Technical Expertise and Its Influence on the Acceptance of Future Medical Technologies: What Is Influencing What to Which Extent?

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Abstract. In this research we examine the influence of technical expertise on future medical technology. Technical expertise is assumed to positively influence the acceptance of modern technologies, and there is evidence within the information and communication technology (ICT) sector for this. While no one would seriously dispute this basic impact of technical expertise on technology acceptance, it is far from clear what the main drivers of technical expertise are. In order to understand the complex nature of expertise on the one hand and its impact on the acceptance of other technology domains on the other, an empirical approach was undertaken. 100 participants (19–75 years) participated in a survey, in which the acceptance of a medical mobile device was explored. Outcomes show (1) that technical expertise is a highly complex construct entailing different facets (knowledge, motivational, emotional and pragmatic components), which are influenced by age and gender of respondents (2) technical expertise in the ICT domain decisively modulates acceptance of medical technology. Interestingly, a low technical expertise does not only reduce the acceptance of the pro-using arguments, but is specifically related to a high confirmation of contra-using arguments.

Keywords: Technical expertise, technical literacy, perceived technical competence, distrust in technology, technology acceptance, medical technology, ICT.

1 Introduction

One of the most important social and societal challenges already in these days, but also in the near future is the contemporaneous occurrence of three major developments: the aging of societies, the ubiquity of mobile wireless technologies and a considerable broadening of technical using contexts (context diversity) and user groups (user diversity). Old and increasingly older users will have to use technologies in many contexts, ranging from information and communication technology (ICT), over mobility services to medical technologies [1], [2]. The usage of these technologies is to a considerably lesser extent voluntary than it had been in former times; increasingly ICT usage represents a necessity for older people in order to have access to social life

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and to maintain an independent living at home. Especially in Western Europe, the imbalance of generations is noticeable and we have to expect a prominent arising of this phenomenon, in combination with personal and structural societal consequences. In this context a lack of caregivers is anticipated and in the opposite a huge number of old and frail persons that are reliant on help [3], [4]. This future scenario makes it essential to think about possible solutions, which entail a complex bunch of measurements on different societal levels.

Future medical technologies in combination with mobile ICT usage might be one promising solution in this supply shortfall [5], [6]. Due to their overall availability, mobile (medical) technologies are assumed to be especially suited to maintain or even enhance older and chronically ill people's mobility, independence and safety. Also, the increasing shortage in the available caring staff- relatives, nurses, caregivers, or physicians could be relieved by mobile electronic assistance, as patients could be remotely cared. Mobile digital medical assistants could also help to minimize hospital stays, and, in so doing enable not only patients an independent life in a domestic environment, but also a relief of the threatening overcharging of sickness funds [5]. Currently, different kinds of mature and sophisticated medical assistive technologies are available to enhance older and ill peoples.

However, recent experience shows that it is not predominately the technical barrier, which hampers a successful rollout and a broad responsiveness of users. Rather, far-reaching acceptance barriers are prevalent which represent serious obstacles to technical solutions [7], [8], [9]. One major reason for this reluctant acceptance and a still negative evaluation might be due to the fact that current developments in this sector are predominately focusing on technical feasibility, inspired by technical disciplines, in combination with medical and computer science knowledge, while the "human factor" and the consideration of users' needs in these systems are fairly underdeveloped [10], [11], [12].

Still, a barrier free and broadly accepted utilization of mobile devices is supposed to happen "along the way". This attitude ignores the enormous difficulties of older users to handle technical devices properly and their hesitant technology acceptance, but also the considerable knowledge gap about the genesis of technical experience.

1.1 Acceptance of Medical Technology

Talking about the acceptance of technology in general is practiced meanwhile for about 25 years [14]. Especially the 1980ies and 1990ies, with the diffusion of computers and the Internet, pushed the subject as a prominent issue in research of different scientific disciplines (e.g. psychology, sociology, economics, anthropology, linguistics, and cultural studies). As technology cycles are increasingly faster, technology acceptance continued to be a key research issue. Technical products are only successful on the long run if users perceive them as useful and easy to use, e.g. [15], [16], [17], [18].

