An Analysis of Independent Living Elderly's Views on Robots

A Descriptive Study from the Norwegian Context

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***Abstract*—This study illustrates the independent living elderly's (≥65 years) views on robots. The data was documented through audio recordings of interviews, photos, and written logs. The analysis was done through qualitative manifest and latent content analysis. The results of the analysis were sorted into three categories: aging during the technological renaissance, domestic robots, and the elderly's expectations of robots. The overall resulted theme was: integrating robots in the elderly's everyday life. The results were discussed through the lenses of the Sense-of-Coherence (SOC) theoretical construct and its belonging elements: *comprehensibility*, *manageability*, and *meaningfulness*. The relevance of this paper contributes to giving an understanding of the domestic robots' requirements specifications and the elderly's expectation of human-robot interaction.**

Keywords-robot; comprehensibility; manageability; meaningfulness; healthy aging; independent living elderly; Norway; Sense-of-Coherence (SOC) theory; salutogenesis; elderly; human-robot interaction, domestic robots.

I. INTRODUCTION

We were interested in this study to investigate how robots are seen by the independent living elderly, before integrating the robots in their homes. Specifically, the study aimed to illustrate the elderly's (≥65 years) views on robots. The research question addressed in this study was: what is the elderly's understanding of robots, and how can these be better integrated into their daily lives?

Studies show that western countries face an increase in individuals' lifespan, and this, in turn, puts pressure on the healthcare systems [1]. Non-digital personal health records have been earlier widely used [2]. However, lately, the elderly prefer to live independently in their homes. To support the elderly's independent living, various welfare technologies have been used. In the past years, robots for supporting independent living got special attention [3][4]. In general, most of the elderly have a hard time accepting and learning new modern technologies. At the same time, earlier research shows that the elderly are not interested in devices designed especially for their age group [5]. However, modern technologies often let the elderly feeling they cannot keep up with those; their design does not always suit the elderly. For instance, a study from the U.K. talked about the mismatch between the technologies and services that are available for supporting the elderly's needs and their real needs [6]. The authors mean that, for designing and providing better technologies, we first need to understand in-depth the elderly's needs [6].

Further, Koelen et al. [7] say that in the next couple of years, it will be not only vital aging in place, i.e., aging in the home of choice, but also "healthy aging." According to Eriksson [8], every individual, even those considered healthy, might have moments when they feel ill. Furthermore, there are still uncertainties about how robots could accommodate aging in place since these technologies are still in development. Moreover, we are still not sure how these technologies could be better integrated into the elderly's homes since they already have a hard time accepting the existing technologies.

The rest of the paper is structured as follows. This section continues by giving a background on this study. Section II presents the theoretical construct of Sense-of-Coherence (SOC) and its elements of *comprehensibility*, *manageability*, and *meaningfulness.* Section III presents our data collection and analysis methods, the setting of the study, and the participants. Section IV presents our findings. Section V continues with a discussion by using the theoretical construct and its elements presented earlier in Section II. Section VI presents the conclusion. Acknowledgments close the paper.

A. Background

This study is part of the Multimodal-Elderly Care Systems (MECS) project. MECS aims to develop knowledge around a caring safety robot alarm for the elderly. The elderly are defined as old adults (≥ 65 years), according to gerontology [9][10]. The insights gotten during this study are intended to contribute to the design of the MECS safety alarm robot. However, before going further, we want to define the concepts of a *robot* as a welfare technology.

Welfare is defined as something *doing* or *being* well [11]. Within the Nordic countries, The Nordic Welfare Center describes the notion of *welfare technology* as technology either compensating due to a disability or supporting it [12]. This definition of welfare technologies includes: "assistive devices, consumer goods, home adaptation solutions, educational equipment, tools" [12]. Among such examples, there are games consoles used for

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rehabilitation and physical therapy, mobile care systems, smart home environments, and automation solutions, robot vacuum cleaners, and safety alarms connected to a healthcare system. Amongst these technologies, a safety alarm robot can be considered as a welfare technology of the future. A *robot* is defined as a programmable machine that can conduct a complex set of actions on its own [13][14]. The term was coined from the Czech "robota" in the '20s and had the meaning of "forced labor" [13]. Robots are similar to other types of modern technologies, wearables, or personal devices. Besides, this type of welfare technology also has the *motion element* which is needed to be taken into consideration [15].

