Older Users' Wish List for Technology Attributes

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A comparison of household and medical technologies

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Abstract. Facing the increasing user diversity and broad diffusion of technology in work-related and private contexts, the sensible tailoring of technology functionalities, attributes, and interfaces – with reference to the requirements and needs of users – is a key prerequisite of a successful rollout and broad acceptance of technologies. However, user diversity and the specific using contexts of technologies have not been sufficiently researched yet. In this study, we examine the wish list regarding attributes for different technologies in a wide age range. Using qualitative and quantitative methodologies, we explored the different specifications for household and medical devices and assessed which attributes users expect for each of the two different technology types. Exploring user diversity, we analyzed effects of age, gender, and health status on the perception of technology requirements. Results show that not only user diversity but also the specific technology type present as critical factors in the definition of proper attributes of technology. The findings may be useful for human-centered product development.

Keywords: User diversity, technology acceptance, age, gender, purchase and usage criteria, household -, medical technologies, ICT, user expectations

1 Introduction

During the last decades, human-computer interaction research has made significant gains in understanding technology acceptance of information and communication technology (ICT) and the requirements that need to be considered for a user-centered technology development. Since the pioneering in technology acceptance 25 years ago [1], a huge number of studies corroborated the enormous impact of ease of using a system and its perceived usefulness on the acceptance of a technology (e.g., [2], [3]). Nevertheless, the knowledge about specific determinants of technology acceptance and the impact of situational aspects of usage contexts is still limited [4]. This is based on the fact that nowadays technology has to cope with much more complex

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using situations compared to the situation of technology usage in former times [5]. A first factor in this context is the user diversity with an ever increasing number of seniors that are confronted with a broad range of technology and urged to understand, learn, and use it [6]-[8]. The second impact is the ongoing diffusion of technical devices. Technology and electronic services are deeply integrated into daily life, thereby raising novel requirements as well as concerns regarding privacy, security, and control [9]. A third factor addresses the different types of technology in different using contexts. One and the same technology, once used in a medical context and once use for daily support, may require completely different using profiles which have not been considered sufficiently within technology acceptance research [10], [11].

For the development of well-accepted future technologies, we need to integrate the users and find out which factors they perceive as relevant for the broad acceptance of different technologies. Technology type, context of use, and age are crucial determinants and highly relevant for the extent of acceptance and the willingness of older people to actually use technology [12], [13].

1.1 Questions addressed

As users' demands and concerns were neglected within product development for a long time, a considerable knowledge gap exists regarding the needs and requirements of users and their expectations for a useful and functionally sufficient technology. In an exploratory approach, we contrast technologies in different contexts of use, specifically household and medical technologies. Both technology types are very frequently used by older adults, a key target group of modern technology. The questions guiding this research were the following:
(1) *What* are the users' demands for household and medical technologies?
(2) *How* do demands for household and medical technologies differ from each other?
(3) *How* do the demands vary for different users (gender, age, health status)?
In order to learn about the impact of user diversity, participants of both genders and of a wide age range (19-74 years) were examined.

2 Methodology

The present study was designed to get a deeper understanding of older adults' requirements and expectations of desired functionalities in different technology domains, contrasting household and medical technologies. One of the basic principles of empirically assessing the willingness of technology adoption is the fact that the method used has an effect on the outcome, especially in a participant group that is not used to take part in empirical studies (as older adults are) and therefore might be highly receptive to expectations of what seems appropriate in the respective setting.
In order to truly understand older adults' wishes, expectations, and requirements in the different technology domains, we opted for a mix of qualitative and quantitative methodologies. Therefore, we compiled a questionnaire that consisted of both an explorative qualitative part in which participants could freely state their opinions (Part I)

and a quantitative part (Part II) in which different aspects had to be evaluated on predefined scales.

