Research Article

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Smart Home Medical Technologies: Users’ Requirements for Conditional Acceptance

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Abstract: One mega challenge for the next decades is the aging of populations in western societies. Ambient Assisted Living (AAL) Technologies provide solutions for these challenges of demographic change. Elderly people living independently in their homes can be monitored for health reasons with integrated information and communication technologies (ICT) to get help in case of emergencies. From the user-centered approach, acceptance of these solutions is crucial. In his work, we focus on the effects of 5 domestic spaces and 3 integrated ICT on acceptance and the influence of user factors. We consider two samples from 2010 (n = 100) and 2015 (n = 148). Results show that visual monitoring is accepted least, positioning best. The role of private and public rooms has a strong influence on acceptance. Also, the type of technology as well as the interaction of technology and room have a strong impact, whereas user factors play only a minor role for AAL acceptance.

Keywords: AAL Technologies, ICT, Technology Acceptance, Health Monitoring, Living Spaces

1 Introduction

The current global conflicts and resulting immigration of refugees into western Europe have far-reaching consequences and pose challenges, not only for the people seeking shelter but also the societies harboring them. One of these challenges is the impact on the – due to the demographic change – already altered population of western Europe [43]. The basis for an ever shrinking populace had been laid with the end of the baby boom after World War II and the decreasing fertility rate since 1965 [11]. However, the increased life expectancy, mainly in high-income countries, shifted this theoretical trend from a shrinking to an aging society. And these developments appear to remain true for both fertility [9] and mortality trends [28].

While, considered on its own, a stagnation in fertility might even bring societal benefits [25], together with the consequences of an aging society, it poses a severe challenge especially for the health and elderly care sectors. Unfortunately, an aging society due to medical improvements does not necessarily mean that older people do not suffer from age-related diseases and constraints [33]. Going hand in hand with that, the number of frail older persons is rising, as are the demands for medical treatments and long-term care provided by healthcare systems [27]. How to sustainably cope with this mega challenge is a central question for present societies, politics, and research [15, 39].

Almost 15% of the population in Europe have to struggle through daily routines that are complicated by physical, mental, or cognitive disability without sufficient professional support [35]. Additionally, chronic diseases are expected to increase in an aging society (e.g., dementia, cardiovascular diseases, diabetes). The number of diabetes patients, for example, has been predicted to increase by 40%, that of patients with cardiovascular diseases by 50% within the next ten years [21]. Therefore, the number of seniors requiring personal care will increase as well in the upcoming years. Even with the latest developments in the medical supply chain and care sector, third-party assistance still seems inevitable in many cases [36].

Information and communication technologies (ICT), as ubiquitous, beneficial, and easily accessible as they have become in the last decades [17, 23], may compensate for the predicted lack of medical and geriatric nursing staff in the near future [10]. From the technological side, a seamless integration of ICT at home could be the standard before long. However, there is still little knowledge about people’s acceptance of home-integrated ICT for medical reasons, especially with regard to user diversity. Aging implies a huge variety of different aspects and not all people age in the same way [5]. Beyond physical and physiological processes, which are know to decline with increasing age, education, family bonding, values, and personality are all highly individual. They not only impact the way people age but also the individual, familiar, and societal concepts of aging [45, 46].

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Research focusing on technology acceptance determines the understanding of individual usage motives and barriers. For living spaces, these factors have been underestimated or even disregarded so far. Apart from the technological feasibility, research should, therefore, focus even more on the users’ needs and wants. Important factors considering conditional acceptance should address dignity, privacy, and people’s requirements for those home-integrated ICT that are at least perceived as being useful [14, 24, 32, 36, 46].

1.1 Chances for Ambient Assisted Living in an Aging Society

With the mass dissemination of personal computers and the rapid improvements of microprocessors and microsystem technologies in the 1990s, the term ‘ubiquitous computing’ was coined [1]. Going along with this hardware-oriented point of view, the seamless integration of microsystem technologies into rooms established the research field of ambient intelligence [18]. At home, the use of external devices (e.g., computers, smartphones, smart textiles, eHealth devices) that communicate with each other and with the integrated ambient technologies inducted the research area of smart living environments [16]. Today, when talking about the chances of smart living environments solving the challenges of demographic change in an aging society, the research field of Ambient Assisted Living (AAL) is primarily addressed, although the boundaries between the different fields of research are blurred.