We have seen that the digitalization of care services for the elderly can be done with wearable sensors and through self-monitoring devices, or personal safety alarms. While body sensor networks are considered intrusive and often not readily accepted, users would instead opt for self-monitoring devices [16]. These include ambient intelligence techniques [17], such as wearables, or mobile devices, as shown in Chiauzzi et al., Petersen et al., and Laidlaw et al. [18]–[20]. Besides, personal alarms are usually used in the form of bracelets or pendant alarms. For instance, almost 20% of the total safety alarm installations used in the U.K. were necklace alarms [6]. Very few of these or other devices were actively used by the elderly [6]. However, these types of alarms can be effective in detecting falls among the elderly, if these are used effectively [21]. It seems like the elderly use of this type of assistive living technologies is often done in wrong ways, such as pressing the button of a pendant alarm when feeling lonely instead of when needing medical help [6]. These types of devices also are often not used when showering, while most of the falls amongst the elderly happen while they shower.

Moreover, these types of devices are not afforded by some of the users, whereas for some, other alternatives should be considered when personal devices are likely to be misused, or not used at all [21]. One alternative is the use of robots, through "connected and secure assistive robots ecosystems" [22]. However, introducing robots in the homes of the elderly requires scrutiny, both of the user and the current use of modern technologies, of the *home* context, and of the technology itself. Previous studies show that a few robots for the independent living elderly are available on the market, whereas the use of robots in homes has excellent potential and could prolong independent living [23][24].

Furthermore, Norway, a welfare state, has its healthcare system partially subsidized by the government [25]. For instance, elderly people that are over 90 years old and may live in nursing homes cost the state around 800 000 Norwegian crowns (NOK) per year (ca 84 000 euros, or 98 000 US dollars) per individual [25]. However, only half of the elderly wish to live in such nursing homes, while some choose to stay in their own homes, and others wish to move in accommodation facilities for the elderly [25]. Furthermore, according to Ramm [26], at the start of 2013, 13% of Norway's population was 65 years old or older, whereas, by 2050, this percentage is forecasted to increase to 21%.

In addition, a similar study of quantitative nature was performed in Norway. The study was based on 1000 phone survey interviews lasting, on average, about 13-14 minutes each [28]. The focus of the research was mainly on the use of Information Communication Technologies (ICT's) and did not include any questions regarding robots [28]. Helsevakta (eng. Health Watch, HW) is another example of a project that was created for investigating the challenges that are met in healthcare [29]. The study was performed in Trondheim, Norway showing so far that the Norwegian healthcare system was not prepared for the upcoming demographic challenges, such as an increasing number of the elderly [29]. Extensive empirical qualitative studies on integrating robots in the homes of the independent living elderly, from the Norwegian context, have not so far been identified.

II. THEORETICAL LENSES

We chose to discuss our findings through the theoretical lenses of Aaron Antonovsky's work [30]. The theoretical construct was chosen to discuss the findings. Antonovsly was a sociologist that challenged the pathologic view on healthcare, focusing on salutogenesis [29][30]. Salutogenesis is viewed as a health promoter [32]. His theoretical model is based on the Sense-of-coherence (SOC) of an individual. He defined it as:

> "a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli, deriving from one's internal and external environments in the course of living are structured, predictable and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement" (Antonovsky, 1987, p. 19 in Super et al. [33]).

The theoretical construct includes three elements: *comprehensibility*, *manageability*, and *meaningfulness*. *Comprehensibility*, as an element of SOC, is illustrated as the motivation behind the challenge of coping with the situation at hand. *Manageability* is depicted as the availability of resources to cope with the situation, whereas *meaningfulness* is represented as understanding the challenge [30]. The theoretical construct, however, was developed to reflect on how one can deal with life stressors [33]. We borrowed these concepts for this study since robots are seen as assistive technologies for independent and healthy living. We argue that having such lenses when designing and integrating these technologies in the elderly's home, could be beneficial for reflecting over the process of understanding their views on technologies. The concepts are also beneficial to understand the acceptance of modern technologies by the elderly.

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There are a few studies that have the same salutogenic perspective on health using Aaron Antonovky's theory. According to [32], studies based on this theoretical construct seem to be quantitative, and just a few qualitative ones are available. Some similar studies are from Lahttiranta et al. [34][35]. Another similar study is from Svaneus [36], where the author takes the approach towards health as "homelike being-in-the-world." The author also asserts that this perspective on modern technologies can be made visible through *medical technologies* [36] – in our case, the robots used in the homes of independent living elderly. We argue that it is essential to make visible the salutogenic approach inbuild in a safety alarm robot for the elderly. Moreover, yet again, the question we ask is: how do they understand the concept of a robot, in order to better integrate it into their daily lives?

