

The domestication of robotic vacuum cleaners among seniors

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S. Frennert, B. Östlund, The domestication of robotic vacuum cleaners among seniors. Gerontechnology 2014;12(3):159-168; doi:10.4017/gt.2014.12.3.004.00 The hype of robots as companions and caregivers for seniors raises questions concerning not only the technology but also its impact on practice, values and norms among seniors. This article focuses on how seniors adopt, utilise and make sense of robotic vacuum cleaners in their lives. Qualitative interviews and observations were conducted with ten seniors over a 13-month period, between July 2013 and August 2014. The findings show that: (i) Seniors are enthusiastic about adopting the technology (robotic vacuum cleaners) because it is perceived as beneficial in the prioritisation and negotiation of activities in everyday practice. (ii) The adoption of robotic vacuum cleaners is a process characterised by complexity and ambivalence, which is affected by societal norms. These include activities seniors consider as 'normal' in everyday practice; in this case, house hygiene. (iii) Robotic vacuum cleaners transform everyday practice and their symbolic meaning is constantly negotiated. Robotic vacuum cleaners are adopted not just because they are functional and useful, but because they are a means by which seniors can cope with everyday life and conserve physical energy for more meaningful activities, such as meeting friends and spending time on hobbies.

Keywords: everyday practice, seniors, robots, adoption, robotic vacuum cleaners

Studies of the use of robotic vacuum cleaners are interesting for at least two reasons: (i) They are a variety of the on-going development of service robots for home use; and (ii) they are included in a new technology that is linked to a well-rooted practice in Western society homes, namely to clean with the help of a machine. To study seniors' use of robotic vacuum cleaners is especially interesting since they are often the target group to test new technology that compensates for decreased mobility and facilitates independence¹. This paper seeks to examine how the interplay between robotic vacuum cleaners, everyday practice and seniors is entwined. On the one hand, technology, expectations, ability and norms affect our everyday practice; on the other, technology evolves through time in conjunction with people's everyday practice².

Despite the fact that eldercare is embedded in our culture and reflects its values, there are few theoretical accounts of seniors' specific negotiations and style of agency as they mediate the intricacies of their lived experience in the field of robotics³. Relatively little is known about how seniors engage in practice with robots or what the significance of this is to their everyday lives. Yet in recent years an increasing amount of literature has been published regarding social robots⁴⁻⁸ and a few studies involving robotic vacuum cleaners have been conducted⁹⁻¹³. These studies show that robot owners are equally likely to be men or women, well-educated and with a tech-

nical background¹⁰ and that younger and older adults with equal technical competence had similar expectations of robots^{14,15}. Robotic vacuum cleaners have also been shown to change current practice on how people clean¹⁶. This paper, however, discusses the domestication of robotic vacuum cleaners among seniors through the lens of practice theory. Previous studies show that the time factor is of significance when studying social meaning and relationships between innovations and everyday life, since it takes time to build up a new practice and acquire tacit knowledge¹⁷. People, objects, things and technology co-evolve in society over time together, as a result of visions and expectations that are socially shared and historically contingent¹⁷.

We argue that future technological developments such as robots need to evolve from typologies of everyday practice and not just from innovative technology (technology push). If there is a discrepancy between the developers' images of older people and eldercare, and the actual practice of everyday life, this discrepancy can result in some robots never being adopted, while others will be abandoned¹⁸. A key aspect of technologies is that they are never neutral but are developed with a specific usage in mind^{6,19}. Research has consistently shown that the intended usage reflects the designer's own understanding of the world, and his or her ideas have been shaped by education, upbringing and experience²⁰⁻²². As a result, the perceived needs of the intended users

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are based on the assumptions of the needs as perceived by the designer²⁰⁻²². Questions have been raised on how technology can empower people as well as reproduce practices and biases²³. The issue of the cultural discourse of aging and seniors, and its influence on a range of causal and adaptive procedures, has been a controversial and disputed subject in the field of Science and Technology Studies (STS)²³⁻²⁸. Far too often technology developed for senior households has focused on security, safety and function instead of the 'lived' user experience and enjoyment among seniors²⁹. There are suggestions that in order to make domestication possible, we need to 'internalise' as well as 'externalise' the artefact. 'Internalising' artefacts means that certain cognitive skills and competences are needed to initially appropriate a certain artefact, such as former experiences and know-how, which determine the learning strategies, and ability people have to appropriate different kind of artefacts³⁰.