Though research has made significant efforts in explaining and predicting technology acceptance of ICT, the knowledge about factors, determinants and situational aspects impacting acceptance is still limited. With the increasing diversity of users (age, gender, technical generation, culture), the diversity of technical systems (visible vs. invisible, local vs. distributed) and using contexts (fun and entertainment, medical, office, mobility), more aspects are relevant for understanding users' acceptance – beyond the ease of using a system and the perceived usefulness. In addition, studies dealing with technology acceptance had been mostly considered ICT within the working context, and it is highly disputable if outcomes might be transferable to other technology and using contexts.

Furthermore, most studies are limited to technology acceptance of young, experienced and technology-prone persons - a user group whose technology acceptance patterns seem not to apply to the broad variety of users nowadays confronted with technology. Technology is no longer an issue for a small number of interested people. Nowadays the usage of technology concerns everyone, men as well as women, and not only young people but also the older ones. Also, the using conditions are different compared to former times, especially in the medical sector: here, (mobile) technology covers vital and essential parts of life, and the usage is not voluntary any more, but highly correlated with involuntariness and dependency.

Recently, research started to include the using context in combination with different technology types in their impact on technology acceptance. Increasingly it is understood that technology acceptance is neither static, nor independently from the specific using context in which a technology is applied [12], [10]. Also, the impact of user diversity and the different abilities and restrictions that influence acceptance receive attention [11]. Among the user characteristics, age and gender effects had been identified to considerably impact the technology acceptance, and, as a strong moderator, users' expertise of technology, which decisively determines the way users handle and evaluate technical devices [17], [18], [19], [20].

1.2 Technical Expertise

Computer expertise is definitively one of the most important user characteristics that influence the quality of human-computer interaction. Studies revealed that users with a high level of technical expertise show considerably higher performance when using technical devices [21], [22], [23], [24], [25], independently of the type of technology: performance advantaging expertise effects had been found for the interaction with personal computers, the Internet, as well as mobile devices (mobile and smart phones). Also, it had been found that users with higher technical expertise revealed a higher technology acceptance in terms of perceived ease of using a device and usefulness [26], [27], [28], [29], [30].

Focusing on the nature of the expertise effect it is assumed that experts in a specific domain are able to reach higher performance levels, because they possess highly organized knowledge structures, more sophisticated procedural knowledge structures, more elaborated mental models and problem solving strategies, which enable them to analyze problems thoroughly and to develop flexible solutions and alternatives [21], [24], [25], [28], [29]. Bransford et al. [31] outlined six main characteristics of expertise: First of all an expert is able to recognize attributes and important patterns of information, which cannot be seen by a novice (especially meta key patterns). Second an expert has acquired a vast proportion of content knowledge [28], [29], [32]. And this knowledge is organized in ways that make a reflected understanding of subject matter possible. Third the knowledge an expert has cannot be divided into single isolated facts. Further it is instead possible to reflect contexts of applicability. The fourth point of an expert's characteristic says, that an expert is able to demand its knowledge with little costs. But although an expert is absolutely in his topic it doesn't mean in the other way that he/she is able to teach others his/her knowledge. The last aspect of an experts characteristics is that an expert has varying levels of flexibility in his/hers approach to new situations.

Although computer expertise and its effect on performance had been studied thoroughly [21], [22], [23], [24], [25], the underlying concept of expertise and its measurement are not exactly defined yet. In most studies computer experience is determined by subjective reports of length and frequency of computer use [33], [34], [35], [36], [37]. This kind of assessment is based on the simplified assumption that expertise can be understood as a function of the time spent operating a device.

Furthermore, this conceptualization of expertise leaves open what knowledge structures are acquired while interacting with the technology and how these knowledge components constitute the nature of expertise. However, it is highly questionable that the time spent at a computer automatically leads to an acquisition of computer-relevant knowledge. Therefore, instead of defining experience by the assessment of quantitative aspects (duration and frequency) of computer usage, possibly qualitative aspects like domain-specific knowledge concepts should be assessed [33], [38].

In addition, there are more questions in the context of operationalisation of computer expertise as a main predictor of performance and acceptance of technology. Studies showed that motivational and emotional factors of human computer interaction are also involved in technical expertise [13], [16], [17]: People with a high self-confidence when using technical devices show higher levels of technical interest in general, and a lower computer anxiety. While both factors are not directly related to computer expertise, there is though an indirect relation: users with high levels of technical self-confidence and low computer anxiety levels show a considerably better performance when interacting with technical devices and the better performance is also correlated to a higher level of computer expertise.