2.1 Empirical research procedure

In the beginning of the empirical process, demographic data was gathered. Gender, age, and self reported health-status were the independent research variables as they are widely known to be key factors regarding technology adoption and willingness to use technology [3], [4], [5]. Regarding the assessment of their health condition, participants could assign themselves to either a "healthy condition" category or a "not healthy condition" category in case of suffering from chronic disease(s).

Then the qualitative part started (Part I). Participants were given the opportunity to freely state attributes they would require of household and medical technologies respectively. Nine attributes could be given at the most. This qualitative approach was realized in an open format by asking for the users' wish list: What attributes should household and medical technologies respectively possess? For both technology types, we operationalized medical and household technologies, giving typical examples from daily experience (e.g. blood pressure meter (medical technology), washing machine (household technology).

Then the quantitative part began (Part II), using the questionnaire, which requested participants to allocate 18 statements either to medical or to household technologies.

For both research parts the dependent variables were the number and nature of attributes ascribed to household vs. medical technologies.

2.2 Participants

In order to study "age" as determining factor for the design of technologies, we examined a wide age range. 36 participants, aged between 19-74 (M=36, SD=18,07), took part in this study. 13 participants were female (36%), 23 male (64%). The sample was split into four age groups (Table 1).

Table 1. Splitting of Participants into Age Groups

Age groups	**N age group**	**% age group**	**% female**	**% male**
Age < 20	6	17	83	17
Age 21-35	17	47	12	88
Age 36-60	8	22	63	27
Age > 60	5	14	20	80

7 participants had at least one chronic disease (19% ill, 81% healthy). Participants were recruited through advertisements in a local newspaper and announcements in public places. Participants were not compensated but volunteered to take part, highly motivated by the fact that they were asked as experts for the design engineering of technology in socially and societally important technology fields.

3 Results

As the present study was mostly exploratory in nature and aimed at uncovering desired functionalities and attributes of technology in different domains, we did not use inference statistical analysis but report the data descriptively (frequency data in %, M = means, SD = standard deviations).

3.1 Part I: Desired attributes of household and medical technologies

In order to evaluate the qualitative data from the wish list for household and medical technology, the stated attributes were categorized. The categories were based on related research [6], [4] and adjusted in the course of the analysis. The number of attributes mentioned by category can be seen in Table 2.

Table 2. Number and percentage of mentioned attributes: household and medical technologies

	Household Technology		**Medical Technology**	
Categories	**n household**	**% household**	**n med tech**	**% med tech**
Design	7	4.1	0	0
Other	4	2.3	3	2.3
Price	20	11.6	7	5.5
Documentation	0	0	10	7.8
Facilitation of everyday life	29	16.9	11	8.6
Unobtrusiveness	4	2.3	16	12.5
Functions & usability	58	33.7	21	16.4
Flexibility & mobility	29	16.9	22	17.2
Reliability	21	12.2	38	29.7
Total of attributes	172	100	128	100

As can be seen in Table 2, more answers were given for household technologies, showing that the participants' mental model of attributes of household technologies is more differentiated than that of medical technologies. Figure 1 depicts the percentage of attributes in the different categories.