The first and still used definition of AAL was recently repeated at the IET International Conference on Technologies for Active and Assisted Living (TechAAL), 19/06/2015: “Active and assisted living (AAL) makes use of information and communication technologies (ICT) in a person’s daily living and working environment to enable them to stay active longer, remain socially connected and live independently into old age. […]” A state of the art overview of recent AAL developments can be found in [30] and [3]. The tremendous amount of technical possibilities and prototypes, e.g., serious games for elderly [12], and the discussion of frameworks and standardization [29] assume that AAL solutions for the challenges of the demographic change are well within reach.

From the societal point of view, these AAL technologies offer great solutions to an aging society. The health and elderly care systems in western societies are lacking both economic and human resources [10]. Politics and communities put a lot of effort into expanding conventional and well-established solutions: They invest in retirement homes and the education of geriatric nurses [6]. However, within the scope of the next five years, all of these efforts will prove to be insufficient when the increasing number of older and care-needing persons faces the continuous decrease of younger and potential care-giving people: Many age-related chronic diseases like dementia, Parkinson’s, multiple sclerosis, but also wound treatments require personal assistance. A tremendous number of older adults are in danger of falls or sudden breakdowns [31]. And they are facing even higher risks, simply because they live alone and might not be found in a timely manner in case of an emergency [20]. Wearable solutions with fall-detection and emergency transmitters are the common approach. Nonetheless, wearable solutions only help when they are within reach or actually attached to a person [8] while integrated solutions in Ambient Assisted Living would provide 24-h telemonitoring. However, AAL solutions are not yet ready to go into production; a fact that might not hinge on their technological feasibility alone.

1.2 Integration of ICT for eHealth at Home – Technological Perspective

The idea to use ICT for AAL purposes seems easy and plausible: The use of basic ICT in everyday family life is common and has been studied since the late 1980s [37]. It is no big technological step to integrate basic information and communication technologies like microphones, cameras, monitors, movement/temperature sensors, etc. into people’s living spaces. For medical surveillance purposes, the monitoring could enable elderly to live in the own home longer instead of having to move into a retirement facility. Monitoring, in this context, can range from simple observation of behavior patterns [13] to video supervision combined with smart home technologies [4].

So what are the reasons that today’s living environments are not equipped with integrated ICT? To understand the barriers of AAL usage, we have to focus on the actual user of these systems, their perception of intrusiveness, privacy, and the willingness to adopt home-integrated ICT.

1.3 Acceptance of Health Monitoring at Home – Users’ Perspective

When confronting people with AAL technologies as a possible solution for the challenges of the demographic
changed, most understand and acknowledge the necessity and usefulness of technical support. However, thinking about implementations in their own home triggers plenty of conflicting positions: restraints and acceptance barriers vs. the wish to remain healthy and independent in the own home for as long as possible [4, 44]. Considering both user diversity and technology acceptance is key to understanding this trade-off. Research becomes increasingly more aware of the different aspects of medical technologies and the limited suitability of traditional technology acceptance models. Deviating from classical ICT, medical assistance devices address predominantly frail, diseased, and older people with particular and wide-ranged demands [5, 19, 41]. The needs of persons with limited mobility, for example, differ significantly from those of people with hearing deficiencies. The necessity for a sensible and comprehensive identification of acceptance factors in smart home technologies is therefore very important [7, 38].

Regarding the specific context of ICT integrated into the home environment, there is an additional influencing factor to understand: The ubiquity of communication technologies may be perceived as a violation of the personal space and evoke privacy concerns and a feeling of loss of control [26]. The “own four walls” are, for most people, the most intimate and private place in everyday life, especially compared to urban and public places [44]. The understanding of how living spaces have different perceptions of privacy depending on the room – or, more accurately, the function assigned to this room – and which technology might be accepted and which declined has a great impact on the implementation of AAL technologies. So far, there is little to no knowledge about the interplay of user factors, different technology types, and living spaces. In addition, technology acceptance may also be a question of customization and familiarity with technical approaches. Usage contexts, societal habits, and public perceptions may change over time and by this modulate technology acceptance. If so, it is reasonable to assume that AAL technologies might be more and more accepted the longer technologies are addressed in the public discourse and the more people know about it.

2 Research Approach

To understand users’ insights into acceptance of ubiquitous monitoring devices at home, this research examines effects of different user factors on the acceptance of ICT monitoring at home. Generally, all research questions can be summed up to one simplified 5Ws-question:

Who (user diversity) would accept what (AAL technologies), where at home (room-dependency), when (2010 vs. 2015), and under which circumstances (preconditions)?