Furthermore, across studies the measuring of "computer"- expertise referred to very different types of technical devices, different using contexts of technology as well as different generations of technology (covering a time frame from 1980 until today). It is more than questionable if technical expertise with former devices may be transferred to current devices. The expertise, which had been acquired in former times, may have a considerable short half-life. In this context the factor users' age becomes an important part. The relationship between age and technology is always to be dealt with the view on general changes in (technical-) history. It is not fully known in how far technical expertise formed by a specific former technology may be transferred to more recent technical devices. Yet, a basic transferability had been identified: It was found that computer expertise was also impacting the performance when handling mobile phones [36], [37], [38]. Beyond a basic positive effect on performance, computer expertise had also a positive effect on technology acceptance, especially on the perceived ease of using technical devices [10], [13].

However can we assume that the expertise effect, which refers to information and communication technologies, is transferable to other domains (e.g. medical technology), which might have completely different using characteristics?

Taken together: On a first sight, technical expertise is a concise construct, which is assumed to positively influence the acceptance of modern technologies. However, there is a lot of vagueness with this assumption. While no one would seriously dispute a basic impact of technical expertise on technology acceptance, it is far from clear what is the main driver of expertise: is it the increased technical literacy (declarative knowledge) of persons, which advantages the interaction with technology? It is an increased proficiency in how to handle technical devices (procedural knowledge, [28])? Or is it the perceived trust into own abilities, or the self-reported competence or even the interest in technical developments, which is mainly responsible for the advantaging effect of expertise? Furthermore, is the expertise effect limited to one technology context (e.g. ICT) or can we expect that expertise in one domain may be transferred to other domains (e.g. medical technology)?

1.3 Questions Addressed in the Present Study and Working Model

The current paper aimed for an explorative study of the different facets of technical expertise, their relation among each other and their impact on medical technology. The research model is visualized in Figure 1.

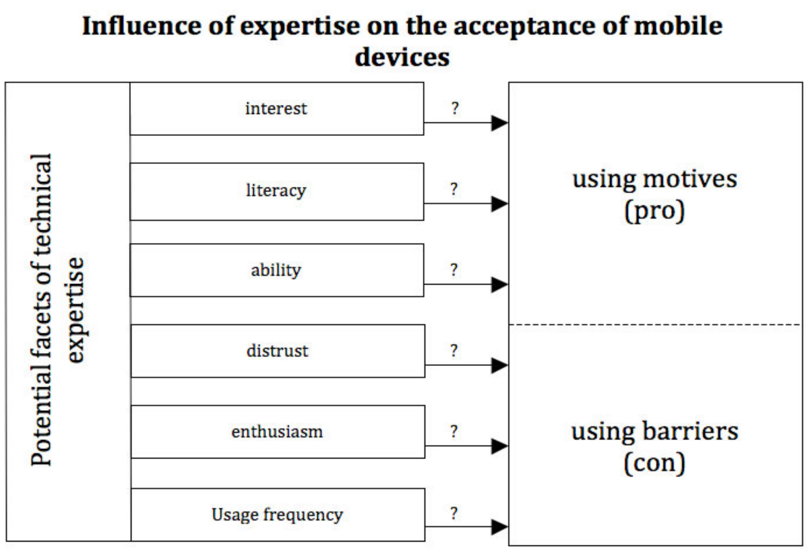

Fig. 1. Research model

Relying on the literature and the different aspects of computer expertise, which were found to be influential across studies, we measured motivational aspects (interest in technology), emotional aspects (enthusiasm when using technology, trust in technology) as well as cognitive aspects of technical expertise (self-reported technical literacy and ability when handling technical devices). Additionally, we assessed participants' reported frequency of using technical devices.

In a second step, we looked at the impact of the different expertise facets on technology acceptance of mobile medical devices. It is quite reasonable to assume that the acceptance of medical technology distinctly differs from acceptance-patterns of ICT for several reasons: First, medical devices are used not just for fun, but also because of (critical) health states [9], [10], [11]. Also, beyond its importance for patients' safety and the feeling of being safe, medical technology refers to "taboo-related" areas, which are associated with disease and illness [9]. Medical monitoring is often perceived as breaking into persons' intimacy and privacy spheres and often leads to a feeling of being permanently controlled [9], [10].

