A Small but Significant Difference – The Role of Gender on Acceptance of Medical Assistive Technologies

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Abstract. The current research aimed to study user diversity with a focus on gender differences in adoption of medical assistive technologies in general, and in particular. In order to understand the gender impact, we conducted two consecutive studies and considered gender as a key moderator of acceptance aspects in the medical context. The first study focused on general aspects of medical technology acceptability: users' willingness to use it, the importance of privacy and trust as well as the general attitude across gender and specified age groups. For a deeper insight into this topic the second study was conducted in order to analyze gendered acceptance on specific health-related device. As results showed people's general attitude towards medical technology and their willingness to use such medical assisting devices is throughout positive. However, gender differences emerge at the time when it comes to an assessment of a concrete medical tool (here smart textiles).

Keywords: Gender, smart home technology, privacy, trust, control, perceived usefulness, TAM, medical technology, smart textiles.

1 Introduction

Adoption of medical assistive devices is an important topic when facing the profound demographic changes in many countries of the world and the considerable bottlenecks arising from the fact that increasingly fewer people are present which may take over the nursing and decreasing supply shortfalls of societal health insurance funds [1]. As several studies in the last years have shown, technology acceptance is a crucial factor for a successful rollout of medical technologies, like for instance electronic health systems (ehealth), smart health, ambient assisted living (AAL), or personal health care systems [2], [3], [4], [5], [6]. Although in the past decades there is growing academic research and societal interest in understanding factors that determine acceptance in this sensitive context of medical assistive devices for elderly people, there is still a great demand for further researches and deeper insights.

In this paper two studies are presented focusing on two points that have not been really considered in the recent literature on acceptance of medical assistive technology yet – especially in their combination – namely age and gender. Before presenting

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those, the underlying principles and theories of technology acceptance as well as the specifics regarding medical context of it are described. And also, the role of gender in acceptance research will be illustrated.

1.1 Technology Acceptance

The technology acceptance model (TAM) [7] and its refinement UTAUT [8], [9] build the theoretical framework in this research. TAM states that the perceived ease of using a system and the perceived usefulness are the key components of technology acceptance. However, with increasing diversity of users as well as diversity of technical systems (visible vs. invisible, local vs. distributed) and using contexts (fun and entertainment, medical, office, mobility) the end-users are confronted with, more aspects might be relevant for understanding their acceptance patterns – beyond the ease of using a system and the perceived usefulness. For this purpose, user characteristics (economic status, culture, gender, age, experience, and the voluntariness of system usage) had been added to the original model and considered in the comprehensive UTAUT-model [9].

With regard to technology acceptance within the medical context several studies were concerned with acceptance of medical and ehealth technologies from the human perspective [10], [11], [12], [13], [14]. Outcomes showed that it is highly questionable that acceptance for medical technologies can be fully understood on the base of the prevailing knowledge of technology acceptance drivers so far. Rather, the acceptance for medical technology sector seems to be more complex than it is for other technical systems, out of different reasons.

A first argument in this context is that ehealth technologies predominately address seniors, who are increasingly prone to diseases with increasing age. Ageing, dependency and illness are – still – negatively connoted in our societies and thus, they carry a stigmatizing potential, which could impact the acceptance of medical technology. Therefore, apart from ageing as a biological factor there is a great need for identification of the supposed stigmatizing factors that prevail in societal culture and cognitive models, in order to counteract these and adequately consider in development and design of medical supporting devices. Last but not least there is a prominent need for an age-sensitive communication concept, which provides reliable and updated information about technical developments in the medical sector and their benefits as well as drawbacks.

A second reason for the higher complexity of technology acceptance in medical context refers to the fact that many technologies incorporated in smart homes (walls, furniture or clothes) might overstep personal intimacy limits and result in justifiable worries about privacy, intimacy and loss of control. Until recently, the most privacy-related aspects in the research concern individual data protection needs in terms of security requirements (e.g., [15]). However, user's perception of privacy needs in terms of intimacy and unobservability with respect to medical technology usage has not been appropriately considered yet. The intension to optimize acceptance in this regard makes it therefore indispensable to take users' subjective perceived importance of privacy and their preference to be or not to be seen by others while using medical device into account.

Furthermore, it should be considered that the status of health and resulting feelings of independency or dependency on technology could additionally impact the general attitude towards and, by this, the willingness to accept and to use ehealth applications. For similar reasons, the question of trust in medical technology arises. Trusting a technology means to believe that a tool, machine or equipment will not fail [16], [17]. It can be assumed for certain that nobody would accept and rely on technology, which is not satisfactorily reliable and/or appropriately certified by accredited test institute, especially when it is the matter of one's own health. Thus, understanding trust in relation to other aspects of the health care systems is important for the assessment and design and provides insights into how medical technologies may be used.

Finally, and this is of specific interest in the present study, the acceptance of medical technology might be also influenced by age and gender.