Table 1: Acceptance matrix for 3 different technologies in 5 different domestic spaces.

<table>
<thead>
<tr>
<th>Monitoring Technologies</th>
<th>Living Room</th>
<th>Home Office</th>
<th>Kitchen</th>
<th>Bedroom</th>
<th>Bathroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
</tr>
<tr>
<td>Camera</td>
<td>A6</td>
<td>A7</td>
<td>A8</td>
<td>A9</td>
<td>A10</td>
</tr>
<tr>
<td>Positioning system</td>
<td>A11</td>
<td>A12</td>
<td>A13</td>
<td>A14</td>
<td>A15</td>
</tr>
</tbody>
</table>

This approach was realized by analyzing the acceptance of three different monitoring technologies (see Table 1), (a) microphone (auditive), (b) camera (visual), (c) positioning system, in five different domestic spaces, (1) living room, (2) home office, (3) kitchen, (4) bedroom, and (5) bathroom.

In order to understand if acceptance changes over time, we had two years in which acceptance was surveyed: 2015 vs. 2010: The present investigation from 2015 is a follow-up study from 2010, partly published in 2011 [44], with a different scenario: While the participants in 2010 had to imagine being ill and dependent on health care, the ratings for acceptance this time were analyzed for their actual living and health conditions. The following user factors were addressed: (1) age, (2) gender, (3) health status, and (4) attitude towards technology.

The circumstances were analyzed and summarized as “preconditions for usage.”

The comparison of the two surveys and samples enables us to validate the results from 2010 and see how acceptance and influence of user diversity developed within a span of 5 years.

Based on latest results in research, our hypotheses are:

H1: Technology-effect: Acceptance is lowest for visual monitoring (camera).

H2: Room-effect: Acceptance drops significantly between rather public (living room) and the more private spaces (bathroom & bedroom).

H3: The acceptance of the positioning system, compared to the other technologies, is independent of the room.

Concerning acceptance research on AAL technologies, age, gender, and health status might influence acceptance. However, results differ regarding various studies and technologies [34].

3 Methodology

The present longitudinal study compares research results from questionnaires in 2010 and 2015. The survey items
are based on qualitative focus group results from 2010 [44] in consideration of the Technology Acceptance Model (TAM2, [40]).

3.1 Questionnaire

The questionnaire consisted of four main parts to measure the acceptance of integrated monitoring technologies: Demographic data of the participants (1), their general attitude towards technology (2), their acceptance of different monitoring technologies for various living spaces (3), and finally their usage requirements (4).

3.1.1 Demographic Data

In a first step, the participants had to specify their demographic information: age, gender, educational level, and health-status. The health-status was measured by four questions concerning chronic diseases, regular check-ups, dependency on medical technologies, and dependency on medical health care. Participants negating all queries were categorized as healthy.

3.1.2 Attitude Towards Technology

The attitude towards technology (ATT, [22]) was measured by five statements assessing different dimensions of technologies in general: interest, ease of use, trust, fun, and avoidance. The participants had to rate from refusal to approval on a four-point Likert scale.

3.1.3 Acceptance of Monitoring Technologies in Different Living Spaces

In the third part, the participants were given a short explanation about the usefulness of home monitoring technologies in case of emergencies. After a short introduction into the challenges of demographic change and AAL technologies as one possible solution, the participants had to evaluate their acceptance of different technologies in different domestic spaces. Each technology was described by its functionality:

- **Auditive** monitoring means installation of microphones. It is possible to hear if someone is still present and breathing. In case of an emergency, the resident could just call for help.

- **Visual** monitoring means the installation of cameras. It is possible to see if someone has fallen or is injured.

- **Positioning** systems could give information on whether someone is still moving or not. Comparing the average movement of residents, it could be possible to indicate whether someone has fallen and does no longer move.

Using a questionnaire format, the participants had to evaluate their acceptance of all three technologies and each of the domestic spaces in following order: living room, bedroom, kitchen, bathroom, home office (see Table 1). The acceptance was measured from rejection (–100%) to approval (100%). While in 2010 a 4-point Likert scale was used, in 2015, it was extended to a 6-point scale as to increase the potential differentiation which was deemed too limited before. As both scales have an even number of evaluation options (no error of central tendency), the survey answers could be compared and evaluated together.