Recent studies [11], [13] showed that medical technology acceptance is a complex product out of positive and negative attitudes, which persist at the same time. Hence, both the positively connoted using motives as well as the negatively connoted using barriers should be assessed to get a complete picture. The following questions were guiding our research and data analysis:

- Which aspects form expertise in the domain of ICT to which extent?
- Are there inter-correlations between motivational, emotional and cognitive aspects of ICT-expertise?
- Is ICT expertise (and if so, which facets) predictive to the acceptance of medical technology?
- Which aspects of the acceptance of medial technology are formed by ICT expertise: The pros (using motives) or the cons (usage barriers)?

2 Method

In order to examine a large number of participants and to consider the diversity within the sample we have chosen the questionnaire method in combination with a scenario technique. Our participants were instructed into a medical scenario:

> "Imagine you came down on with diabetes mellitus and from now on forced to check your blood sugar meter several times a day. Imagine further that your medical device has the option to select the collected data via WLAN. This technical solution offers you the opportunity to collect and analyze your data easily. In addition to that you could also use the option you could send your body health parameters to your doctors, without being forced to bring them personally".

2.1 Variables

As independent variables different aspects of technical expertise were selected.

- *Interest in technology* and *technology enthusiasm* as motivational components
- *Technical literacy* and *perceived ability when handling technical devices* as cognitive components and
- *Distrust in technology* as an emotional component.

Dependent variable was the acceptance for medical technology, operationalized by five pro and con statements, each. The statements reflected arguments collected in focus groups (prior to the questionnaire study), and covered different aspects of the usage of medical technology, including safety, reliability, ease of use issues as well social and financial aspects (items are described in detail in section 2.2.).

2.2 Questionnaire-Instrument

The questionnaire was arranged in four main sections: The first part included demographic data concerning gender, age, and educational level. The second section of the questionnaire inquires information about the technical expertise of the participants and attitude towards technology. First we asked for the frequency of using technology in a private or in a job related context. On a five-point scale the participants had to evaluate their frequency (1 = very little to 5 = very often). In this context we also asked for information about the possession of different devices (ICT and medical technology), the frequency of usage and the ease of use. Additionally participants rated the general attitudes toward technology (Table 1).

Table 1. Components of technical expertise (1 = very low to 6 =very high)

Interest for Technology...
My technical interest is…
My enthusiasm for technology is…
My technical literacy is…
My ability in dealing with technology is…
My distrust against technology is…

The third section of the questionnaire was concerned with the technology acceptance for a medical device, including both, “pro” using motives (Table 2) as well as “cons”, i.e. usage barriers (Table 3).

Table 2. Pro Items for medical device(1 = complete confirmation to 6 complete rejection)

The following arguments might supporting the usage of the device...
I feel save, when a medical devices controls my body functions constantly.
I am sure that the most innovative devices are solid.
I want an easy instruction manual.
I expect a positive feedback of my social surrounding.
I would use the device, if the sickness funds pay for them.

Table 3. Con items (1 = complete confirmation to 6 = complete rejection)

The following arguments might hinder the usage of the device...
I feel observed, when a medical devices permanently documents my body functions.
I fear that a new medical device is not matured.
I am afraid, that the new devices are not easy to use.
I fear that my surrounding doesn’t support my technical device
I fear that the devices would be expensive.

2.3 Participants

The intention in the recruitment procedure was to survey users of a wide age range and health status in order to explore and to compare their motives and barriers about future healthcare solutions.

A total of 100 participants between 19 and 75 years volunteered to take part in the study. The purpose in the recruitment procedure was to survey users of a wide age range in order to compare their motives and barriers about future healthcare solutions. For younger participants (N = 49), ranging between 19 and 30 years of age, 65.3% were females, 34.7% male. Regarding the middle-aged group (31 to 55 years of age, N = 35), 62.9% were female and, 37.1% male. Finally, for the older participants (N = 29), between 56 to 75 years of age, 57.5% was female and 42.5% was male. Participants were reached through the authors' social network and corresponded to notices posted on campus and in public places of the city. The educational level of our participants was rather high. 59% (N = 59) declared to have an academic degree. 24% (N = 24) have at least the A-school level. Regarding the health condition, 45% of our sample reported to be healthy. 33% had one or two chronic illnesses and 22% were affected by comorbidity[1].

3 Results

Outcomes were analyzed by ANOVA procedures and Spearman rank correlations. First, we analyzed the independent variables regarding their influence on technical expertise. Then, we examine whether there is a direct influence of technical expertise on the evaluation of the smart devices - blood sugar meter.