1.2 The Gender Impact on Use of Technology

The impact of gender on the acceptance of medical technologies is, until now, not widely examined. A few studies focused on gender differences in attitudes towards ageing concepts and related medical care respectively life-prolonging technologies. Studies revealed that women in general were less likely to want treatments to prolong life [18], [19]. Further, women voiced "other oriented" reasons for their opposition, particularly not wanting to be a burden for others [20].

Another aspect concerning usage of medical technology that is widely examined is the gender difference in the (social) ageing process. Elderly men reveal to have more problems organizing their daily life when living alone, due to the fact that most of the required activities were in the traditional role allocation the wife's part. This is also the reason why women in older age have fewer problems to maintain social contacts although they are living alone [21]. Regarding coping strategies, there are also significant gender differences, since women tend to search for help in their social environment more often than men do [22].

Gender differences concerning the use of technology and the attitude towards technology is another broad research field. Whereas gender is widely researched in the context of information technologies, it has not been subject studies on acceptance of medical technologies, yet.

Several studies revealed that men have a greater interest and a more positive attitude regarding computer usage, due to a higher self-esteem and greater experience with information technologies [23], [24]. In the context of technology adoption in workplace studies showed that there are different aspects that influence the decision to adopt new computer technologies of men and women. For men it is mainly their attitude towards using a new technology whereas women are more influenced by subjective norm and behavioral control [25], [26].

With regard to technology acceptance within the medical context it seems to be necessary to not just notify, whether gender differences regarding the willingness to adopt these technologies exist, but to get a deeper understanding of the underlying principles of why they exist.

Assuming that women and men may draw on different aspects of their identities, life-experiences and knowledge base when considering the complexity associated with acceptance of medical technologies, it seems to be reasonable to examine gender in combination with age.

1.3 Questions Addressed

For the evaluation of acceptance regarding ehealth technologies, especially age and gender are assumed to play a prominent part. However, different age groups may consider medical assistive technology from different perspectives of perception. In the same way it could be assumed that men and women differ in their perception of medical devices due to their social roles and (technical) experiences. Furthermore, gender roles may vary between age groups, as well as perception and assessment of medical technologies that goes in hand with it.

For young and technology-experienced adults (about 20-30 years of age), which are not personally affected by the necessity of usage medical devices in the near future, the medical technology could represent highly useful and appropriate technological solutions for societal health-related problems. The middle-aged adults (about 45-60 years of age) could adopt another attitude: as they have the duty to care for their older parents, medical technologies could support the well-being of their parents by monitoring critical bodily functions, reminding of medication, etc. In addition, modern medical technologies could help save them costs (e.g. for nursing homes) and could spare them family caring duties. Finally, from the perspective of the older adults (70+ years olds) still different and controversial aspects could impact the degree of medical technology acceptance. On the one hand, medical technologies could allow them to feel safe in the privacy of one's home and to stay independently from the help of others. On the other hand, feelings of being permanently controlled in combination with low trust in technology could provoke ambivalent feelings towards medical technologies.

From these considerations arises the question of "how much impact has user diversity with particular attention to gender divergence on acceptance and usage behavior of medical technologies?" These factors should be examined in the following two studies.

2 Study 1

In the first study we attend to examine the general attitude towards usage of assistive medical technologies (e.g. blood pressure meter) with regard to user diversity (gender, age). Firstly, effects of age and gender on the attitude towards and the willingness to use this kind of technical devices are assessed. Later on, effects of the same users' characteristics are verified with respect to acceptability aspects like importance of privacy, trust in system's reliability and the perceived necessity of control of own health status.

2.1 Method

Questionnaire. As the method to collect the data we chose a questionnaire. The questionnaire was developed as a result of previously conducted focus groups, whereby specific details and information about peoples' perception and opinions about medical technologies were collected.

The questionnaire was formulated in German – the native language of all participants. It contained closed questions about attitudes toward technology, in general, and about the (intended) usage of assistive medical devices, in particular. Regarding medical technology usage, questions were designed to measure the attitude towards,

and the willingness to use medical technology. Respondents had to express their degree of approval or rejection on a 5-point Likert-scale (from 'I fully agree' to 'I do not agree at all') rating statements like for instance: "Medical assistance devices enable older or diseased persons to improve their life quality by keeping them longer independent from health care facilities", "I would rather use/learn to use medical assistance technology than become burden to my family or friends".

In addition, the questionnaire explored the role of aspects, which are potentially highly associated with usability and a successful rollout of medical devices. These are the importance of privacy (= not being seen as diseased using medical device), the question of trust (= degree of confidence about device's reliability) and the perceived control (= periodical health check on selected vital functions). The items were designed in terms of usage motives and were to be rated on a 5-point Likert-scale like above. Here are some examples:

-"I would not / I do not use medical devices because I do not wish other people to see that I am ill or diseased" (privacy),
-"I (would) use medical devices because it gives me the feeling of a better control over my critical vital bodily functions" (control),
-"I (would) use a medical device only when it is trustworthy certificated and satisfactory attested"(trust).

In order to assure that all participants respond to the asked questions about usage motives, a previous scenario introduced them to empathize with a chronically ill person, who's health status requires regular collection and storing of vital parameters data (blood pressure meter, pulse, body temperature and weight). In this way each respondent felt involved and the results brought a broad range of comprehensive opinions with regard to (anticipated) medical technology usage behavior.