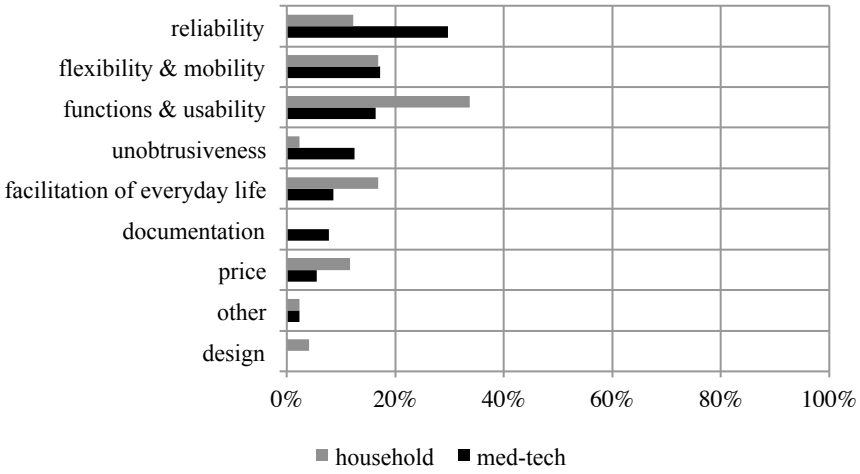

Figure 1. Mentioned categories for medical and household technologies

As can be seen in Figure 1, desired attributes for the different technology domains differ not only with respect to the mere number of mentioned functionalities. The attribute patterns differed also qualitatively and revealed how very different the wanted attributes are between the two technologies.

"Reliability," for instance, was found to be the key category for medical technologies outdoing all other attributes. Conversely, "functions and usability," obviously less important in case of medical technology, plays the key role in household technologies. Interestingly though, not all attributes depend on the type of technology. "Flexibility and mobility" are similarly wanted in medical and household technologies as the second most important category.

Gender effect. In this analysis, gender effects are focused on, based on the question if female and male users require different attributes within the different technology domains. In Figure 2, the requirements for household technologies are depicted.

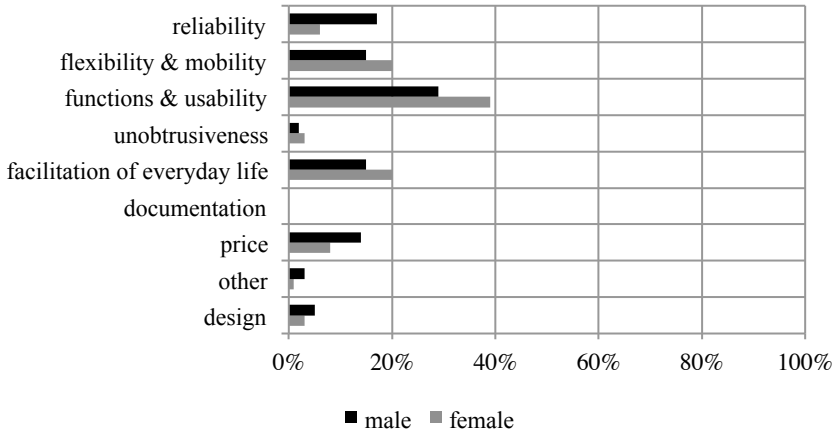

Figure 2. Mentioned categories for household technologies: gender effects

When looking at household technologies (Figure 2), it is apparent that women attach higher importance to "functions and usability," to "flexibility and mobility" as well as to "facilitation of every day life." Men, in contrast, value "reliability," "price," and "design." Neither gender reported "documentation" requirements, thereby suggesting household technologies are easy to use and learn, without the use of specific documentation.

In Figure 3, findings of gender-related requirements regarding medical technologies are illustrated. Again, there are considerable gender differences.

The most obvious difference regards the reliability requirement that is more than twice as important for men as it is for women. For women, again "functions and usability," "flexibility and mobility" but also "unobtrusive design" and "facilitation of everyday life" are important key features in the medical technology domain.

Two other findings seem noteworthy in this context. In contrast to household technology, the price is less important in the medical technology domain (more important to men, though) and "documentation" is needed for medical technology devices (more important to women).