3.1 Aspects of Technical Expertise

Before we look at the inter-correlations of the different aspects of expertise, we descriptively analyzed the different aspects of expertise, in order to learn the degree of each of the aspects as well as the distribution within the sample. Outcomes are visualized in Figure 2 and 3.

As can be seen from Figure 2, the motivational aspects of expertise, interest in and enthusiasm for technology showed similar patterns. Only few persons reported to have very low and low interest/enthusiasms for technical issues. The majority (about 70%) ranked themselves with 3, 4 or 5 points out of 6 points possible.

Regarding the distrust, we see a "perfect" distribution (normal distribution): more than 40% reported to have a medium degree of distrust in technology in general.

Regarding the cognitive components of technical expertise (Figure 3) - the reported literacy and the handling competence – we also found quite similar patterns. While only few participants stated to have a "very low" declarative (technical literacy) and procedural knowledge (handling competence), about 80 % of participants ranked their literacy and handling competence with 3, 4 and 5 ("high") points out of 6 ("very high") points possible.

[1] Presence of one or more diseases in addition to a primary disease.

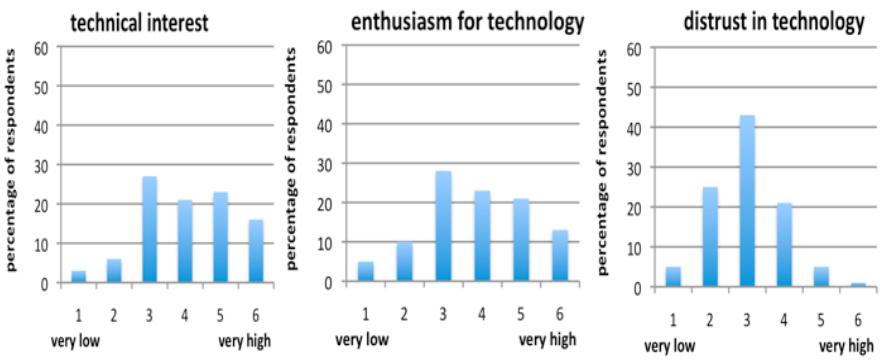

Fig. 2. Descriptive outcomes in different expertise facets: left: interest in technology; center: enthusiasm for technology; right: distrust in technology (N = 100)

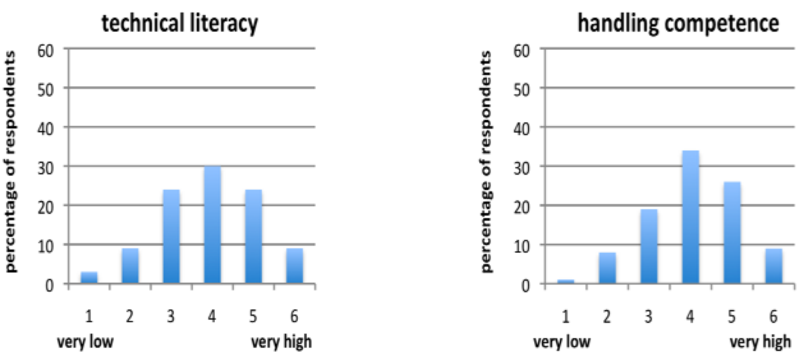

Fig. 3. Descriptive outcomes in different expertise facets: left: technical literacy; right: reported competence when handling technical devices; (N = 100)

In a second step, we looked at the relations between and across the single components. According to correlation outcomes, all expertise facets revealed high intercorrelations. Figure 4 illustrates the statistic connections between the relevant items, revealing that cognitive, emotional and motivation aspects do significantly contribute to the concept of technical expertise.

In order to reduce the number of factors for further analysing of the relation between expertise and acceptance of medical technology, we selected one motivational, two cognitive aspects and one emotional aspect of expertise: Interest in technology, technical literacy, ability (handling competence) and the perceived distrust in technology.