III. METHOD

The present study had a qualitative inductive research design. Next, we present the study context, participants, and data collection.

A. Study context

The study was performed in the southern-east part of Norway, in the area of Oslo. Norway has a population of approximately 5.2 million inhabitants [37], where the elderly represent about 14.6% of this number [38]. In Oslo, the capital area, live about 660 000 inhabitants. This study has been performed in a subarea of the old Oslo district area. The district has a total population of roughly 53 000, out of which nearly 3000 are senior citizens over 67 years old. Some of these citizens have home-care; some live in the nursery cares, whereas some live in accommodation facilities for the independently living elderly. The accommodation facilities usually include apartments that can be rented individually by the elderly, or together with their partner. The facilities also include a reception available 24/7, where at least two personnel staff are available at all times. The facilities also include a gym, a restaurant available for non-residents, an open area where various social events are taking place, and a library. The building is equipped with various sensors: WiFi, light and heating sensors, motion sensors, but also tablets installed in each of the apartments. The residents can use computer tablets, for instance, for seeing the menu available at the restaurant in the building, ordering food, or navigating the Internet. Similar studies have been performed in such accommodation facilities, but none of them involving robots [39]–[44].

B. Participants

The participants in this study were recruited through an accommodation facility, which has 91 apartments. Ninety (90) residents were living as of April 2017. Fifty-two (52) of them were females, with an average age of 84, and 38 males, with an average age of 80. The residents were spending at the time, on average, around 577 days, in the accommodation facility – according to an internal document.

Sixteen participants participated in three group interviews and one pilot interview. Four researchers involved in this project (two senior researchers and two junior researchers, including the authors SD, HJ) had a meeting with the two management representatives at our partner organization, before the first two group interviews. We documented the meeting through a log report, followed by a visit of the junior researchers (including author SD) at the elderly's facilities, and a presentation about the project held for the elderly and the employees (including the authors SD, HJ). Some of the elderly signed up for the group interviews at the presentation, whereas others joined during the presentation itself. The participants were self-selected, i.e., entered the study based on voluntary choice. For the third group interview, the elderly were informed approximately one month before the activity, and they participated, this time as well, voluntarily. The third group interview was part of a half-day workshop. Two of the participants taking part in the first group interviews also took part in the third group interview.

The participants' background was mixed: they have worked in the public sector (library, university, military, other public authorities), arts and handcraft, and industry (including office work that requires the use of computers, but also factory work). All were over 67 years old, with ages ranging up to 90 years old. Some of the participants used walkers and some wheelchairs. During the interviews, they explained that several of them experienced balance problems, and they sometimes fall. Three hundred five (305) falls were reported amongst all the facility's residents between 2015-2017. Other health-related issues pointed out were: impaired or weak vision and hearing and memory loss. Table I below gives an overview of the participants and their background experience with computers.

TABLE I. OVERVIEW PARTICIPANTS.

#	Gender (Female F, male M)	Age	Comment on the participants' work experience (Not available N/A)
1	F	>65	Public sector
2	F	84	Arts and Craft
3	M	81	Arts and Craft
4	M	>65	Worked with computers.
5	F	94	Private- and public sector. Worked with computers.
6	F	>65	Public sector
7	F	90	Private sector
8	F	>65	N/A
9	F	>65	She worked previously in the private sector.
10	M	>65	N/A
11	M	>65	N/A
12	M	>65	N/A
13	F	89	Public sector.
14	M	>65	Public sector.
15	M	>65	Public sector.
16	F	90	Public sector. She had experience with computers before.

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C. Data collection

Our primary data gathering method was group interviews. A research interview aims to develop an understanding of the investigated phenomena surrounding the persons and situations in their contexts and social reality [45]. All three group interviews were semi-structured. All the interviews included some demographic questions, where the participants were asked to share, based on free will, their name, age, and background. Moreover, the interviews contained questions regarding the participants' familiarity with digital technology, including smartphones, computers, and robots. The author (SD) has also participated in multiple meetings, one public discussion, together with the author (HJ). Further, we give details on group interviews one and two, a pilot interview that took place after the first two group interviews, and a third group interview. The pilot interview and the third group interview was based on the findings first two group interviews. Some photos from the group interviews are illustrated in Figure 1.