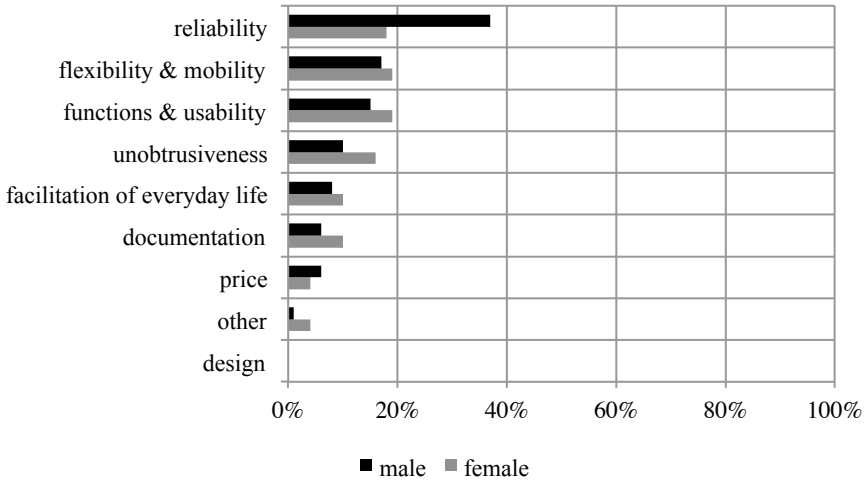

Figure 3. Mentioned categories for medical technologies: gender effects

Age effect. When looking for age differences, we see a rather inhomogeneous picture for household technologies (Figure 4).

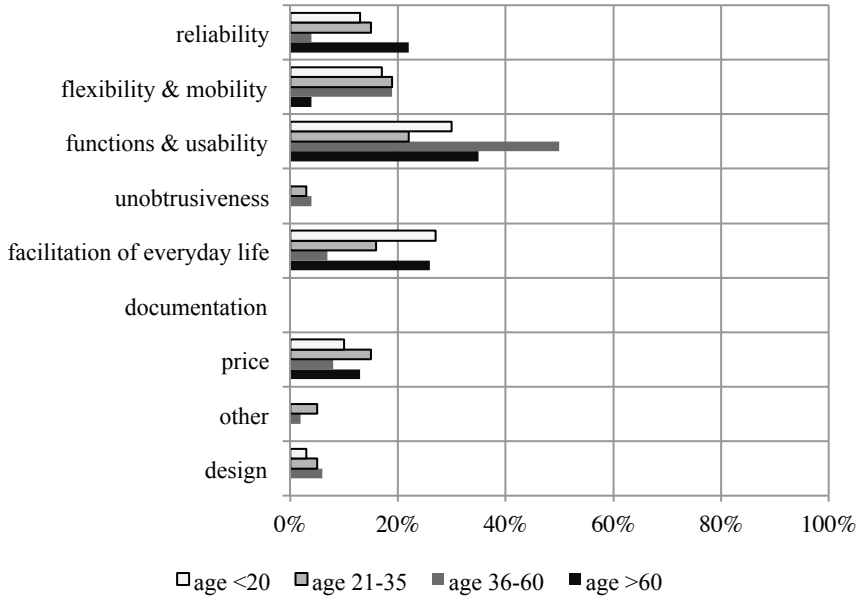

Figure 4. Mentioned categories for household technologies: age effects

For the oldest group, “functionality and usability,” “facilitation of everyday life,” and “reliability” were the most important features. Across all ages, “functionality and usability,” “facilitation of everyday life,” and “price” seem to be the most important categories for household technologies.

Are age effects also decisive for medical technologies? Figure 5 shows that the requirements are affected to a lesser extent by age. For all age groups, “reliability” of medical technology is the most important feature. “Flexibility” is mentioned as important for all groups except the oldest (over 60 years of age), which did not attach importance to this criterion at all. “Functions and usability” was not as relevant for the oldest group, in contrast to attributes like “unobtrusiveness” and “facilitation of everyday life,” which were found to be crucial characteristics for medical technology in the oldest group.

