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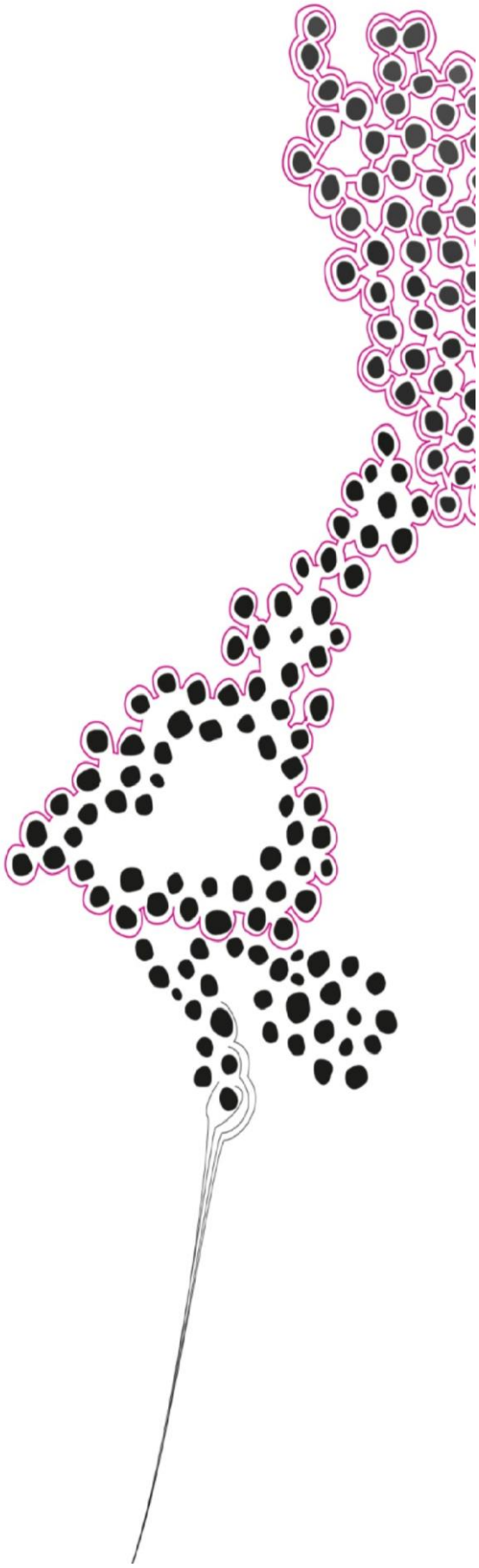

Usability test of the ActivityCoach to promote Active Ageing in daily life: assessing the needs and wishes of older adults

Bachelor thesis

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Abstract

Background: Mobile technologies facilitate innovative interventions to promote active ageing in daily life. To ensure adoption, such interventions must be designed in cooperation with the intended end users. This work presents the first usability test of the new version of the ActivityCoach, a smartphone application that monitors physical activity, well-being and weight. Methods: Eleven adults aged 65 years and above used a smartphone, a step counter and a SmartScale for a period of four weeks. Afterwards, an interview was performed to assess the participants' subjective experience regarding the use of the system. The actual behavior was compared to the self-perception of physical activity. Results: In general, participants were satisfied and would like to use such system in their daily lives. Five participants had an accurate perception of their level of activity. Four participants became more active during the period in which they used the technology. Participants recommended incorporation of tips and warnings tailored to personal needs and capabilities. Conclusion: Older adults are willing to use the ActivityCoach to monitor their health and to coach them into healthier lifestyle. Mobile application must be tailored to the individual needs and wishes, instead of taking a one-size-fits-all approach.

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Background

One of the main concerns regarding our human society in present times is the increasing aging population worldwide. In the Netherlands 15.6 % of the adults are aged 65 years and above. Life expectancy is up to 79.7 years (Revision of World Population Prospect, n.d.). The healthcare sector is confronted with increasing expenses which also influence the person's quality of life. As a consequence a lot of research aims at the empowerment of older adults in managing their health more independently. The most common health problems under the elderly population is caused by chronic diseases, e.g. diabetes, rheumatism, dementia or chronic obstructive pulmonary disease (World Health Organisation (WHO), 2015). Most of them can be prevented or delayed by engaging in healthy behaviour. If declines in functioning are detected early enough, health problems can be effectively managed. Already in 2002 the WHO released a policy framework in regard to active ageing. This framework defined active ageing as "the process of optimizing opportunities for health, participation and security to enhance quality of life as people age". Its goal is to ensure that "older people remain a resource to their families, communities and economies" (WHO, 2002).

A shift from treatment to prevention has taken place in order to ensure that older adults live independently and stay active for as long as possible. Physical activity plays a major role in preventing chronic diseases, maintaining independence and improving the quality of life (Sun, Norman, & While, 2013). Besides physical inactivity has been identified as one of three key health behaviours (in addition to tobacco use and dietary patterns) that together are responsible for approximately 50 percent of global mortality (Oxford Health Alliance, 2009). Despite these facts, older adults represent the most inactive portion of the world population (King, & King, 2010). Research shows that even the oldest people can benefit from regular physical activity when they are tailored to individual needs (Pahor, 2006). Further, through increasing physical activity of older adults, the huge responsibility of the healthcare sector would be acquitted. The World Health Organization defines physical activity "as any bodily movement produced by skeletal muscles that requires energy expenditure" (WHO, 2015). Adults aged 65 and above who perform regular and adequate level of physical activity have lower rates of coronary heart disease, hypertension, stroke, diabetes, colon and breast cancer, a higher level of cardiorespiratory and muscular fitness; healthier body mass and composition and enhances bone health; and higher levels of functional health, a lower risk of falling, and better cognitive function (WHO, 2015).