Before distributing, the questionnaire was revised by an usability expert with respect to issues of comprehensibility and wording of items, and it was test-run by a sample of different aged adults (n = 12). The fill in took 20-30 minutes.

Variables. In the first instance we refer to the *independent variables*. As the topic of the current paper is to identify – when existent – gender differences in usage or intention to use medical devices, the parameter gender is considered as an independent variable in all statistical analyses. Moreover, aspirating high diversity of the respondents and, consequently, a wide spectrum of differently founded perspectives, different aged persons were addressed in the survey, and age itself was analyzed as independent variable too. Thereby, four age groups with varying technical backgrounds and technical affinity were built: (1) the group of the youngest respondents, (2) the younger middle-aged group, (3) the older middle-aged group, and (4) the oldest age group. A detailed description of these age groups is given in the following section.

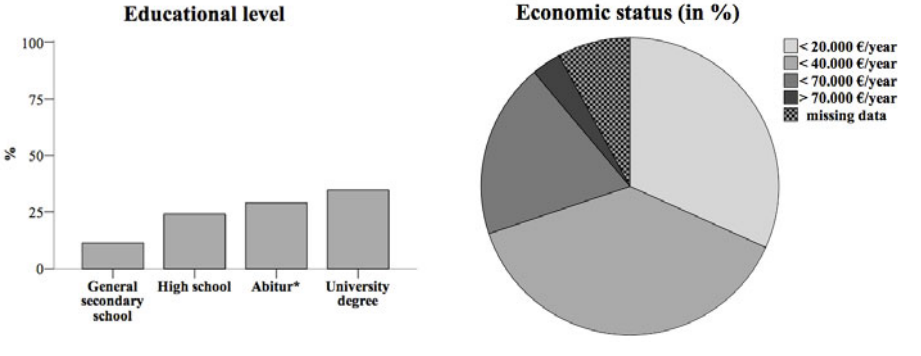
As *dependent variables* firstly the general attitude towards medical technology usage was assessed (built as the sum of items with respect to usefulness, necessity, perceived advantages and benefits; Cronbach's $\alpha = .93$). Secondly, influence of age and gender on the willingness to use medical assistance was analyzed (differently poled items regarding, amongst others, the readiness for monitoring of vital functions, preference for medical attendance: nursing vs. medical devices; Cronbach's $\alpha = .77$). And thirdly, the impact of independent variables on aspects of privacy, control and trust in context of medical technology usage – as exemplarily showed above – was examined.

Participants. In the first place it is noteworthy that – according to the comments of people asked to participate in this survey – participants showed an extraordinary high interest for the topic and a high motivation to join this research. This motivation reflects an evident public awareness of societal needs for medical technology, but also a controversy of attitudes within this topic.

The sample consisted of 126 participants, aged between 20 and 80 years with the overall proportion of 46% female and 54% male respondents. For the purpose of statistical analyses in order to find relevant effects with respect to the diversity of (potential) users of healthcare related devices or applications, the sample was split in four age groups, whereby the division corresponds approximately to the current demographical proportion of younger in comparison to older people. The first and *the youngest* age group contains $n = 25$ persons aged between 20 and 30 years ($M = 26.3$, $SD = 2.7$; 40% female). The second age group – *the younger middle-aged* – consists of $n = 41$ of 31-45 year-olds ($M = 37.3$, $SD = 4.9$; 49% female). The third age group ($n = 36$) – we call them *the older middle-aged* – is composed of males (55%) and females (45%) at the age between 46 and 60 years ($M = 53.8$, $SD = 4.4$). And finally *the oldest* age group is made up of $n = 24$ respondents within the age range between 61 and 80 years including 50% women and 50% men ($M = 68.9$, $SD = 5.3$).

Participants were reached on different ways using advertisement in local newspapers (Aachen, Germany), authors' existing network as well as social contacts of respondents, which were asked to pass the information of recruitment by interest on to their family members and friends. There was not other gratification than a "thank-you-very-much" for the participation.

The sample covered a broad range of professions (from teachers, engineers, physicians, notaries, university lecturers trough office administrators, nurses, police officers to hairdressers, farmers and housekeepers) and according to this a broad range of different educational levels as well as economic backgrounds (see figure 1).



*General qualification for university entrance in Germany

Fig. 1. Educational level ($n = 123$; left) and economic background ($n = 116$; right) in the sample

It was intended to survey different aged people picked randomly out of the population in order to explore their current attitude towards medical technology and their usage behavior of general accessible assistive healthcare devices at home (e.g., blood pressure meter, blood sugar meter). Thereby, as it was assumed that frequent usage of common information and communication technologies (ICT), like for instance personal computer or mobile phone, would be associated with easier access to and navigation of medical devices, respondents were also asked about the usage frequency and perceived fun in private and job-related context. Looking at the whole sample participants referred to use technical devices quite frequently in both aspects of life (private: $M = 5$, $SD = 1.2$; work: $M = 4.7$, $SD = 1.7$ out of maximum 6 points). When regarding both gender groups separately significant differences in private using context and in having fun using technical devices appear. Men show considerably more frequent private usage ($M = 5.3$, $SD = 1$) and declare to have more fun ($M = 4.5$, $SD = 1.2$ out of maximum 6 points) in comparison to women when interacting with ICT (private usage: $M = 4.5$, $SD = 1.3$; having fun: $M = 3.8$, $SD = 1.4$). The differences in job-related interaction with technology is similar oriented but nonessential. These initial findings go along with the results of many previous studies and confirm the popular image of male-dominated preference in technical matters.