Figure 1. Sample photos from group interviews 1 and 3.

All the details regarding the group interviews and the pilot interview are available in Table II below.

TABLE II. OVERVIEW OF THE DATA COLLECTION.

Group interview #	Number of participants and their gender	Time for data collection	Type and duration of data collected
1	5 females, 2 males	Spring 2017	Interview 60 minutes, Photos
2	2 female 3 males	Spring 2017	Interview 60 minutes, Photos
1 Individual Pilot	1 female	Spring 2017	Interview 60 minutes, Photos
3 (part of a half-day workshop)	1female 2 males	Spring 2017	Interview 45 minutes, Photos
Total	16 participants (9 Female and 7 Males)		

D. Analysis

The textual data was fully transcribed. The author (SD) has listened to the audio recording and written logs for the two parallel-group interviews, and the pilot interview, immediately after those took place, to help her remember better the context. She also took unstructured notes during the first and third group interview. After listening through the transcriptions, the authors have discussed their understanding of the data, making the analysis more reliable. The data was transcribed verbatim and was coded through open-coding. The authors have later decided to leave the data for a while before coming back to it. At this stage, both conscious and unconscious reflection took place. After a few months of an incubation stage, we have chosen to analyze the data by using qualitative manifest and latent content analysis [46]. The analysis was performed through the following steps: first, the whole transcripts were read through several times to get a sense of the content. The next step was decontextualization of text with the identification of meaning units. We identified in total (n= 132) meaning units. The next step was condensation and coding of meaning units (n = 13). The systematic grouping of codes to sub-categories and categories, with reflective discussions with the aim of the study as the base, was performed together by authors (SD, PZ). The analyzing process towards the formation of categories was the result of manifest content analysis. The latent analysis started with the reading of the transcript again and trying to capture what text was talking about. The result of the final step was the theme "Integrating robots and welfare technology in the elderly's everyday life." The process between the group interviews is shown in Figure 2.

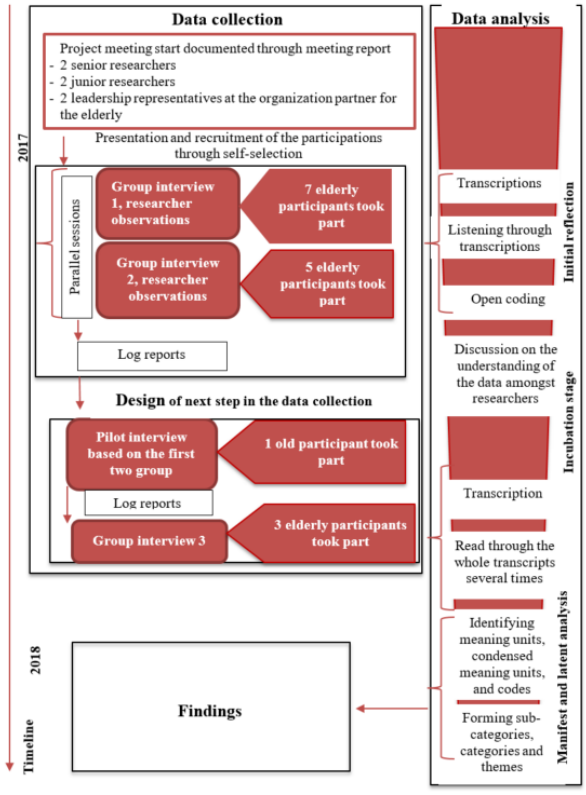

Figure 2. Overview of the process.

E. Ethical considerations

The project was conducted accordingly to the ethical guidelines from the Norwegian Center for Research Data (NSD) Ref. Nr: 50689). This work was performed on the Services for Sensitive Data (TSD) facilities, owned by the University of Oslo, Norway, operated and developed by the TSD service group at the University of Oslo, IT-Department (USIT). The participants were self-selected. The participants were given detailed information about the study, and they could withdraw at any time without giving any explanation and without any consequences for them. All the participants willing to participate signed informed consent before taking part in the study.

