferability of our results.

In this paper we offer three contributions to PD: an analysis of participation in PD by applying the general conceptual framework from Bratteteig and Wagner (2014) on PD with old people; an analysis of old people's preconditions for active PD; and a description of how PD can be organized and facilitated to meet the old people on their own terms based on the previous analysis. The old participants participated by creating, selecting, concretizing and evaluating choices, and their influence was visible in the design results. We participated by facilitating and tailoring the PD process to our old user participants so that their choices made it to the design results.

Notes

1. The research project 'Autonomy and Automation in an information society for All' (A3), see <http://a3.ifn.uio.no>

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