2.2 Results

The results of the first study were analyzed by bivariate correlations, multivariate and univariate analyses of variance with a level of significance set at 5%. Outcomes within less restrictive significance level of 10% are referred as marginally significant or significant by trend. The significance of omnibus F-Tests in ANOVA-analyses was taken from Pillai values. Mean value differences were analyzed with T-test.

The impact of age and gender was examined in all analyses, which in the result section of Study 1 are presented as follows: at first, the impact of independent variables on respondents' attitude towards medical technology and their willingness to use it is tested; with the next step correlative relationships of the presented variables are evaluated; and finally effects of user diversity on aspects assumed to be associated with usability and acceptance of medical assistance devices, i.e. privacy, trust and control, are variance analyzed.

Influence of Age and Gender on the General Attitude Towards and the Willingness to Use Medical Technology. Regarding the general attitude towards medical technology as well as peoples' willingness to use it, neither age nor gender effects could be found. This result evidences the absence of differences within the examined gender and age groups with respect to those parameters. Considering them separately, it was observed that the general opinions about medical technology are thoroughly positive and high pronounced reaching average values from about 42 to 44 out of maximum 55 points. More precisely it means that men and women independent of their age have a similar positive attitude towards usage of medical assistance devices.

Also, the willingness to monitor one's critical bodily functions by dint of medical technology is much more preferred than a permanent sick nursing of external caregivers or even family members (mean values ranging from 28 to about 31 out of maximum 35 points). Interestingly, a marginally significant interacting effect of age and

gender was encountered in this regard (F (3,118) = 2.5, $p < 0.1$), identifying in particular younger women and younger middle-aged men to be the most willing to use medical technology in comparison to the dependency of caregivers' support (see figure 2). What is more, the willingness to use medical assistance is decreasing in women over the years, while the referred opinions of male respondents deviate in different age groups. However, considering the eldest, and at the same time those with the highest probability of chronic diseases – and consequently highest requirement to use medical assistance –, men more than women are motivated to use it. This result is the opposite way around to the opinions in the youngest age group.

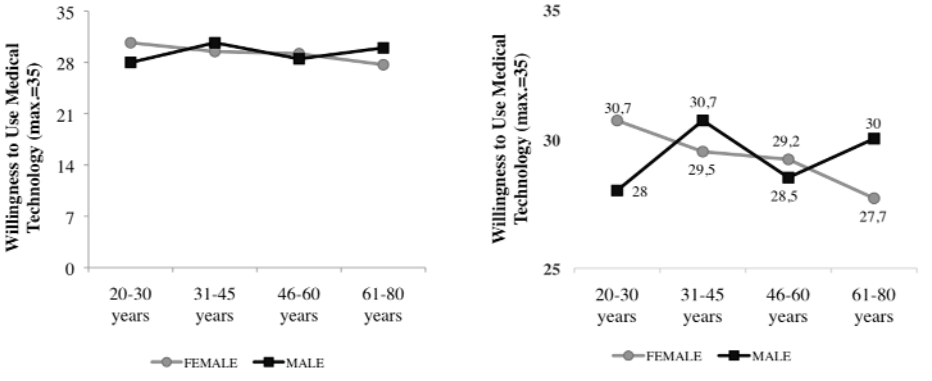


Fig. 2. Interacting effect of age and gender on the willingness to use medical technology (N = 126); on the right side a zoomed copy of the resulting mean values

Impact of User Diversity on Aspects of Acceptability (Privacy, Control, Trust). Tending to ascertain, which factors may additionally shape the acceptability and usage behavior of medical assistance technologies, in the present study we examined participants' assessments regarding perceived importance of privacy, of control and of trust towards assistive health technologies.

Considering the interrelation among these acceptability aspects it is firstly to observe that importance of privacy is rather weakly related to the perceived necessity of regular control of own health status ($r = 0.2$, $p < 0.05$). This indicates that some of the respondents do not wish to be disturbed from third parties by their private health measures. Secondly, a strong connection of trust and control regarding medical technology was found ($r = 0.6$, $p \leq 0.001$). Apparently the intention of periodical health check is strongly encouraged by the feeling of greater confidence and trust in its reliability. However, while the latter results are still evident in both gender groups (females: $r = 0.58$, $p \leq 0.001$; males: $r = 0.6$, $p \leq 0.001$), a significant connectivity of privacy and control disappear when men and women are considered separately.