IV. FINDINGS

A. Integrating welfare technology in the everyday life of the elderly

The overall theme of this study that emerged is: "*Integrating welfare technology in the elderly's everyday life*.". The theme comprises the elderly's daily experiences with personal devices (smartphones, computers) and modern technologies used in homes (sensors in a smart home, semi-autonomous robots). In general, the use of personal devices by the elderly would be minimal and limited to their needs, such as using internet banking, for checking the account balance. Some of the participants did not own a smartphone, and some even a mobile phone, *but* a fixed home phone. Only a few of the participants owned both a smartphone and a tablet. These participants were also those who were highly interested in the use of modern technologies and to influence rules or policies, at some level. They were often engaged in other types of organizations for the elderly. Although some of them were highly engaged with this type of personal devices, the majority had limited knowledge about the use of robots in homes. The general impression was that they could not follow up with the fast development of technologies. In general, they felt left out, as one participant expressed it: *"for me, it goes too fast… for me, it goes too fast… I cannot keep up with it.. unfortunately".*

The findings also showed that, besides the fast technological advancements, the elderly need to keep up with, the authorities need to develop legislation accordingly, at the same pace, in order to have a functioning and inclusive society. They viewed this as especially important when trying to introduce domestic robots in their homes. Detailed results are presented descriptively, as follows.

B. Aging during the technological renaissance

We started by asking the participants to talk about their relationship to the use of modern technology (e.g., computers, tablets, and smartphones) in their homes. The majority of the participants answered that they use modern technologies for checking their bank account balance – internet banking was a common motivation for using computers. Regarding the autonomous technology used in homes, they would recognize this type of electronic technology from the building they were living in, as it has light and motion detection sensors.

The majority would describe their interactions as being limited to computers for writing emails and checking the account balance, TV, phone (home phone, mobile phone, smartphone), and printers. However, one of the participants expressed a high interest in "*everything new*." This participant also used more advanced terms that their peers did not know about, such as *cloud computing* and *bitcoin*. Bitcoin, for instance, had to be explained by one of the female participants to others as "*valuta in the cloud*." The same participant confessed that she uses modern technology for solving crosswords, sending emails, search on Google, and using Facebook.

Regarding the price of modern technologies, such as robots, the elderly found those expensive. Hence, they did not recognize themselves as being the *right* target-group/consumer group. They were also reluctant to robots that are big due to taking too much space in their apartments, usually consisting of a small living room integrated with an open kitchen, a small bedroom, and a bathroom. Robots were viewed by them in general as inferior, subordinates to people, as one participant says: "he is *just* a robot." Specifically, companion robots, such as an AIBO robot, were not interesting enough for the participants, as they were "*nothing to cuddle with*," as one participant described it. They rated robots from a cost-benefit perspective, always seeking a *practical perspective/benefit*. However, they admitted that such a robot could decrease some of the feelings of loneliness. The participants agreed that a companion robot could supply some daily dialogical interaction-when they do not have anyone else to talk to.

Four of the participants (two males and two females) pointed out that they cannot follow and keep up with the fast development of modern technology, feeling surpassed. They expressed feelings of hopelessness, exclusion, and technological illiteracy, as one of them pointed out:

> "*I feel like I am in another world, you know.. I do not know so much about these things we discuss now… and this has to do with the [world] we grew up within… a different one, yes. What I mean is that we start getting so old, that there is so much surpassing us. We are not able to keep up the pace. However, the authorities do not take this into account*."

In general, they felt anxious about dealing with modern technologies, due to *fear of doing something wrong*, or *failure*. This, despite the majority that was willing to learn about modern technologies. In this sense, they mentioned that having an own pre-understanding and familiarity towards those (e.g., having used modern technologies before), and a *clear objective of the use*, as one points out: *"When I should learn something new, I am asking – what's the point?*", is imperative. They also specified that they

often rely on help from their family members (children and grandchildren). However, to trust a robot, they mentioned that they need to have some control over it. They suggested that this could be done through, for instance, control via voice recognition. One female participant pointed out that such a safety alarm robot would make her feel safe in situations where they do not have the safety alarm wristband on them, such as when using the shower. The robot should also have *predictable* ways of moving in order to feel safe around it.

C. Domestics robots

At the start of the discussions, the participants did not know "*what a robot is*" and said that they had seen robots only on TV. However, immediately after starting the conversation about the robots, they were wondering if an autonomous vacuum cleaner or a lawnmower is counted as robots. They found this type of home appliances, so-called *domestic robots*, more familiar for them, and could place them in their understanding. However, some of them were familiar with industrial robots: robots that are used in factories and robots used in hospitals.