3.1.4 Preconditions for Usage

In the last part, the circumstances for technology usage were retrieved: Six preconditions for the use of monitoring technologies in general had to be rated from “unimportant” to “important” on a 4-point Likert scale:

1. “I must know the persons monitoring me.”
2. “I need full control (de-/activation) of the technologies at all times.”
3. “Protection of data security must be warranted.”
4. “Technology requires flawless and reliable functionality.”
5. “The data must be protected from third parties.”
6. “The integration at home must be seamless and unobtrusive.”

3.2 Participants

**Sample 2010:** This sample consists of n = 100 participants. 57% are female; the remaining 43% are male. The sample was divided into two age groups. 14 participants aged 48 years and younger, form the young group (M = 31,5, SD = 6,6), whereas the other 86 participants belong to the older group (49 years or older, M = 65,5, SD = 10,3). In terms of the health status of the sample, it can be noted that more than half of the participants could be regarded as healthy (51%) and 46% as ill (not all participants answered questions on their health status).
Sample 2015: While in the first sample, the focus lay mainly on older participants, the second survey focused on the younger, future users of AAL technologies. The second questionnaire with \( n = 148 \) participants was completed in 2015. In this sample, the percentage of male participants is slightly higher (54.7%) than the female portion (45.3%). Considering the age distribution, 109 people belong to the young group (48 years or younger, \( M = 28.6, \ SD = 5.6 \)) while 39 people form the older group (\( M = 59.6, \ SD = 9.2 \)). Analyzing the health status shows that two thirds of the sample are healthy (67.6%), one third (31.1%) is ill. In both samples, the educational level was above average.

4 Results

Q-Q plots and boxplots indicated that all our scales and items were normally distributed. Data were statistically analyzed by MANOVA procedures and ANOVAs using SPSS. Significance level was set at 5%. Results on the less restrictive significance level of 10% were classified as marginally significant.

As introduced in 3.1.3, the acceptance rate is measured from –100% to 100%, the unit will be left out in the reporting of the means for better readability. The considered \( N \) total for statistical measurements was 227. We report the Greenhouse-Geisser corrected tests for factorial repeated-measures design in case Mauchly’s test indicated that the assumption of sphericity had been violated.

4.1 Overall Acceptance by Room & Technology

In a first calculation, we analyzed the overall acceptance of AAL technologies using a factorial repeated-measures design. In this step, neither survey year nor user factors are considered. The focus lies solely on the dependent variable “acceptance” by different rooms and technologies (A1–A15, see Table 1).

The results show that the type of technology has a significant effect, \( F(1.8, 408) = 34.6, \ p < .001 \), on accepting monitoring at home. While visual monitoring (\( M = -27\% \), \( SD = 67 \)) is least accepted, the difference between auditory (\( M = -1.8, \ SD = 73 \)) and positioning systems (\( M = .9, \ SD = 71.8 \)) is marginal (see Figure 1).

For the overall technology acceptance, hypothesis H1 can therefore be confirmed.

4.1.1 Acceptance by Room

Without considering the different technologies, statistics revealed that the type of domestic space has a significant effect on acceptance, \( F(2.6, 577) = 49.1, \ p < .001 \). The mean acceptance rates drop from living room (\( M = -.66, \ SD = 71.2 \)) and home office (\( M = -1.4, \ SD = 72.5 \)) over kitchen (\( M = -4.3, \ SD = 71.6 \)) to bedroom (\( M = -18.8, \ SD = 68.8 \)) and bathroom (\( M = -21.9, \ SD = 68.7 \)), illustrated in Figure 2.

Therefore, hypothesis H2 can also be validated: The acceptance declines from rather public to private domestic spaces.

4.1.2 Interaction Effect of Room x Technology on Acceptance

As results show, not only do the type of room and type of technology have a significant effect on monitoring...
acceptance when viewed separately, but so does their interaction F(4.7, 1066.3) = 16.3, p < .001. Figure 3 illustrates these interacting effects. As the interaction of rooms and technologies (3 × 5) result in 15 acceptance results, each with different affecting factors, we report significant effects only. However, we omit each mean and standard deviation for better readability:

1. The acceptance patterns of auditive and visual monitoring are similar in the different private spaces. Acceptance is higher for more public rooms (living room, home office, kitchen) than for more private rooms (bedroom, bathroom). Standard errors indicate there is no significant difference between the two types of rooms.
2. For more public rooms, there is no significant difference in the acceptance of auditive monitoring and a positioning system.
3. The acceptance of the positioning system does not significantly differ between domestic spaces.

For the overall acceptance, hypothesis H3 can be confirmed: The acceptance of a position monitoring is independent of the room.