Using multiple analyses of variance we investigated the effects of age and gender on the mentioned acceptability aspects. The MANOVA revealed an omnibus effect of age (F (9,354) = 2.4, $p < 0.05$) and an interacting effect of age and gender on importance of privacy, perceived control and trust (F (9,354) = 2.5, $p < 0.05$). Gender alone does not significantly influence these factors according to our findings.

As showed in figure 3 (on the left) the referred importance of privacy is most present in the younger middle-aged group of respondents (31-45 years) and the means for the judgments drop down with increasing age. Interestingly, the resulting average values of the youngest and the oldest participants are equally valued, meaning that both population groups would make the fewest effort, not to be seen outward as diseased because of using a medical device. One possible explanation for this fact could be the distance to the illness itself: while very young people do not feel the real nearness to it yet, the older aged adults are so close to it, that the question of privacy in this case has rather the lowest priority.

The same age groups of the questioned sample – the youngest and the oldest – show lower confidence in medical devices' reliability in comparison to the middle-aged groups (figure 3 on the right). The opinions of the latest resulted slightly higher. However, in all age groups the observed trust judgments are highly pronounced proving a high belief in devices' reliable functionality, in general.

Regarding respondents' perception of control about their own health by means of assistive medical devices (figure 3 in the middle), the 31 to 45 year olds show the highest confidence in medical technology. Surprisingly – as it is often assumed that this group is the most technically affine – the youngest participants' results are the lowest (M = 7.7, SD = 1.3 out of maximum 10 points) amongst the investigated age groups, which is probably arising from the absent closeness to or realistic imagination of (chronically) illness and the surplus value of using medical assistance technology. However, the overall resulting high means of all respondents with respect to this aspect prove a quiet positive perception and reliance on the possibility to regular check of (critical) vital bodily functions by means of medical devices at home.

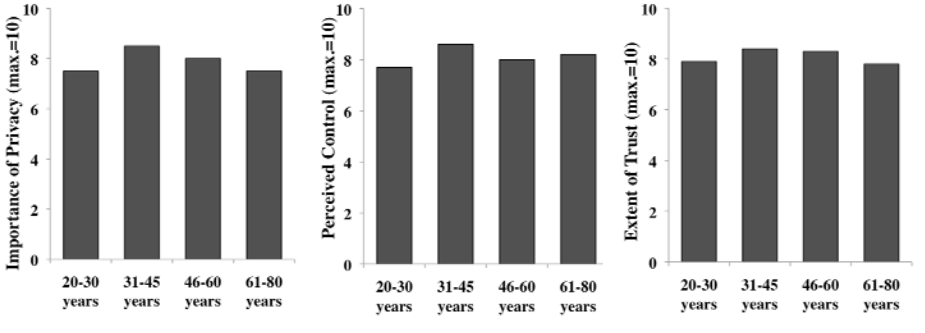


Fig. 3. Main effect of age on privacy, control and trust towards medical technology usage (N = 126)

Furthermore, in figure 4 the interaction of age and gender in the acceptability aspects discussed here is presented.

With regard to privacy (figure 4 left) the interaction effect becomes especially apparent in older middle-aged and oldest participants. The oldest women in comparison to those younger ones report significantly lower importance of using medical technology exclusively in private or even hiding it from the outside world. This finding is the opposite to opinions of the men in the same age group who reach distinctly higher

mean values for privacy aspect of using medical technology in home environment. Apparently, the ambition of being seen as healthy and full of vigor is prevailing a male domain in the age beyond 60'ies. Looking at the whole sample, the oldest men and the middle-aged women seem to emphasize privacy in context of medical technology at the most.

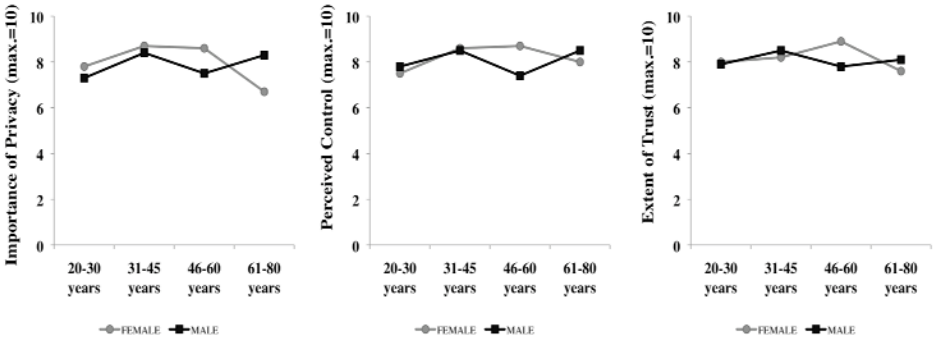


Fig. 4. Interacting effect of age and gender on privacy, control and trust towards medical technology usage (N = 126)

Moreover, regarding perceived control and extent of trust using accessible medical devices the major gender differences result in participants aged between 46 and 60 years (figure 4 middle and right). In this age group women attach more importance than men to the regular control of their health parameters considering a higher confidence in medical devices' reliability at the same time. Unlike, in the group of the oldest respondents it is the men who report higher trust in medical technology and a higher necessity to periodical control of their vital bodily functions. In the younger age groups, however, the perception of health control and trust in devices' reliability is comparable. Female and male respondents reach in both aspects very similar relatively high-pronounced mean values ranged in the top third of the scale.