Their description of the robots used in homes fitted under the description of *assistive* and *servant robots*, as a female participant points out, about what a robot should do:

"*To fix the TV when it gets stuck. Or the computer when something went wrong. It would have been nice to have such a robot for this"*. Another participant explained: *"The robots have to have a practical aim. I think many feel ill and do not have the energy to bring food from downstairs... This could be something a robot could do."*

When we showed pictures of various robots, we also showed pictures of *companion* robots. It was clear that the elderly sought some practical attributions of the robots, and they were less interested in safety alarm robots. The majority of the participants agreed that the robots need to have some practical function for them to use those. Only one participant brought attention to the implications of introducing such a robot in their homes, such as potentially reducing their physical activity. Regarding the appearance of a robot versus the functionality, it was a difference between the female and male participants: whereas for the female participants, the robot appearance was necessary, for the male participants were not. However, both female and male participants agreed that functionality is more important than appearance.

Among the functionalities of the *domestic robots*, they named that they would like to have semi-autonomous robots (e.g., servant robots, assistive robots) that help them clean or wash the floor. To be able to interact with the robot via voice recognition, and specifically being able to interact in Norwegian, were essential for the participants. Physical interaction, such as having a stop button, was also vital to them. The feedback received from the robots should be, according to them, auditive, visible, and visual, as they have learned from their interaction with the industrial robots, i.e., signalizing with red and green blinking lamps.

Besides these types of functionalities, robot navigation within the elderly's homes has also been discussed. The participants found problematic the robot-human encounter, especially if they had to move with the help of a walker, or a wheelchair. They were also concerned about the obstacles they had in their homes, such as furniture. Some of the participants compared the behavior of a robot when navigating inside the home, with the driving of a car – the robot should behave in a similar fashion when encountering humans.

D. The elderly's expectations of the legislation and regulations around robots

The participants pointed out some expectations regarding the well-functioning of laws and regulations in practice. For instance, one female participant gave an example where the laws and regulations at a national level do not always match on an organizational level. She ended: "*It is not ready… the laws are not ready yet.. for these.. which is quite advanced.*". The same participant, in a later interview, says that, although the laws and regulations are not fully developed, *they* still have to *adapt* to the use of modern technology, because "*the authorities do not allow resignation*." In addition to their perceived control regarding laws and regulations, the participants also expressed the need for having *autonomy* over the robot itself.

Although the focus of the MECS project is around developing a safety alarm robot, for the majority of the participants, it seemed important that the robot would help them with physical activities in homes.

V. DISCUSSION

Integrating robots in the homes of the elderly should be done gradually, where the acceptance of these technologies is taken into consideration. Studies support this idea, saying that these types of technologies cannot be introduced only when the elderly need extensive care [47]. Moreover, domestic robots, such as care robots, should not be introduced in the home of the elderly, solely to reduce society's care burden with the aging of the population, as shown by [48]. However, integrating robots in their homes means that these technologies also need to be comprehensible, manageable, and meaningful, for the elderly. We base further our discussion on the SOC from Aaron Antonovsky earlier described (Section 2).

A. Comprehensibility and manageability of robots in the homes of the elderly

This study shows that the majority of the participants used modern technology for simple everyday tasks, such as checking the bank account balance. However, not many of them felt that they were skilled enough to using these technologies. This indicates that the elderly do have limited

comprehensibility of these technologies. They were familiar mostly with robots used in the industry.

Moreover, they were unsure if an autonomous vacuum cleaner or a lawnmower are also robots. This indicates their limited understanding (comprehensibility) of domestic robots. They also considered using in-motion technologies, such as robots, only if this type of technology had a practical benefit. This indicates that they sought some manageability in those.

A study showed that people are afraid of interacting with technology that they do not understand [49]. While the participants mentioned the importance of using their natural language in the interaction with robots, Sciutti et al. [49] emphasize the importance of mutual understanding: not only concerning language, but the robots should consider the people around them. In literature, robots are being portrayed as agential actors with emotions and autonomy [50]. If we strictly refer to a robot, a robot is autonomous through, for instance, independently moving around. In this case, the additional element to be considered and understood by the elderly is the motion element. This adds to the complexity of the manageability of a robot. After all, a care robot, an in-motion technology, would be a new element in the elderly's homes that will move around. Facilitations and adjustments of the home, to adapt the robot would probably need to be made. This is nevertheless a question of autonomy: of the person him- or herself, and the technology. In the case of in-motion technologies, such as robots, the elderly may loose from his-/her autonomy if they cannot master the robot.