In this study, the researchers introduced the technology: a robotic vacuum cleaner. A robotic vacuum cleaner is an autonomous robot programmed to detect dirt and to avoid objects such as furniture and walls. It has a dirt sensor as well as optical and acoustic detectors to tell where the dirt is and when the bin is full. When the battery is low or the machine has done its work, it returns to a self-charging base. It has timer and memory functions that can be set in order for it to work on a regular basis without having to press the start button. The robotic vacuum cleaner was introduced with a remote control.

Past research shows that if a new technology mimics a familiar one, it will support personal interpretations and memories during the interaction³¹. In the case of robotic vacuum cleaners, they are modified and autonomous versions of ordinary vacuum cleaners. This, however, does not automatically mean that they will be accepted and adopted. It has been demonstrated that technologies are, in effect, set social agreements, where people in a particular moment of time continue to think of a specific technology and define it jointly, in the same way³². Thus, this paper explores how robotic vacuum cleaners shape and are shaped by seniors' practices through the lens of practice theory³³⁻³⁵. The paper addresses the following questions: (i) How do seniors and their everyday practice shape the role of the robotic vacuum cleaner? (ii) How does the robotic vacuum cleaner form everyday practice among the seniors?

THEORETICAL FRAMEWORK

In this study, the conceptual framework of domestication is applicable since it describes the

process in which new technologies become part of everyday life³⁶. The framework organises and makes explicit the observations as a set of four phases in the process of domestication³⁷:

(i) Appropriation: Ways in which robots are introduced; symbolic and functional claims about the robot, evaluated by the user on how well it fulfils his or her perceived needs. This initial phase provided us with a picture of the reasons for introducing the seniors to the new technology, and the relations the seniors had to those who introduced and were involved in it – relatives, caregivers, researchers or others.

(ii) Objectification: How is the technology displayed? Where is it placed? How does the user reconstruct the physical environment to adapt accordingly? Where is the robot placed while it recharges? Where is it placed during visits of neighbours, friends and family? Who uses the robot?

(iii) Incorporation: How is the robot 'incorporated' into the daily life of the users? How is time 'spent' when the robot is doing the chores the user once did?

(iv) Conversion: The robot becomes a part of everyday life. How does it shape and is shaped by the user? What adaptations does the user make? Beyond adoption, this phase provides us with knowledge on how the user relates to the world outside the home, societal norms and values attached to technology^{37,38}.

Social practice as defined by Schatzki refers to doing and sayings defined as "a set of doings and sayings organised by a pool of understandings, a set of rules and teleoaffective structures"³⁹. These teleoaffective structures refer to affective and normative agreements of what counts as ethical and useful actions to achieve a goal³⁹. In research on cleanliness, comfort and convenience, it is demonstrated how the developments of our infrastructure and living arrangements have affected the meaning and normality of personal hygiene, such as daily showers, and perceived comfortable indoor climate⁴⁰. However, social practice will not change if the societal norms remain static⁴¹. For example in Sweden in 1988, the bread-baking machine was the Christmas present of the year but the technology never managed to reshape the Swedish people's bread baking habits⁴². The advantage of baking your own bread over buying it was not clear because for some, baking their own bread was perceived as a relaxing and meditative practice, and for others, having to buy all the ingredients and clean the machine was a disadvantage compared to just buying the bread⁴². In some cases, the social agreements on what the artefact does are defined at a different point in time, and thus by a different technological development; they end up being a

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standard, and are still used even though better alternatives have been developed⁴¹. Another example is the QWERTY keyboard developed for typewriters: the layout was produced to keep the mechanical keys from jamming when typing fast. The QWERTY keyboard became a standard layout and is still used in laptops even though better arrangements of the keys are available. Competitors have not been able to penetrate the market since users are reluctant to change their keyboard layouts. Sometimes the old way is good enough for users and making changes seems unpractical³². In this paper, we pursue the questions of if and how robotic vacuum cleaners change everyday practice among seniors.