3 Study 2

The second study aims to determine whether gender differences exist concerning the acceptance of a specific medical device – a smart textile [27]. A smart textile was introduced as a part of a mobile system, whose major function is the monitoring of the nutritional and water balance of human bodies.

3.1 Method

In order to examine a large number of participants the questionnaire-method in combination with a scenario technique was chosen as empirical approach.

Participants. A total of N = 280 respondents participated, with an age range between 14 and 92 years of age (M = 46.7), including 149 women (54%). Participants were recruited through the social network of authors and came from a broad range of

professions. All participants volunteered to take part and showed a very high and personal interest in the topic, what can be taken from – for questionnaire studies – high response rates of about 80%. Participants were not gratified for their efforts. There were participants of all ages, which indicated to suffer from a chronic disease (26.4% women, 25.4% men) and which reported to use medical technical devices (18% women, 19% men), respectively. Additionally to the demographical data people were asked to specify the sector in which they are actually working in, in order to control for prior experience effects. As pointed out in figure 5, participants were almost equally distributed in four different profession areas.

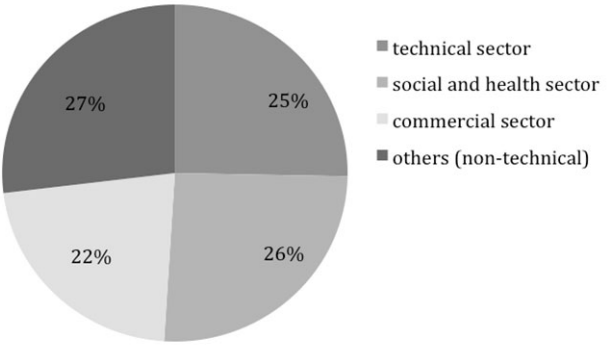


Fig. 5. Working area of participants (n = 246) in the sample in %

Questionnaire. At the beginning of the questionnaire participants were introduced into a medical scenario:

> "Imagine that in the year 2025 a vast majority of people in our societies are 65 years and older. Many of these people will be frail and therefore reliant on medical care. Due to shortcomings in the caring sector (economic bottlenecks and a decreasing number of nursing staff) it is a basic question how older people can live independently at home, and have access to medical services. Yet, there are already mature technical developments, which enable continuous medical care at home. One example for these developments is a so-called smart textile. Smart textiles are able to monitor the nutritional and water balance of human bodies. This is especially important in cases of weak health as well as for older people who often forget to drink enough. For the attending doctors it is quite difficult to diagnose such dehydration because the symptoms are not very clear. As a consequence, the hospitalization is extended and the mortality increases dramatically. To avoid such serious effects and to improve the quality of life for all persons concerned, it is important to control the nutritional status and water balance of the body. The smart textiles enable the continuous mobile measurement of nutritional parameters, 24 hours a day, 7 days a week."

In order to ensure respondents' understanding of the scenario and its consequences, the described scenario was tested in a sub-sample before the main data collection began.

After the introduction, socio-demographic variables were assessed, followed by the items to individual aging concepts. After that participants should evaluate their intention

to use the specified device, as well as the usage motives and utilization barriers. In the end they were asked about their technical experience, their attitudes towards technologies in general and medical technologies in particular.

In the following, dimensions and items are described in detail.

Variables. In order to assure a high measuring quality, reliability of the (latent construct) scales was analyzed prior to testing.

Independent variables: Independent variable is the biological gender of participants. As there are several important variables that could potentially confound gender differences in acceptance of medical assistive devices, we assessed mediating factors like technical expertise, individual health status, usage of medical devices, and attitude towards technologies.

Technical Expertise (TE)
Cronbach's Alpha amounts .80 for TE, suggesting high reliability.

Table 1. Items for **T**echnical **E**xpertise (1 = totally disagree to 4 = totally agree)

Which of the following actions apply to you?
I can assemble a prefabricated object (e.g., furniture) from pieces by myself
I can hang up a picture on the wall by myself
If something breaks I usually seek to repair it by myself
I easily handle a mobile phone and use it regularly
I easily handle a computer and use it regularly

Attitude towards Technologies in general (AT)
Items presented in table 2 assessed attitude towards technologies and technical progress. Reliability analysis for the latent construct AT revealed a Cronbach's Alpha of .69, which is acceptable.

Table 2. Items for **A**ttitude towards **T**echnologies (1 = totally disagree to 4 = totally agree)

Which of the following attitudes apply to you?
Technical progress bodes well for people
Technology allows people to live comfortably
Technology is more a threat than a benefit for people
Technology limits people in their personal liberty
Technical devices are often opaque and difficult to control
I like trying out new technical equipment

Dependent Variables: Dependent variables were the perceived usefulness of the smart textiles and the intention to use them if necessary. Items were formulated from the perspective of participants (first person), in order to enhance comprehensibility. Items

had to be confirmed or denied on a four-point Likert-scale from 1 (totally disagree) to 4 (totally agree).