### 4.2 Effect of Time

So far, we analyzed the overall acceptance for the whole sample, not differentiating between the two different years of inquiry. Whether the hypotheses for the mean acceptance can really hold up over time is yet to be proven. Therefore, in a next step, the different survey years 2010 and 2015 are taken into consideration in a longitudinal study.

As we have seen (in subsection 4.1.3), the interaction between room and technology type plays a crucial role for acceptance and too many important details get lost if one considers only the mean of acceptance of either room or technology.

The results indicate that the survey year has a significant effect on acceptance regarding the technology (F(1.8, 410) = 9.4, p < .001), the room (F(2.7, 605) = 25, p < .001), and the interaction of technology and room (F(4.9, 1102.3) = 14.1, p < .001). Comparing Figure 4 and Figure 5 we see that, in fact, some acceptance patterns have significantly changed over time.

Though the acceptance patterns indicate a decrease from more public to private rooms, the line charts for nominal scales (Figures 3–5) are statistically not correct. However, for visualization and better understanding of the data, we consider their use suitable.
Summarizing the findings, the longitudinal analysis reveals three major points:

1. The acceptance of an integrated camera for health monitoring is still the lowest, for all domestic spaces.
2. The acceptance patterns of auditive and visual monitoring are congruent in 2010 and in 2015. Consistently, being heard (microphones) is more accepted than being seen (cameras). However, the acceptance has changed in regard to the evaluation of technologies implemented in more private (bedroom, bathroom) vs. more public rooms (kitchen, home office, living room). While in 2010, acceptance was higher for the more public rooms compared to the more private rooms, in 2015, the effects were less strong (yielding no statistical significance).
3. The acceptance of the positioning system is evaluated similarly in 2010 and 2015. The mean acceptance balanced evenly between approval and rejection, as did the consistent evaluation over all investigated rooms. In sum, this longitudinal study reveals that two (H1 and H3) of three hypotheses hold up over time:

4. (H1) The visual monitoring for health reasons is less accepted.
5. (H3) The type of domestic space does not affect the acceptance of a positioning system for health monitoring.

Although the effect of room type on technology acceptance could not be replicated, tendencies show it should not be discarded altogether.

4.3 Effects of User Diversity on AAL Acceptance

So far, effects of user diversity have been ignored. For the recent sample (2015), a closer look at the effects of user diversity on acceptance patterns is taken. In a first step, the relations between user factors were examined. To understand the mutual influence of factors, the correlation (Spearman) between the introduced groups of age, gender, health status, and attitude towards technology was calculated (see Table 2).

Table 2: Correlation of user factors, ATT (attitude towards technology)

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Gender</th>
<th>Health status</th>
<th>ATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td>−.103</td>
<td>−.384**</td>
<td>−.292**</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>−.044</td>
<td>.438**</td>
<td></td>
</tr>
<tr>
<td>Health status</td>
<td>1</td>
<td>.061</td>
<td>.061</td>
<td></td>
</tr>
<tr>
<td>ATT</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The positive correlation of gender and ATT indicates that women’s self-assessment towards technology is significantly weaker than men’s, which corroborates earlier findings (e.g., [22]). The other correlations reveal that older people tend to be less healthy and are less technology inclined than younger people. Due to the strong dependence on gender and the sample size of 2015 (n = 148), the factor ATT will not be considered for the repeated-measures design. Results show that (beside the already described effect of technology, room, and the interaction between both), age x health status had a marginally significant effect (p = .064 < .1) on the acceptance of different monitoring technologies (F(1.7, 224.6) = 2.9). Acceptance patterns are visualized in Figure 6.

Confirming hypothesis H1, the positioning system is generally accepted by users, shows stable acceptance rates, and is independent of user diversity.

Old and ill persons do accept AAL technologies to a larger extent than healthy people. This holds true for all technologies but especially for visual and auditive support systems. However, overall acceptance levels remain quite low (Figure 6). In contrast to the elderly, the acceptance tends to decrease when young people are not healthy. The understanding of health status is quite complex, but it is crucial for the acceptance research of Ambient Assisted Living technologies.

![Figure 6: Interacting effect of age x health status on acceptance for different technology types.](image-url)
4.4 Requirements for AAL Acceptance

After surveying how different factors impact AAL acceptance, we take a closer look at the basic demands that users require to accept these technologies. Therefore, we measured the approval rates of six statements (see 3.1.4) concerning different technology and privacy dimensions.