METHODOLOGY

Mindful of the fundamental purpose of this research – to explore seniors' engagement with robotic vacuum cleaners in the context of everyday practice – several key methodological decisions were taken. Before initiating the study, the research plan was reviewed and approved by the Regional Ethical Review Board at Lund University, Sweden.

Data collection

First, a multiple case study approach was used in that each older person was seen as a separate 'case' with his or her own individual life experiences, experience of technology, opinions and values. All of the participants were living in or around Lund (a small town in southern Sweden); they were over the age of 70, displayed an interest in participating in research on robots and older people, and had significant health difficulties such as mobility, hearing and visual problems. The seniors were initially recruited through contact with senior service centres and then through local newspaper coverage and adverts. The initial plan was to start with a pool of ten seniors and to add more along the way until the richness of the data indicated that no further seniors were needed⁴³. However, collecting data from the ten seniors generated a sufficiently rich set of data and further seniors were not needed.

Second, the data were collected over a 13-month period between July 2013 and August 2014. The phenomena of the domestication of robotic vacuum cleaners are set in everyday life practice and are difficult to capture since they involve tacit knowledge. Previous studies have also reported that compared to the majority of younger users, most seniors have less experience of modern technologies and their applications³¹. As a result some seniors may lack a language or metaphor by which they can relate to a specific technology^{31,44}. The domestication of new technology is a process that users go through but may

be unaware of. In order to catch both tacit and non-tacit information we used both interviews and observations carried out in the participants' homes. Each senior was interviewed four times: prior to the robotic vacuum cleaner being installed; a week after the vacuum cleaner was installed; six months after the vacuum cleaner was installed, and thirteen months after the vacuum cleaner was installed. The pre-installation interview focused on the seniors' expectations of robotic vacuum cleaners as well as their cleaning habits. The interview conducted a week after the installation of the robots focused on the initial experience and attitude to the robotic vacuum cleaners as well as observing the actual usage and maintenance of the robotic vacuum cleaner. The interviews conducted 6 months and 13 months after the instalment of the robots focused on cleaning habits and robotic vacuum cleaning practice and experience. During these interviews the seniors were asked to use the robotic vacuum cleaner and show their cleaning routines and talk about their experiences. Each interview lasted approximately 45 minutes to 1.5 hours. The researcher participated in the seniors' cleaning routines before the robot was installed as well as after. The observations included walk-through tours in the seniors' homes, modelled after an ethnography technique called technology biography⁴⁵. The seniors were asked to guide the researcher around their homes showing all the technology they use (personal technology history). Field notes were taken in addition to the interviews and during the observations.

Third, questionnaire data were also obtained twice (before the instalment of the robots and 13 months after instalment), describing the subjective health status of the seniors. They were requested to answer the five-item 'WHO Well-Being Index'⁴⁶, and the 'Falls Efficacy Scale International' to assess fear of falling⁴⁷. The perceived health status of the seniors was collected to identify whether physical and psychological capability affects the technology adoption process. The seniors were also asked if they perceived themselves as technophobes or technophiles.