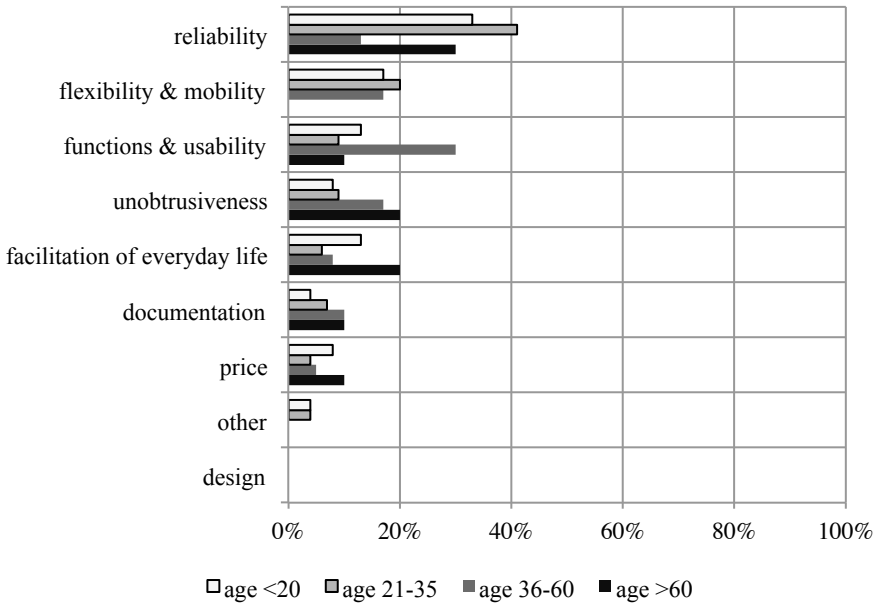

Figure 5. Mentioned categories for medical technologies: age effects

Effects of health status. A final analysis considers the health status of participants. One might expect that the health status should have no effect on the key requirements in household technologies (Figure 6), yet that in medical technologies (Figure 7) healthy persons should have less requirements compared to ill persons, and “reliability,” “flexibility and mobility” but also “usability” should be the key attributes.
Household technologies are considered first (Figure 6). As expected, chronically ill and healthy persons assess the same attributes as (un)important. The most important feature is the usability requirement, independent of the health status. Among the unimportant attributes are “design” and “documentation.”

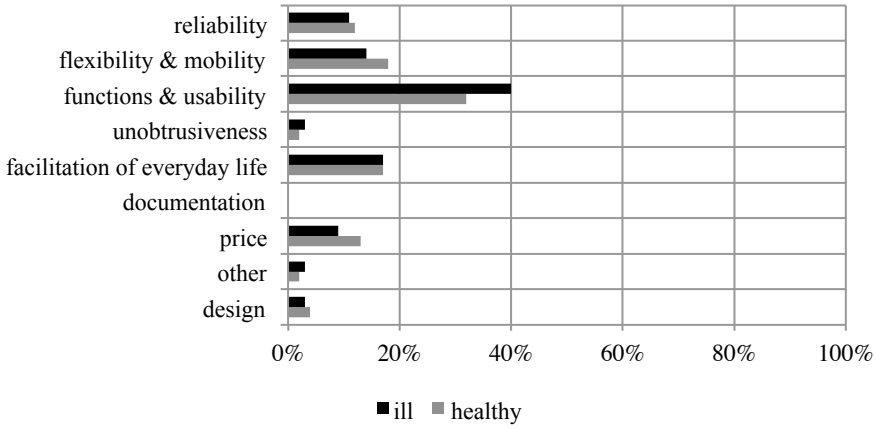

Figure 6. Mentioned categories for household technologies: effects of health status

When looking at the requirements of medical technology, considerable differences emerged between the attributes reported by healthy and ill persons (Figure 7).