Further, the participants also indicated that they could not keep up with the technological advancements, as they often were afraid of doing something wrong when they interact with it. To be able to interact independently with such systems, they suggested being able to interact with the robots via voice recognition. Moreover, they specifically suggested that this should be available in their mother tongue, Norwegian. This indicates that such systems should be manageable by them, in their mother tongue (manageability). At the same time, studies recommend that it should be of high priority to make scalable care systems that support voice recognition [1]. They recommend systems that are socially aware, but at the same time, that do not need the user to interact with the system continuously [1].

Moreover, another study showed that the robots used in hospitals were expected to be able to talk [51]. However, even advanced build-in ways of interactions, such as talking, may still not lead to the acceptance of a robot [51]. Based on the findings presented in this study, we consider that this point is also valid for robots used for supporting the elderly's independent living in their own homes.

Further, introducing new emerging technology for health monitoring in the home may change the relationship amongst people interacting with them [1]. This type of system may have implications beyond the intended use [1]. For the elderly to feel well, it also needs to be considered the broader context of use, including the need for social connectivity [52]. The need for voice interaction could be one aspect of social exchange. However, as one study shows, people may tolerate robots in different ways, depending on the context [51]. Robots, for instance, used in hospitals in different settings, were viewed as: "an alien, a hospital worker, a colleague, a machine, or a mixture of these" [51].

In the same way, this is confirmed by the current study: a robot that would be able to talk might be easier understood by the elderly. However, being able to interact with the robots through voice does not guarantee that domestic robots will be accepted. Although they may be manageable by the elderly, it does not mean that it also will be meaningful for them. However, for integrating these types of technologies, it is not enough to be comprehensible and manageable. These also need to be meaningful.

B. Meaningfulness in the robots for the elderly

"When I should learn something new, I am asking – what is the point?" asked one of the participants. Besides finding the welfare technologies and robots *useful* for their health monitoring, the elderly also need to find them *meaningful*. Older adults need to be motivated and get enough time to learn how to use new digital tools [53]. Further, the elderly seem to dislike devices that are "off-putting," i.e., reminding them of medical instruments and monitoring instead of feeling personal and appropriate for their dis-/un-ability (Lehoux et al. in Procter et al. [6]). We have also seen that technologies can support aging in place, through monitoring [52]. However, this solution is somehow limited: monitoring is supporting in the first place the caregiver, not the elderly [52]. Integrating these technologies in their homes also means that they should be *meaningful* for the elderly in the first place.

The present study showed that the participants were familiar with domestic robots, such as semi-autonomous vacuum cleaner, and lawnmower robots. The functionality of robots was more important than appearance, but the appearance had some importance for the female participants. When it comes to robot appearance, literature often discusses the anthropomorphic robotic looks [50][54] [55]–[58]. The literature also talks about the notion of the uncanny valley, defined as the look of a robot that may set expectations on its functionality as well [59]. Further, an early study since 2004 was conducted about the use of robots in professional settings on how people would collaborate on tasks with human-like vs. machine-like robots [54]. The study concluded that the participants felt more responsibility when using a machine-like robot, as they saw it more as a tool that helps them fulfilling a task [54]. Furthermore, studies show that human-like robots were preferred in stressful or complex situations, where the participants have to delegate responsibility due to stress and work overload, but also where such robots could perform/process better and faster than a person [54]. At the

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same time, functionality and appearance are interconnected. We have shown that the elderly saw the robots mostly as *servant robots* and that the robots that looked more humanoid-like were "*nothing to cuddle with*," as one participant said. If a safety alarm robot would be designed as a machine-like robot, this, on the other hand, could potentially put more responsibility on the elderly as they would feel more responsible towards the robot. However, they seem to find servant robots more meaningful.

Studies talk about the "domestication" of technology when integrating it into daily lives [53]. To be able to manage these technologies and give them meaning, the elderly seem to adapt them to their own. Small details of the devices' design are significant for the configurability and adaptability of the devices' to the elderly's individual needs [6]. For instance, bricolage is often used to adapt to technological devices to individual needs [6]. This is a way of *domesticating* and integrating the technology in their homes, in such a way that it becomes meaningful for them. According to [53], domestication is a prerequisite for integrating technological devices in the elderly's daily lives. This is also talked about sometimes as *appropriation.* Procter et al. [6] suggest the possibility of customizing the technology itself as a solution to this. This could perhaps contribute to some degree to the meaningfulness of the robots and yet ease the integration of those in their homes.