Data analysis

Multiple forms of data collection were used for triangulation purposes (observations, interviews and questionnaires)⁴⁸. The interviews were recorded and transcribed. The transcriptions and field notes texts were analysed using line-by-line coding modelled after the constructivist grounded theory method⁴³. The initial analysis started after the first round of interviews. Labels that reflected self, identity and cleaning practice were coded. After that, labels that reflected power, advantages and disadvantages were coded. Then

the second round of interviews was conducted. Focused coding followed in order to identify explanations of why and what makes seniors adopt or reject robotic vacuum cleaners. These codes helped to shape the themes for the third round of interviews. During the entire analysis, memo writing was conducted in accordance with Charmaz⁴³. These memos helped identify the hypotheses for interview three: (i) Seniors are enthusiastic about adopting the technology (robotic vacuum cleaner) because it is perceived as saving time and conserving physical energy. (ii) Technology adoption is a process characterised by complexity and ambivalence, which is affected by societal norms, for example, what activities seniors consider as 'normal' in everyday practice. In this case, when it comes to house hygiene and active aging, 'normal' is considered being able to keep one's home clean. (iii) New social practices must be learnt and are constantly negotiated.

In the third and fourth round of interviews, the hypotheses were tested and evaluated with the seniors. To support trustworthiness and to validate the collected data, all seniors were asked the same questions regarding themes and hypotheses (triangulation of sources)⁴⁸. A description of the domestication process was formulated for the first case (i.e. the first older person) and the theory was tested case by case. As soon as a new variable was discovered, its importance was explored in all cases, case by case. This strategy was iterative and as a result, the findings illustrate how complex the domestication process was.

RESULTS

This research is an attempt to address the strategies of actions and styles of agency utilised and embraced by seniors in their interplay with robotic vacuum cleaners in everyday practices. Mindful of the need to integrate the understandings of seniors' usage of robotic vacuum cleaners with broader theories of technology usage, the findings are presented in the framework of domestication, drawing on the work of Silverstone and Haddon^{18,38}. First, the characteristics of the ten participants (the ten case studies) will be presented followed by the four dimensions of domestication: appropriation, objectification, incorporation and conversion.

User characteristics

Eight women and two men participated in the study. All of the seniors had one or more medical disorders, such as muscular weakness, poor vision, hearing impairments and heart failure. Nine out of ten had back pain or poor balance that affected their cleaning habits and abilities to use an ordinary vacuum cleaner. The five-item 'WHO Well-Being Index' that screened for emotional

functioning and depression showed that four of the participants rated their general well-being as good, two as fair and four as poor. The 'Falls Efficacy Scale International' that screened for fear of falling showed that all but one of the participants were limited in their ability to push a vacuum cleaner and manage several flights of stairs. The results of the 'WHO Well-being Index' and the 'Falls Efficacy Scale' appeared stable over time: after 13 months the distribution showed the same results. The result also revealed that all the participants were independent in managing personal hygiene and in preparing meals. The majority of the participants paid privately for cleaning or received cleaning help from relatives. The results indicated that all of the seniors felt a need for help with vacuuming and that none of them had ever had a robotic vacuum cleaner.

On the question about technology usage, six of the participants described themselves as technophobes while four as technophiles. Nine of the seniors owned and regularly used a computer and all owned and used a mobile phone. The computer was most often used for searching the Internet and emailing, while the mobile phone was used as a safety device to phone for help if needed. During the timeframe of the research it became obvious that the technophobes consulted children and grandchildren to a higher degree than the technophiles to help them initially use the robotic vacuum cleaner. Seniors who considered themselves as technophobes initially contacted the researcher frequently to ask questions about usage and maintenance. The researcher also visited all the homes of the so-called 'technophobes' in order to show them how to clean the brushes, change the language of the program and to give them printed user guides. A digital user guide was provided from the start but the majority of the technophobes requested a printed version while the technophiles did not make such requests. In other words, the technophiles seemed to be more independent and self-assured in exploring the usage of the robotic vacuum cleaner while the technophobes showed initial anxiety and need of reassurance.

However, in the fourth interview (conducted 13 months after instalment) the so-called 'technophobes' and 'technophiles' seemed equally confident in using their robotic vacuum cleaners. After 13 months nine out of ten participants had integrated the robotic vacuum cleaner totally in their everyday routines. The one senior who used the traditional vacuum cleaner in favour of the robotic vacuum cleaner was the person who had no back pain or poor balance that affected his cleaning habits and who was able to operate an ordinary vacuum cleaner.