Intention to Use (IU)
Participants were given the in table 3 following answers regarding their intention to use technology, if necessary. Cronbach's Alpha values for IU reached satisfactory .93.

Table 3. Items for the **I**ntention to **U**se (1 = totally disagree to 4 = totally agree)

Using the medical device… (smart textiles)
…would increase my contentment and satisfaction
…allows a sensible medical care
I can imagine using the device to…
… longer live independently at home
…facilitate your living conditions

Usefulness
Usefulness was assessed by usage motives (UM) and usage barriers (UB) as described in the following:

Table 4. Items for **U**sage **M**otives and **B**arriers (1 = totally disagree to 4 = totally agree). "Under which conditions would you use the smart textiles?".

I would use the smart textiles… (α = .79)
…in order to save caring costs
…in order to escape from the indignity of being cared for
…in order to keep independency
…because I can take them off
No, I would be reluctant to use the smart textiles… (α = .79)
…because I fear that they are not reliable
…because others would come to know about my health status
…because I do not want to be dependent on a technical device
…because I fear high costs for acquisition or maintenance

3.2 Results

Results were analysed by ANOVA - procedures (differences between gender groups) and bivariate correlation analyses (Spearman) to assess the interrelation between factors and variables. In a further step we used regression analyses to examine in particular the role of gender.

Gender Differences. The descriptive statistics (means and standard deviations), categorized by gender as well as intercorrelations of the constructs and age are given in table 5.

Table 5. Descriptive statistics and intercorrelations of research variables (N = 280; gender coding: men = 0, women = 1)

	Women		Men								
	M	*SD*	*M*	*SD*	**Gender**	**Age**	**AT**	**TE**	**UM**	**UB**	**IU**
AT	2.80	0.41	2.96	0.41	-.18**	-.25**		.34**	.35**	-.33**	.23**
TE	3.10	0.72	3.56	0.54	-.37**	-.42**	.34**		.19**	-.15*	.16**
UM	2.87	0.73	2.88	0.70	-.02	-.13*	.35**	.19**		-.36**	.62**
UB	2.49	0.69	2.28	0.64	.18**	.06	-.33**	-.15*	-.36**		-.39**
IU	2.54	0.76	2.67	0.82	-.08	-.16**	.23**	.16**	.62**	-.39**	

*$p < 0.05$; **$p < 0.01$.

With the exception of usage motives (UM) and intention to use (IU) the mean values between men and women were statistically different ($p < 0.05$). Age revealed a significant correlation with all constructs except for usage barriers (UB).

The Influence of Gender on the Intention to Use (IU). Multiple linear regressions were used to analyze the hypothetical relationships. We introduced gender as a dummy variable to test the moderation of the different relationships by gender. Results indicated that the relationship between UB and IU were moderated by gender, as well as the relationship between AT and UB.

By further analyzing the data for women and men separately, it appears that women's intention to use smart textiles is influenced by using motives (UM), using barriers (UB), and attitude towards technology in general (AT) while men's intention is predicted only by usage motives (UM). This result can be also confirmed in a gender-separated correlation analysis. In men there is exclusively a significant association between usage motives and intention to use smart textiles ($r = 0.7$, $p \leq 0.001$). In contrast to that, women's intention to use such a medical assistance device is statistically relevant related to several variables: usage motives ($r = 0.7$, $p \leq 0.001$) as well as to a lower extent usage barriers ($r = -0.3$, $p \leq 0.001$) and the attitude towards technology ($r = 0.3$, $p \leq 0.001$).

As presented in table 6 factors explained about 50% of variance in the intention to use smart textiles within both groups. Although age was included into the analyses, it had no significant effect on the other variables.

Table 6. Regression models for men's and women's intentions to use smart textiles

	Women		Men	
Predictor	**Adj. R^2**	**β**	**Adj. R^2**	**β**
	.50		.51	
TE		.09		.08
UM		.64**		.65**
UB		-.22**		-.09
AT		-.18*		.05
Age		-.08		.03

*$p < 0.05$; **$p < 0.01$.

4 Discussion

The major goal of this paper was to lighten the role of gender and user diversity when analyzing acceptance of medical assistive devices. For this purpose two studies were conducted. In the first study the general attitude towards and willingness to use medical technology in general were examined with regard to the effects of gender and age. The second study focused on gender influences when analyzing acceptance of specific health assistive technology using smart textiles as example.

Summing up the results of study 1, we can now state that the general attitude towards medical technology and the willingness to use it do not differ in the specified age and gender groups but the reported opinions about both aspects are overall highly pronounced. Considering the absence of age and gender differences, and the high acceptance values in this regard it is thus to conclude that there is in general a positive tendency towards and a high readiness to use medical devices, which confirms findings of the recent research [28], [29], [30].