As in many studies technical expertise had been determined by reports of length and frequency of computer/device use, we now analyze whether the simplified assumption that expertise can be understood as a function of the time spent operating the device, can be validated. We asked for the possession and the usage frequency of

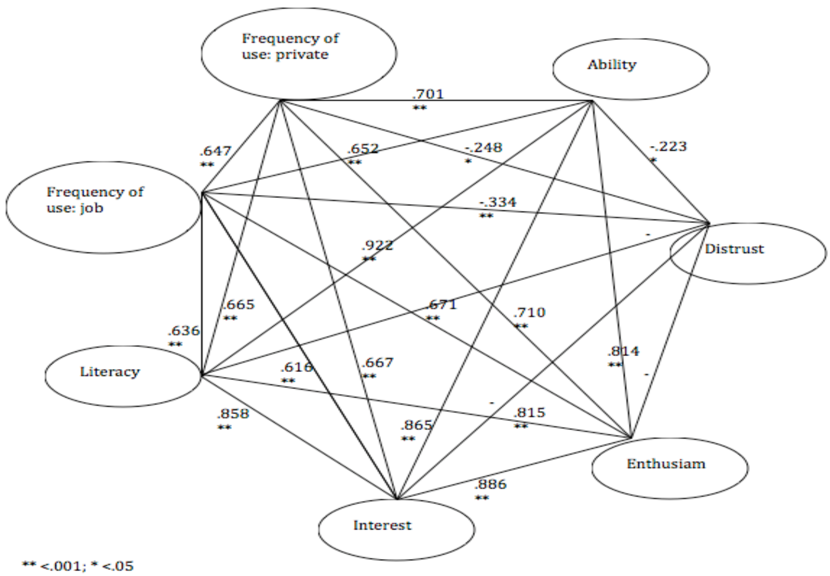

Fig. 4. Inter-correlations between expertise aspects. Device usage refers to a mobile phone.

ICT (PC, mobile phone, fax, digital camera) and medical devices (blood pressure / sugar meter, hearing aid, pulse watch), as well as the reported ease of use (Table 4).

Table 4. Correlations (Ease of use, frequency of device usage and technical expertise)

Expertise Items	**Ownership**	**Evaluation: Ease of use**	Correlation coefficient	significance	**Frequency of using** Correlation coefficient	significance
Reported Interest	ns	computer	-.711	.000	.211	.04
		mobile phone	-.468	.000	.267	.009
		camera	-.409	.000	.324	.002
Reported Literacy	ns	computer	-.692	.000	.175	.084
		mobile phone	-.494	.000	.292	.004
		camera	-.364	.000	.284	.006
Reported Ability	ns	computer	-.748	.000	.248	.015
		Mobile phone	-.520	.000	.262	.010
		camera	-.394	.000	.331	.002
Reported Distrust	ns	computer	.278	.005	-.278	.005
		mobile phone	.259	.010	-.224	.027
		camera	.217	.037	-	-

For the ownership, no significant relations to neither of the expertise aspects were found. Also, the usage frequency of medical devices did not reveal statistically significant relations to the extent of technical expertise.

Though, regarding some ICT devices (PC, mobile phone, and digital camera), significant correlations between expertise and ease of use ratings and well as frequency of usage were found. Thus, we can conclude that for common ICT devices, frequency of usage and ease of use ratings show a basic interrelation to the technical expertise, operationalized as interest in technology, literacy in technology, handling competence when using technical devices, and distrust in technology

Another meaningful finding in this context is that expertise components are highly correlated to gender, and less pronounced to age. Regarding age, we only found one relation: with increasing age, the distrust in technology raises ($r = .23$; $p < .05$). In contrast, gender showed to be highly connected to expertise components. Women report to have a lower interest in technology ($r = .43$; $p < .05$; a lower self-reported handling competence ($r = .58$; $p < .05$) and also a lower self-reported technical literacy ($r = .52$; $p < .05$) in contrast to male respondents. Interestingly, the level of distrust is not different between both gender groups.

In the following, we now focus on the influence the technical expertise aspects on the acceptance of medical technology, taking a blood sugar meter as an example, thus an external mobile device, which may have similar attributes than the mobile phone.

3.2 Technical Expertise and Its' Influence on the Acceptance of Medical Technology

In order to learn something about the influence of the technological expertise and its influence on the acceptance of future medical technology we picked the following items to prove whether they have an influence on the evaluation of the pro or con arguments: reported interest (motivational component), reported literacy (cognitive component), reported ability/handling competence (cognitive component), and distrust (emotional component). Each of the expertise components was dichotomized by the median in a "high" and a "low group" (e.g. high interest, low interest).

In a first step, we looked at the main effects (ANOVA procedures) of expertise aspects on the acceptance of medical technology, separated for the pros and the con items Secondly we analyzed the influence of the expertise components on the single items of the pro using arguments and the using barriers (using Spearman rank correlations).