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Appropriation

The robotic vacuum cleaner was introduced by the researcher in charge of the project and not by the user him- or herself or anyone else. The need to conserve physical energy and the importance of prioritising activities was the reason for their willingness to change cleaning habits. Some of the seniors stated that the experience of using their ordinary vacuum cleaner made them feel drained of physical energy. Most complained about the amount of time spent on vacuum cleaning and how tired they became. Some of the seniors needed to break up the task of vacuum cleaning with rest periods. As a result, a whole day was spent on vacuum cleaning instead of doing other more meaningful activities. Mrs. O is an 80-year-old widow with great pain in her back, legs and shoulders. She enjoys singing in the local choir and playing bridge. She lives in a three-bedroom flat on the ground floor and has a small garden. She explained:

"I can only use my ordinary vacuum cleaner for a short period of time. I need to rest in between cleaning my different rooms. It feels like it's a full day's work cleaning my flat, since I need breaks and get totally drained... sometimes I feel depressed and lonely but without my activities I would be even more depressed. The activities motivate me to keep on living even though getting old is not much fun".

Meaningful activities such as social activities are a distinct and appreciated characteristic of the everyday practice of the seniors. The participants described the importance of keeping a balance between rest and activity. The robotic vacuum cleaners were perceived as 'labour-saving technology'³³. As a result, they offered an opportunity to rest or take part in more meaningful activities while the machine was doing the cleaning. Even though the robotic vacuum cleaners were perceived as something good and meaningful, there was a gap between the expectations and the actual capability of the robot. A sense of tension was noticed in the interviews regarding their lack of efficiency, worries about their damaging furniture, lack of control and high maintenance. Mrs. H is an 84-year-old widow who suffers from depression and breast cancer. She lives in a big flat (163m²) and has a huge balcony. She mentioned how the robotic vacuum cleaner misses entire sections in her big flat:

"It's very irrational in its behaviour. I have a big flat with an open plan main floor with my kitchen and living room. It wanders away and misses large areas of the living room space. I try to divide my large open space into sections since the robot seems to be a lot better at managing small

areas... I have started to use furniture to divide the large rooms into smaller areas for it to clean ... It's also very noisy and requires a lot of maintenance such as cleaning the brushes on a regular basis but I still prefer it to vacuuming myself – I'm just too old for doing that".

Mrs. H's experience with the robotic vacuum cleaner exemplifies her ambivalence between her expectations and its actual capability. She feels that she needs to experiment with her living arrangements to adapt to the capability of the robot (Figure 1).

On the other hand, Mrs. N, a 75-year old woman who lives with her husband in a detached house, does not hold the same view:

"The robotic vacuum cleaner is very convenient. I use it daily and let it roam around for an hour or so. It's very funny to watch it when it cleans. It's like a playful puppy with a will of its own. It doesn't involve any hard work and I like the fact that my floors and rugs are clean all the time".

It appears that in line with the users' expectations, the overall user experience is affected; but even though the robot's capability does not correspond to the expectations of some of the users, they try to negotiate and change practice to meet the capability of the robot since it offers a relative advantage over non-usage. The rationale for using the robot appears to be to conserve physical energy and save time to do more meaningful activities. The capability of the robot does not correspond to what some of the users expected, but at this point in time, the robotic vacuum cleaner still offers an advantage compared to the alternatives.

Objectification

Domestication theory concerns the cultural, practical, temporal and spatial space a given



Figure 1. Mrs. H's home and how she uses chairs to divide her large room into smaller areas

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Figure 2. Three of the participants' homes and how the robotic vacuum cleaner is displayed

technology has in an individual's everyday life. In other words, where we put and display our possessions at home reveals something about our identity and interests to visitors. The robotic vacuum cleaners in the seniors' homes were either placed in the kitchen or the living room (Figure 2). They were visually displayed in contrast to the seniors' ordinary vacuum cleaners, which were hidden in the closet. The reasons could be practical such as the robotic vacuum cleaners running on schedules and thus the need to be out in the open (a function that none of the participants used), or the robotic vacuum cleaners needed to be plugged into the wall to charge in their docking station, and thus could not be placed in the closet. The robotic vacuum cleaners also differed greatly in size from normal ones. However, when the participants were asked about the placement of the robot, they said that they liked to display it since it generated a lot of interest and discussions.