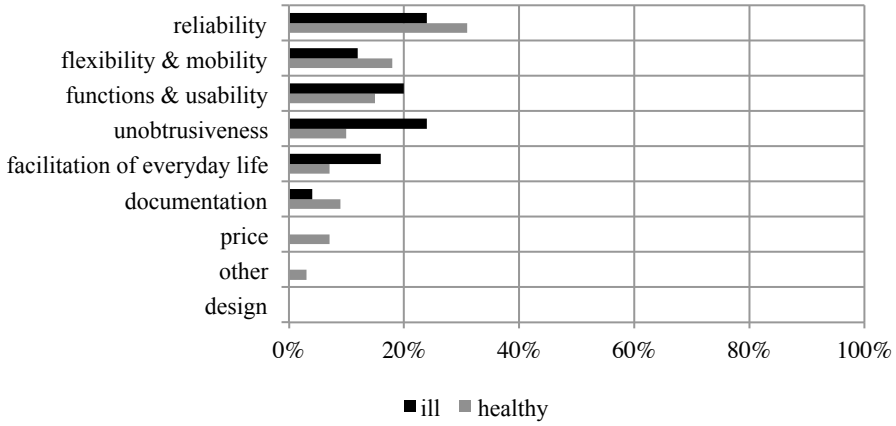

Figure 7. Mentioned categories for medical technologies: effects of health status

For chronically ill persons, "reliability," "unobtrusiveness," "usability," and "facilitation of everyday life" are most important. While most of the desired functions are easily comprehensible, the requirement for "unobtrusiveness" by ill persons seems to be especially noteworthy. It shows that the stigmatization of illness is a sensitive aspect for people and might be compensated by unobtrusive designs. For healthy persons, interesting findings were revealed as well. It is worth mentioning that healthy people attach higher importance to reliability than ill persons do. This finding is contra-intuitive at first sight. Though, possibly, reliability might be less important to ill

persons due to their higher domain knowledge of how to handle medical technology. This assumption is corroborated by the higher need for documentation in healthy persons, again referable to their higher insecurity when dealing with disease-related information.

Summarizing the findings so far, we can conclude that users perceive different requirements for technologies in different domains. In addition, the key requirements are also modulated by user diversity. Gender, age, and health status are sensitive factors that need to be considered quite early in the design process of a technology.

3.2 Part 2: Allocated statements to household and medical technologies

After the qualitative approach, we presented 18 different statements and asked participants to allocate the statements to either medical or household technology.
The selection of the statements was based on interviews carried out prior to this study [7], [8], [9]. The statements represent alternative endings of the sentence "I would use the technology, if," depicting conditional acceptance using motives (Figure 8).

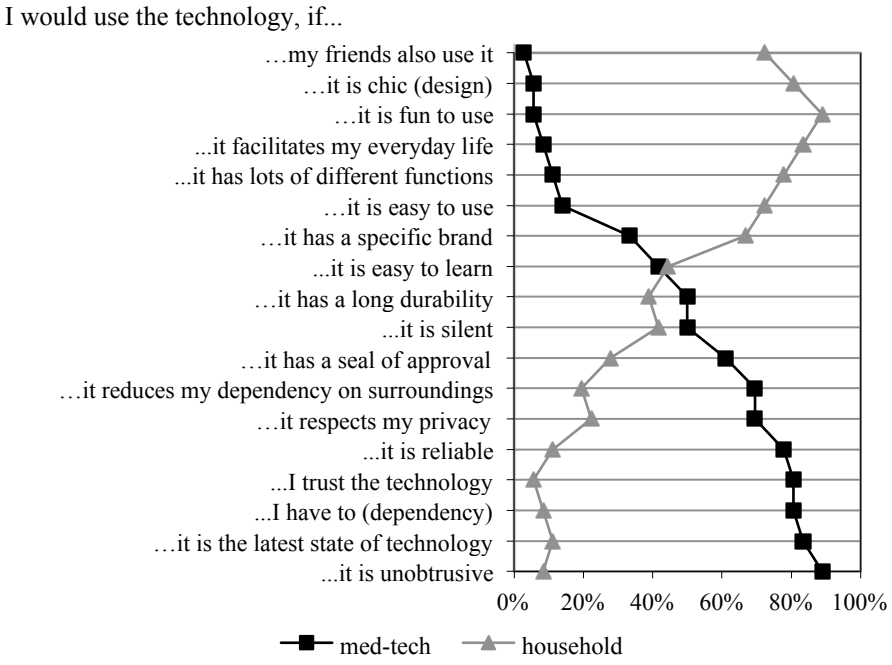

Figure 8. Conditional acceptance using motives in the different technology fields

It can be seen that there are completely opposing requirement profiles for both technology domains. The curves for medical technology and for household technology cross in one main aspect: the ease of learning the system, followed by a high durability, and a silent mode while using the technology.