The overall importance for the preconditions was, with a mean of 68.5% (SD = 26.2%) on a scale from –100% to 100%, very high. As the preconditions are based on focus group results, they do not claim to be a reliable scale (Cronbach's alpha = .55) for measuring AAL conditions in general.

The analysis of the preconditions is therefore presented on a descriptive level. With 88% of the participants rating the statements as important, data security and data protection are the two prerequisites that have to be taken into consideration the most. Less important but still relevant are statements on functionality and control. The unobtrusiveness of stigmatizing health technologies at home and the wish to know the people monitoring the inhabitants are rated as least important.

5 Discussion

This paper addressed the question under which conditions users would accept AAL technologies in their home. Undisputedly, there is a general consensus that societies have to develop technically-supported solutions to meet the demographic change and enable older adults to stay at home longer. However, there still remain considerable objections to adopting the technologies in the own home. In order to understand the different aspects that form the overall attitude, we examined technology acceptance for different technology types (cameras, microphones, and positioning systems) in different rooms at home. Based on earlier research [44], we differentiated more private rooms (bedroom, bath) and more public rooms (home office, living room, kitchen). We collected acceptance evaluations at two different points in time. The first inquiry was done in 2010, the second in 2015. This longitudinal investigation should clarify the question in how far technology acceptance is modulated by familiarity with AAL technologies and its handling in public discourse.

Overall, the acceptance for AAL technologies at home is low. However, there are preconditions that are more accepted than others. Using cameras is disliked independently of user diversity and point in time when the survey took place. Being watched evokes feelings of discomfort in combination with fear of losing intimacy and privacy. In contrast, knowing that there are microphones that allow being heard and provide an acoustic connection to potential caregivers that might help is more accepted. Apparently, acoustic technologies give users the feeling of security and, at the same time, privacy protection. Position systems are accepted the best.

When referring to user diversity, older and ill persons acknowledge the usefulness of those technologies to a higher degree than younger persons. Still, the fear of losing one's dignity and privacy at home is prevailing in all user groups. In line with this, we could identify preconditions that must be met before people would be willing to use those technologies. In this context, trust, control, and reliability of the technology are of utmost importance. Thus we can conclude that, overall, AAL technologies are perceived as useful. However, people are quite sensitive when technologies are suspected of taking over control and possibly violating human values and trust as they fear losing face. These perceptions are deeply anchored...
and should be respected, not only by technology design but also by a transparent communication and information policy that allows persons to critically discuss these issues and to be included in the technology developments.

The final point in this section is concerned with potential limitations of this research with respect to both technical and methodological aspects. On the basis of such a critical review of the own procedure, future research duties can be out-lined.

Sample: A first limitation regards the selectivity of the sample in both time surveys. Even though we tried to collect answers from users of different states of health, ages, and educational backgrounds, we still only got a quite selective view. On the one hand, we still need older participants and users with a higher extent of age-related disabilities. This would allow an even more critical view on the acceptance of AAL technologies. On the other hand, most AAL technologies are not yet ready for the market. Therefore, the focus on younger generations is very important to understand the future users’ wishes and needs to accept these technologies.

Culture: A second shortcoming of this research is the culture-specific view which decreases the generalizability of the out-comes. Of course, as the sample is only from one country and cultural background, we do not know in how far acceptance of AAL technologies is also impacted by the different societal and cultural values in other countries. Recent research shows that acceptance of telemedical treatments are highly culture sensitive (et al. [2, 45]), therefore a further research duty is to validate the outcomes in other cultures.

Time of inquiries: In this research, inquiries were spaced at intervals of five years. The idea behind this “longitudinal” approach was to understand if overall acceptance declines or increases for AAL technologies. However, having only two measuring points seems to be too little to reliably determine significant shifts. Therefore, we have to repeat the survey on a regular two to five year basis in order to observe shifts in the attitude over time.

Method: Also, we have to keep in mind that a questionnaire study can only give results to perceived acceptance. As we have seen in recent research [42], the acceptance of the same object of research strongly depends on the chosen measuring method. People discussing monitoring at home (e.g., in focus groups) may encourage each other in their refusal while, on the other hand, “seeing” and “feeling” Ambient Assisted Living (e.g., in Living Labs) might decrease reservations and bolster the acceptance.

As we have seen in 2010 and 2015, the interactions of technology, room, and user factors have a significant effect on AAL acceptance. The use of conjoint analysis could improve the understanding of the trade-offs, when acceptance switches to rejection – when is the room the key factor and when the technology? And do user factors still play only a minor role?

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