Most of the discussions about the seniors' vacuum cleaning practices originated in their perception that not being able to keep one's home clean was considered a stigma and a sign of failure. Mrs. D is a 90-year old lady who lives alone in a two bedroom flat. She is originally from Germany but came to Sweden after the Second World War. She explains:

"In the past I always cleaned and cooked for my friends and family. Nowadays I can't keep the standard that my relatives, as well as I myself expect. It is hard to admit but while I am getting older, I am also getting more tired. Having children and grandchildren visit is nice but I know that I need to clean before as well as after they leave. I do not have the drive to do that. It's just too hard work and in the past I often cancelled their planned visits because I felt that I would let them down, but now I use the robotic vacuum cleaner and let it take the blame if the floor isn't clean. I just say to my visitors that I have used the robotic vacuum cleaner before they came ... paying for a cleaner is expensive and you have to be at home when they clean or else they can steal your things".

In this extract, Mrs. D is visibly grappling with her own sense of her capability versus the perceived collective consensus of those around her (for instance, family, friends). In this instance, Mrs. D is aware of her inability to keep up with former practices but she feels impelled to keep her home as she did before she became incapacitated^{25,27}. Although Mrs. D feels powerless in the face of capacity change, having the robotic vacuum cleaner seems to ease the feeling of loss of power and enables her to redirect blame (of not living up to her own beliefs and values regarding cleaning) to the machine.

Incorporation

It became evident amongst several of the seniors that the domestication of the robotic vacuum cleaners was an on-going process. The robotic vacuum cleaner changed and affected current cleaning routines and practices. As mentioned in the literature, the domestication process is not linear but involves trying out different ways of using a technology and negotiating what works, to what extent and in which way³⁷.

Mr. L is a 78-year-old widower who has had seven heart operations. Although he has been close to death on two occasions, he still enjoys life and tries to have as many social activities as possible. He lives in a small flat and reported:

"In the beginning I let it [the robotic vacuum cleaner] roam around the flat without any boundaries, but then I did not know where it had cleaned. I watched it move around and in some places it seemed to clean forever while it did not visit other places. Now I tend to move it between the rooms. I let it vacuum one room at a time because then it feels like it won't be missing as much as when it had the whole flat to clean at once ... I stay home to watch the vacuum cleaner clean. I like to know where it has cleaned and what it has missed. It's good that it does the vacuuming but I like to be in charge ... it does not clean 100% but at least it cleans better than I do and it cuts down on how often I feel I need a cleaner or to do a full vacuuming".

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The seniors in this study used the robotic vacuum cleaner on a regular basis and considerably more often compared to using their ordinary vacuum cleaners. This confirms previous studies articulating the pragmatic approach taken by seniors as being more opportunistic cleaning⁴⁹. The reasons for this were that the seniors had the competence to use the robot through their history of practice (for instance, vacuum cleaning), and that its autonomous ability constituted help in everyday practice. The question of trust was repeatedly raised concerning whether the robotic vacuum cleaner would damage furniture. Mr. P is a 75 year old single man living with cancer. He enjoys using his computer and searching the Internet. He lives in a two-bedroom flat. He explained:

"I know that it is supposed to detect objects and that it does, but it really bounces repeatedly against the furniture. I am thinking about making some kind of extra padding that I could put around the vacuum cleaner ... it does a good job cleaning under the bed and sofa but unfortunately it bangs into the furniture. The repeated banging into the furniture worries me. I have old pieces of furniture that have been in my family for generations and they are very precious to me".

Among all of the seniors, ambivalence in the tension between the convenience of using the robot and its actual efficiency in vacuum cleaning can also be seen. The seniors adjusted their cleaning routines and environment to the capabilities of the robot (for instance, moving and readjusting furniture). They thought about adjusting the robot such as by adding extra padding for the technology to better suit their needs and wants.