When defining the pro-using profile of medical technology, “unobtrusiveness of technical design,” “the latest state of technology,” “having no alternatives to using it,” “trust,” and “reliability” are key. The very same arguments are the least important features for household technologies. For the latter, the pro-using profile is characterized by “attractive design,” “fun to use,” “technology facilitates life,” and providing many “different functions.” No age, gender, or health effects were revealed, showing that user diversity is indistinctive in the perception of household technologies.

4 Discussion

In this paper we focused on users’ wish list regarding attributes of different technology types: household and medical technologies. On the one hand, we identified generic attributes, which should be present in both technologies and independent of user diversity: Here, adequate functionality and high usability are key attributes, but the extent to which technology facilitates everyday life is also important. Furthermore, independent of the participants’ age, gender, and health status, there are also some generic attributes that seem to have no importance at all (at least they were not mentioned on the respective wish lists). As such, documentation and instruction come to the fore, which is quite astonishing considering the mostly suboptimal design of many technical devices’ manuals. Regarding medical technology, reliability and usability are crucial for all users, which was expected, confirming previous research outcomes in the medical technology context [14], [15]. It is an insightful finding, though, that unobtrusiveness is a critical attribute of medical technology, especially for older and chronically ill persons. One could have expected that unobtrusiveness of technology might be less important for a group that is quite dependent on technology. Apparently, this is not the case and represents the typical designers’ error: ignorance towards the customers’ experience. As older and ill participants noted, the stigmatization of being old and ill is very negatively biased in our society and therefore unobtrusiveness is indispensable for people using the technology.

Regarding the methodology, the mix of qualitative and quantitative procedures revealed a rich field of insights and allowed us to screen user diversity and technology contexts in a very sensible way. The task of providing a “wish list” for different technology types that are very familiar to the participants pleased them. In addition, participants were highly motivated to work on technology design principles and were very willing to contribute their knowledge. They appreciated being integrated into technology development as key users, especially as this opposes the traditional designers’ approach of first producing a technology and later realizing said technology designs might have severe usability barriers or are outright rejected by the (intended) target group.

A final remark is directed to the older persons as an important future user group. In contrast to the usual procedure in which younger technical designers develop technology for older users by just imagining what could be useful or necessary for senior persons. We should be aware that this procedure is naïve if not ignorant. Aging is complex and quite differential [16], [17|. Not all users age in the same way and the requirements, the needs and whishes towards a well-accepted technology might be

individual. In addition, designers should be aware of the fact that aging and technology generation should be distinguished. Even though the age-related decrease of sensory and motor abilities might be comparable over times, the acceptance for and the requirement towards humane technology might be different in the different generations, reflecting upbringing aspects, mental model of how technology works and different societal needs [17]. Thus, including users into early stages of technology developments is indispensable in order to reach broad acceptance of technology [18], [19].

5 Limitations and future research duties

Finally, there are some limitations that will have to be addressed in future work. One is the comparatively small sample size. Even though qualitative research approaches often have small sample sizes, we cannot expect a broad generalization of the findings unless we validated the outcomes with a larger sample size. This will be accomplished in future work. Also we are aware that household and medical technology are only exemplary technology fields, which might be relevant against the background of the demographic change. As a matter of fact there are other technology development, smart clothing or robot development, which should be also examined in this context. The other is the focus on a decidedly European perspective. In future studies, we will have to work out to what extent insights won here also apply to other cultural backgrounds and societies with different value systems, different education levels, and different economic structures [20], [21].

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