Main effects of expertise facets on the medical device blood sugar meter

First of all, the pro-using arguments are focussed at. While the ANVOA revealed no significant effect for the interest in technology, the technical literacy and the handling competence, the distrust in technology ($F(5,92) = 3$; $p < .05$) revealed to be a main driver for the pro-using motivation of medical technology. When looking at the usage barriers, the interest in technology was significantly impacting the using barriers of medical technology ($F(5,88) = 2.4$; $p = .05$), the technical handling competence ($F(5,98) = 4.9$; $p < .05$) as well as the distrust ($F(5,92) = 5.1$; $p < 0.05$) significantly influenced the negative connoted acceptance of medical technology. Comprising statistical analyses, the more distrust in technology persons report, the lower is their pro-using motivation and the higher their reluctance if not refusal to use medical technology if necessary. Beyond the distrust in technology, which was found to impact both, the pros and the cons, the reported competence in handling technical devices and the interest in technology was influencing exclusively the using barriers, thus the reluctance of using medical technology. The lower the interest in technology and the lower the self-reported handling competence with ICT technology, the higher is the unwillingness to accept medical technology.

Influence of expertise facets on the pro and con items in detail

So far, we considered all pro-using items and all con-using items as a total score. As it might be insightful to get a deeper insight into the relative extent of (dis-) agreement for the specific pros and cons, we used correlation analyses to find out the relative relation between expertise components and the single items with the expertise components. As can be seen from Figure 5, for the pro items there are only two statistically significant relations between the expertise component *distrust in technology* on the one hand and the pro-using argument "*I feel save if a device checks my vital values constantly*" and the pro-using argument "*I would use the device if the sickness fund pays for it*" on the other hand. Apparently, for persons having high distrust levels, there are two arguments which militate in favour of using the medical device: the public sickness funds pay for it, which could be interpreted by high distrust persons that the reliability in the devices is high and that they are constantly informed about their own health status and vital parameters, respectively.

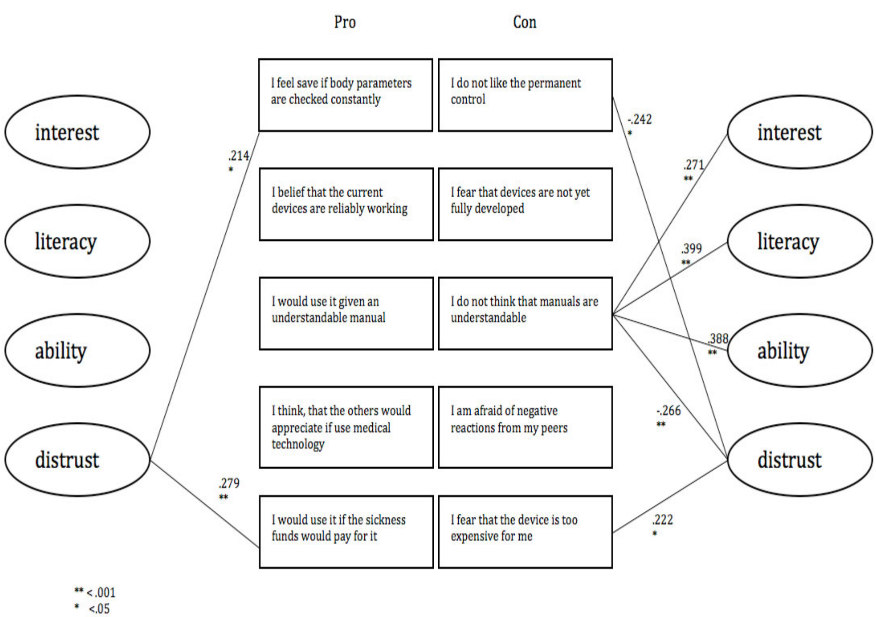

Fig. 5. Intercorrelations between pros (left) and cons (right) and expertise components

When looking at the usage barriers (right side in Figure 5), all facets of expertise showed significant correlations. Thus it can be concluded that participants with high levels of distrust, low levels of technical interest, technical literacy, and a low self-reported handling competence when using ICT technologies tend to refuse the usage of medical technology and to overestimate the negative aspects in contrast to the positive using argumentations.

4 Discussion and Suggestions for Future Research

The aim of the present study was to analyze the impact of expertise on the acceptance of medical technology, taking a mobile blood sugar device as an example. The following questions were guiding our research: (1) Is ICT expertise (and if so, which facets) predictive to the acceptance of medical technology? (2) Are there inter-correlations between motivational, emotional and cognitive aspects of ICT-expertise? (3) Which aspects of the acceptance of medial technology are formed by ICT expertise: The pros (using motives) or the cons (usage barriers)?