In the first three rounds of interviews, most of the seniors tend to use the robots as a complement and not as a replacement for human cleaners or ordinary vacuuming. The advantage of the robotic vacuum cleaner was that it could be used in between visits from human cleaners. However, in the fourth round of interviews (13 months after instalment) it became clear that the robotic vacuum cleaner had become incorporated in everyday practice. In nine homes (out of ten) the seniors had incorporated the vacuum cleaners into their everyday lives and when asked if they still considered the robotic vacuum cleaner as a supplement to ordinary vacuum cleaners, they were hesitant. Shove et al.¹⁷ highlight that conceptualisation of human activities as configurations made up of heterogeneous elements such as people, objects, technology, visions, expectations and the social context, captures the fact that changes in each element trigger further changes

in the whole configuration of practices and activities. Furthermore, Shove et al.¹⁷ point out that people do not change objects or technology due to functional or objective needs but due to re-defined expectations. Such expectations among the seniors became apparent in the fourth round of interviews and as one of the participants said:

"I do not know who or what is the supplement to whom or which. I use the robotic vacuum cleaner on a daily basis while seldom having a cleaner over or using the ordinary vacuum cleaner. Initially I considered the robotic vacuum cleaner as a supplement but now I can't live without it".

Conversion

Baudrillard argues that the use (or non-use) of a specific artefact is not defined by the artefact's functionality but by what the artefact signifies⁵⁰. What the artefact signifies for an individual is not defined by what it does, but by its relationship to a whole system (the society and personal networks one belongs to). In this study, a majority of the seniors said that they had talked to friends and family about their experience of having a robotic vacuum cleaner and that people showed a lot of interest in robotic vacuum cleaners. Some of the senior women especially mentioned that they had received a lot of attention from senior men about their robotic vacuum cleaner. As in Mrs. G's case:

"All the senior men I speak to are very interested in my robotic vacuum cleaner. They seem to be impressed by me having a robotic vacuum cleaner".

In a similar fashion Mrs. A stated:

"My children are impressed by me having a robotic vacuum cleaner and the grandchildren want to turn it on while they are here. The other day one of my daughters even bought one herself".

The attention and positive attitudes regarding the robotic vacuum cleaners from others seem to motivate and strengthen the domestication process among the seniors⁵¹.

The entertainment aspect of having a robotic vacuum cleaner was not anticipated by the seniors but it turned out that most of them developed a feeling of ownership and loyalty towards their robot. Eight out of ten participants gave their robotic vacuum cleaners a name. When asked if they normally gave their artefacts a name, all of them said no. The reason for naming the robotic vacuum cleaner seemed to be related to it having characteristics of a pet, as shared by Mrs. N:

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"I think it is such a funny thing. It is like a puppy; it compulsively chases dirt and dust on the floor. It bumps into furniture and moves my shoes around the house. It is not always very efficient but it is very funny – it makes cleaning fun".

Some of the seniors mentioned that before they tried out the robotic vacuum cleaners they were unaware that they were available for all consumers to buy. They thought robotic vacuum cleaners were rare artefacts but after they became familiar with the technology, they spoke to people who had one, as well as seeing advertisements about robotic vacuum cleaners in the newspapers. Before they just had not been 'ready' to see the advertisements or talk to people about cleaning and robotic vacuuming. This highlights that there is a potential among seniors to use new technology if they get the information of its existence. Other important conclusions for designers to consider in the process of testing new technologies in the home are the time factor and the complexity of domestication as shown in this study.

DISCUSSION

This study set out to elucidate seniors' adoption of robotic vacuum cleaners. More precisely it set out to investigate: (i) How do seniors and their practice shape the working of the robotic vacuum cleaner? (ii) How does the robotic vacuum cleaner form new practices for the seniors? We provided an account of ten seniors' experience and adoption of robotic vacuum cleaners through the lens of practice theory and the framework of domestication theory¹⁸. To conclude, we synthesise the major points identified in the paper into the following.