In opposition to the rather male-dominated positive attitude towards popular information and communication technologies, the findings of our survey prove that regarding health-related technologies there is an essential difference in thinking about it. It is not longer divided in male and/or female specific domains, and it is not fun driven any more. Facing the own health status it is rather much more important how reliable the system works and how it is going to deal with the sensitive data. In this context questions about the importance of privacy and trust arise. As could be shown, those aspects in turn split the opinions of the (potential) users. The oldest and the youngest respondents report the lowest priority of privacy in comparison to middle-aged persons, and on the other side the lowest trust in reliability of medical devices amongst other age groups.

However, the general confidence about their functionality is, on average, highly pronounced. It is likely that the findings regarding privacy matters represent two poles of the same phenomenon, namely the distance to the necessity of medical technology usage. While the oldest respondents – due to their rather frail health condition and the higher probability to use medical technology in the near future – disregard or give privacy only the secondary importance, the youngest persons feel possibly not close enough to the necessity to use it [28], [29]. In contrast to that middle-aged persons attach more importance to the unobservability, unobtrusiveness, and invisibility by third parties when using medical devices. Here, social prestige, professional esteem, and societal status might play a significant role, which possibly make potential users to maintain a specific person image that might be not compatible to using and needing medical technology.

Regarding gender as separate variable, no explicit differences could be identified in the general attitudes towards medical technology matters. However, gender interacting with age revealed certain diverseness in attitude patterns. Women's reported opinions about the willingness to use ehealth applications, their privacy importance and trust in this regard show similar patterns, decreasing with increasing age. At the same time the judgments of male respondents vary much more among the different age groups. Opinions of the latter with respect to the examined variables move up and down depending on the stage of their life.

In contrast to the general attitudes towards acceptability of medical solutions a somewhat different picture emerges when analyzing more concrete ehealth technologies. The results of the second study revealed that gender plays an important role by forming underlying structures of acceptance. Although we could not detect differences between men and women regarding their reported intention to use smart textiles – both gender groups showed, alike to study 1, a relatively high willingness – significant differences appeared in analysis of usage barriers as well as in technical experience and attitudes towards medical technologies. Women tend to experience greater barriers when facing the usage of the medical device and have in general less positive attitude than men. These findings and even the higher technical experience of men are in line with prior research in the context of information technologies [23].

Furthermore, regression analysis revealed different structures of factors for predicting the intention to use the smart textiles of men and women. Whereas for men just one variable – usage motives – explains 51% of variance in the intention to use, for women three factors (attitude, usage barriers, and usage motives) are needed to explain about 50% of variance in their intention to use the smart textiles. These results suggest two conclusions: first, the intention to use smart textiles in the female part of the population is more complex to communicate, whereas for male users only the perceived usefulness of a device is decisive for their usage intention. Second, and most important, these results show that formation of acceptance patterns is gendered when focusing on a concrete device.

Taking results of both studies into account, it becomes clear that – besides age – gender plays an important role and needs to be considered when looking at technology acceptance in medical context [31]. Although both studies showed that there are no significant gender differences for the acceptance of medical technology in general, especially results of study 2 pointed out that taking a deeper look into the role of gender putting medical support in concrete terms (i.e. smart textiles) reveals very well differences for males and females – similar to the results of comparable studies (e.g., [32], [33]).

Understanding the different structures in acceptance motives of both gender groups is particularly important in the development of assistive medical devices considered for diseases that, due to their prevalence, affect either men or women more frequent. With an increasing comprehension of factors forming the usage acceptance of medical technologies in men and women, developers, designers as well as marketing experts can profit in creating user adjusted technology and advertisements.

Moreover, the knowledge about gender-specific acceptance of medical assistive devices may contribute – especially in old age – to the maintaining personal independency and mobility in everyday life, and by this, users' stay away from long-term care facilities. Thinking even further ahead, implementing gender-suited medical technologies in home environments could advantage several aspects of life quality like for instance an enhanced patient-physician communication (e.g., VoIP), better control of health status (monitoring of bodily functions), maintenance or improvement of memory performance (brain jogging), etc.

Last but not least, developing well-adapted medical support devices would probably launch new services and break into new markets. It is even conceivable, that adjusted medical systems in private homes would induce not only cost reduction but also relief in currently considerable overburdened medical healthcare sector.

5 Limitations and Suggestions for Future Research

Though results are insightful, a cautionary note has to be considered regarding methodological specificity, and the basic vulnerability to artifacts. The results described and discussed here are based on a questionnaire method, in which participants envision to use the respective technology, which they are not familiar with. On this base they evaluate the pros and the cons of the envisioned usage of these technologies.

However, we cannot finally exclude that this method provokes artificial findings. It is reasonably to assume that any envisioning of being ill and needing a specific technology might lead to an unrealistic assessment, and possibly to an overstressing of negative feelings due to the unfamiliarity with the interaction, and the basic fear to foreign matters and circumstances. And also, it is just possible that persons, who are not chronically ill, actually underestimate the worries and threats of needing to use medical technology. This, on the other hand, could be gendered as female users are known to be rather cautiously regarding the usage of technology and tend to underestimate their self-competence when using technical devices [34], [35], [36]. Therefore, future studies will have to validate the findings by using other empirical methods, including a real interaction with medical technologies.

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