C. Integration of robots viewed through the Sense-of-Coherence

'*The authorities do not allow resignation*,' as the elderly specified about adopting new robots. However, comprehensible, manageable, and meaningful welfare technologies and robots seem to be still not enough for achieving consistency, e.g., a *sense of coherence*. These should also be aligned with political legislation and regulations. Developing policies by promoting the sense of coherence is done in time, but it requires synergies amongst individuals, groups, organizational- and societal levels [60]. Earlier, the emphasis on the alignment between technologies and governmental regulation was put through the (technical) standardization. Such an example is enabling the exchange of patient records all over Europe (Read in Hanseth et al. [61]). The technology was, at the time, predicted to have a vast potential to improve the Norwegian health care system [61].

Further, The Norwegian Social Ministry has since early 2000, a salutogenic approach on elderly *home* care: they listed 16 regulations regarding the quality of life and well-being for the elderly [62]. Amongst the listed prioritized areas were: *autonomy*, *self-worth*, and *ways of living*. However, at the time, this referred to homecare (comp. to *independent living*). Besides, in a Norwegian report from 2011 [63], it is pointed out that welfare technology should support, amongst others, self-help, independence, having own control despite eventual impairments [63]. This was in line with the Active Ageing framework from 2002 [64]. Active Ageing was at the time defined as: '[…] the process of optimizing opportunities for health, participation, and security in order to enhance the quality of life as people age.' [64]. However, 'healthy aging' replaced the old term framed in 2002 and is the new framework for 2015-2030 [65]. The new policy focuses on the diversity of people, independently of their health status (whether considering them healthy or not). Light et al. [66] supports this indirectly by addressing the technologies as *enabling*, instead of *'assistive.'* The authors also say that this approach will ease tensions amongst national policies.

Finally, in the independent living accommodations for the elderly, based on our empirical data, it seems we still deal with the same issues: political, institutional, and standardization issues. As another participant pointed out, *"It is not ready… the laws are not ready yet.. for this.. which is quite advanced".* While the global or national standards are already there, we still lack standardization that prioritizes less knowledgeable users, such as independent living elderly with reduced ICT literacy. With the integration of new *living technologies*, such as in-motion robots, in the elderly's homes, we should perhaps consider SOC. We argue that the elderly could achieve a greater SOC, as a result of an increased comprehension, manageability, and eventually meaningfulness of robots. This could facilitate the integration of these technologies in their homes. We also admit that there might be other individual or external factors that contribute to SOC.

VI. CONCLUSION

In this work, we have presented views of the elderly on robots. To analyze the data, we have used a qualitative inductive approach by using the content and latent manifest analysis method. The analysis resulted in three categories: aging during the technological renaissance, domestic robots, and the elderly's expectations of legislation and regulations on robots. The overall resulted theme was integrating robots in everyday life. We have later discussed our findings through the lenses of the SOC theory and its concepts of comprehensibility, manageability, and meaningfulness.

Through this study, we have contributed to the understanding of the integration of robots in the homes of the elderly. We have brought concrete examples of how the elderly seek to understand (*comprehend*) and to be able *to manage* welfare robots. We also drew attention upon the importance of having meaningful technologies for them – that are not only useful (for them and their caregivers).

Further, studies show that in the coming years, people will not only live longer but also be more preoccupied with their "*meaning, purpose, and well-being*" in their later stages of life, while "looser family ties" will be more common [67]. This may yet put more pressure on the welfare system provided by the society's public services [67]. As the authors show, this "*self-empowering*" care approach for the elderly, in Norway, is predicted to be *mostly home-based*, but *enabled by* governments, through

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municipalities, vendors of welfare technologies, and residents and their families [67]. In another study, it is explained that the population aging, as a global phenomenon, would be addressed through "home-based care and multidisciplinary care," by *meeting the demands of the elderly* for living longer at home [68]. However, aldeen Al-Halhouli et al. [69] notified that while "smart house systems" are taking shape, the elderly "do not have *extra time to learn* new technologies" [69]. We have argued in this paper that we should consider the elements from SOC: *comprehensibility, manageability, and meaningfulness,* for better *integration* of robots in the independent living elderly's homes.

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