First, the results showed that the different dimensions in the process of domestication of robotic vacuum cleaners by seniors appeared concurrently and not sequentially. The phases of appropriation, incorporation and conversion emerged during overlapping time periods and occur with time.

Second, the findings indicate that the process of domestication is characterised by fitting expectations and redefining expectations to practical and symbolic values. The reasons for trying out a robotic vacuum cleaner seemed to vary but it appeared to be because the seniors expected one or more benefits as a result of cleaning using a robotic vacuum cleaner. These expectations in turn, seemed to serve as a motivation. Thus, initially there was a gap between the seniors' expectations of the robot and its actual capabilities but with time the expectations were redefined in conjunction with the abilities of the robot (in

nine cases out of ten). The user who did not redefine his expectations ended up rejecting the robot vacuum cleaner since he did not see the relative advantages of using it over his ordinary vacuum cleaner. He made the following comments:

"I tried it out but I have to move furniture around and remove cables from the floor. Also I think it is good for me to do it myself or else I will become passive. I need the exercise".

In contrast to the others, he was able to push an ordinary vacuum cleaner himself. Hence, the juxtaposition of expectations and redefined expectations within the domestication process highlights the importance of studying robots outside the lab in the context in which the innovation is intended to be used.

Third, interestingly the older individuals' self-perceived technology competence had an initial effect on the appropriation of the robotic vacuum cleaners. The results of this study indicate that seniors who consider themselves as technophiles were more confident in employing the robotic vacuum cleaners into their 'normal' cleaning practice while those who considered themselves as 'technophobes' initially needed more reassurance and support from their personal network. However, after the seniors had incorporated the robotic vacuum cleaners into their cleaning practice, no differences were perceived between 'technophobes' and 'technophiles'. The domestication of the robotic vacuum cleaner emerged, in practice, when the senior users formed a meaningful relationship with it. The findings indicate that the robot vacuum cleaner related to the seniors in ways they perceived as meaningful. A general pattern was that all the seniors stressed the importance of prioritising activities. Social activities as well as rest were considered as more meaningful than vacuum cleaning. These findings suggest that in general, technology is important to seniors if it increases their personal freedom and makes life more convenient. Thus, robotic vacuum cleaners are not just accepted because they are functional and convenient but because they are a means for the seniors to cope with everyday life and save physical energy for more meaningful activities such as meeting friends and spending time on hobbies. Such considerations are relevant for understanding what a more advanced assistive robot should support.

Fourth, the domestication of the robotic vacuum cleaners was also a result of the attention and positive attitudes the seniors received from others regarding their usage of robotic vacuum

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cleaners. According to Ilmonen³⁰, this conversion could be called 'externalisation' because he claims that during a successful domestication process the emotional experience of making an artefact your own is often shared with friends and family. Similar findings have been observed by Venkatesh et al.⁵¹ who argue that social influence has a considerable impact especially for older women in the early stage of experience of a system.

Some possible implications for the adoption of robots among seniors should be mentioned. As stated above, it is important for designers and engineers to understand what affects the use of technology in a real life context and how this may be different from laboratory tests. This study shows how usage develops over time, to a certain extent fitting redefined expectations. It shows that initial attitudes to technology change over time as well, and that attitudes from oth-

ers – externalisation – affect the domestication process. The results suggest that the autonomy of the robot made it possible for the seniors to carry out other activities while the robot cleaned, but also gave them a feeling of loss of control. Understanding the machine seemed to be of minor importance compared to the feedback from the machine that it was doing its job, in this case cleaning the home.

CONCLUSION

It is clear that in times when aging and incapability are prevalent, the domestication process of robotic vacuum cleaners can both expand older people's preferences and expand their space of action. To realise this potential, awareness of the domestication process taking place in the user's social context is of utmost importance to create sustainable gerontechnologies and to provide developers with reasonable expectations on the effects of technology in practice.

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