Before findings of the research are discussed within implications for research, application and future research demands, it should be noted that the topic "acceptability of medical technology" is highly sensitive. People asked to participate in this research showed a high interest for the topic and a high willingness to participate, independently of generation and gender. Apparently, a high public awareness for the societal needs of medical technology is present as well as a high motivation to express own opinions and fears connected to its usage. On the basis of the results we now can answer the research questions:

(1) On the one hand we now can clearly say that technical expertise, operationalized by four components - interest in technology, technical literacy, handling competence and distrust in technology in general- is in fact impacting the acceptance of medical technology. The higher the technical expertise the higher is the acceptance of medical technology and the higher the intention to use the medical device. Apparently, there is a basic transferability of the positive expertise effect from one domain (information and communication technology to another quite different domain: medical technology.

(2) When asking which of the facets of expertise, the cognitive, the emotional and the motivational part, we now can say that the emotional part (distrust in technology) is the strongest player for both, the pro-usage and the contra-usage motivation of medical technology. Beyond the emotional component, also cognitive and motivational factors) play also a role, especially in the unwillingness to accept medical technology. This findings lead to the final point, which is the most important one in our perspective.

(3) Expertise, especially the missing or low technical expertise, is nearly exclusively related to the high confirmation of using barriers and the not-acceptance of medical technology. Conversely, the pro-using arguments and the positive expectations when using medical technology nearly play no role for persons with a low extent of technical expertise. From this it can be derived that it is not specifically the acceptance of medical technology, which is problematic. Rather, the low technical expertise with ICT technology and the low self-confidence of persons when

interacting with common ICT devices acts as a general brake which is then transferred to the medical technology application context.

Even though this study revealed detailed insights into differential components and effects of technical expertise on the acceptance of a medical mobile device, still there are many duties for future research:

Other technology contexts: This study mainly concentrated on one medical technology, a mobile external device (blood sugar meter). This was selected because many people - though not chronically ill - know diabetes as a quite popular disease as well as the disease's handling by means of a blood sugar device and therefore should have sufficient shared knowledge and experience. However, future studies will have to concentrate on other forms of mobile technology, which are not that prominent yet. Currently, mature medical technical solutions cover smart artifacts, a promising context for medical technology, as all-day objects equipped with special functions like sensors, memory and communications skills and are assumed to be appropriate in disease handling (e.g., Smart Sofa [39], Smart Pillow [40] and Smart Dishes [41]). Another technological context regards 'wearable computing', that makes the computer to an integral part of everyday clothing [42]. Future studies will have to study technology acceptance for this new forms of medical technology.

User diversity: Another research duty regards user diversity, beyond technical expertise. In this study we did not differentiate in a detailed way whether other user characteristics may affect acceptance outcomes. This, however, is of prominent interest considering the complexity of personal and individual factors, which might impact acceptance of technology. As opposed to the past, when mostly sophisticated and technology prone professionals were the typical end-users of technical products, now broader user groups have access to technology. Still, the development of technology in general seems to be limited to dominantly young, technology experienced, Western, middle- and upper class males [43], [44]. Although the vital importance of ensuring that a technology produced is both usable and acceptable for a diverse user group is known in the meanwhile, the recognition of the importance of users' diversity is only slowly influencing mainstream usability studies and not yet considered within the development of technical products. Design approaches thus have to undergo a radical change taking current societal trends into account, which have considerable impact for the inclusion of a diverse user group.

Thus, it is a central claim that mobile displays are designed to be in line with older users' specificity and diversity [45]. Design approaches should therefore take the user-perspective seriously. The duty of further research efforts is to fill the knowledge gap, and to systematically integrate user diversity—age, gender, social and cultural factors—into usability approaches.

Self-reported technical expertise vs. factual expertise: It should be kept in mind that the expertise-aspects, which were assessed in this research, are exclusively subjective and represented users' judgments about own abilities and attitudes. Users taking part in this study evaluated their own technical interest, literacy, their competencies when handling technical devices as well as their distrust in technology. However, so far, we do not have an external validation of the respective high or lower expertise levels. In addition, the real expertise level of participants should be determined by a psychometric testing procedure [33].

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