There are several technologies which aim at maintain and/or improve health. Mobile technology facilitates innovative interventions to promote active ageing in daily life. Moreover, these technologies provide a more cost-effective solution in comparison to traditional interventions. Tudor-Locke and his colleagues conducted a review in 2011 to translate public health guidelines in terms of steps per day. They found that healthy older adults have an average of 2000-9000 steps per day. Evidence suggest that 7.000-10.000 steps per day can be translated to 30 minutes of moderate physical activity. To ensure long-term adoption, interventions aiming to promote physical activity in the daily life must be designed in cooperation with older adults

In 2012 a first meta-analysis was done to synthesize current research which focused on the use of mobile devices for increasing physical activity (Fanning, Mullen, Mcauley, Fanning, & Hall, 2012). It revealed that such mobile devices are gaining popularity and that they are effective means to improving physical activity. Through monitoring functions people are getting more self-aware of their health status. Through feedback functions people are capable of adjusting their behaviour without reconciling with a professional. The advantages of native applications which can store data locally and exchange them via Internet lead to greater flexibility and complexity to software and intervention designers (Fanning et al, 2012). In addition, the integration of advanced sensors which measure bodily movement more precisely contribute to a more accurate assessment of physical activity (Fanning et al, 2012). However, little is known about the true effectiveness of such applications due to the lack of consistency in the research methods used in the evaluation of smartphone applications. Most of the theoretical background is grounded on the technology acceptance model (TAM) which predicates why people accept and use a technology (Davis, Bagozzi, & Warshaw, 1989). This model suggests that the perceived usefulness and the perceived ease-of-use determines if someone will indeed use the technology.

The Dutch rehabilitation centre Roessingh located in Enschede offers older adults to engage in a unique European project PERSSILAA (which stands for Personalised ICT Supported Service for Independent Living and Active Ageing). It aims at screening for and preventing frailty (PERSSILAA, n.d.). The most common causes of frailty are insufficiencies in mental stimulation, nutrition and physical activity. PERSSILLA aims to support the users in maintaining and/or improving their health status on these three domains. This service provides an innovative way of how to organise healthcare which focuses on screening, monitoring and training. More than 300 older adults are continuous involved in the evaluation of the service to ensure increasing system efficiency and easy end user acceptance. The results

show that location, social interaction, type of activity and day of the week significantly influence the daily physical activity of the participants (Cabrita et al. 2015). These and other findings are used to model the behaviour of participants and provide tailored recommendations on how to maintain a healthy lifestyle.

Multiple researchers from the PERSSILAA project are engaged in the development of the application ActivityCoach that aims at monitoring and/or improving physical health of older adults. For mobile applications to be effective and continue to be used, they must be well-designed in accordance with the needs of the intended users (Klasnja, Consolvo, McDonald, Landay, & Pratt, 2009). This study presents a first usability test in cooperation with possible end users. The International Organization for Standardization defines usability as "the extent to which a product can be used by specific users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (International Organization for Standardization, n.d.). The effectiveness is the accuracy and completeness with which users achieve specified goals. The efficiency is the effort of achieving results of certain accuracy and completeness. Satisfaction is the freedom from discomfort, and positive attitude towards the use of the product. Those levels of usability are an iteration on the aforementioned TAM. It picks up the concepts of perceived usefulness and ease-of use and further specifies it into the effectiveness, efficiency, and satisfaction.

Those concepts will be used to evaluate the usability of the ActivityCoach. With the first five research questions we aim thus to explore the concept as thoroughly as possible. The sixth question is concerned with the actual impact of the product.

1. What is the perception of a sample of Dutch older adults towards technology which aims in monitoring and/or improving general health?
2. What functions do they like/not like?
3. What screens do they like/not like?
4. What is the subjective experience with the ActivityCoach?
5. Which information would they like to see that is currently not there?
6. Do older adults become physically more active through the use of the Activity Coach?

Methods

The following section describes the participants, the design, the used procedures and the analyses of the acquired data.

Participants

The technology was given to 12 participants. The target group were healthy people aged 65 years and above living in the Netherlands. Seven females and five males between 65 and 78 years took part in this study. One participant dropped out of the study because he/she was too afraid that the personal information would be misused. As a result, eleven participants finished the study. Five participants were selected through the Langgezond/PERSSILAA information market in Geesteren and Hengelo. Five participants are currently in the PERSSILAA project and the other two were reached through participants who took part in the study. Table 1 provides a summary of the participants' demographic information. An information letter was sent to emphasize the possible contribution to a further development of technology which aims in monitoring and/or improving general health. Also the opportunity to get a better insight in the physical activity of oneself for a period of four weeks was underlined.

Table 1 Descriptive data of participants

Age (mean, range)	69, 65-78
Gender	7 (58%)
Female	5 (42%)
Male	
Living Situation	
Alone	3 (25%)
With someone else	8 (67%)
Missing	1 (8%)
Recruitment	
PERSILLAA	5 (42%)
Info market Hengelo/Geesteren	5 (42%)
Invited by participants	2 (16%)

Materials

The used technology consisted of three components, namely a smartphone (plus charger) with the ActivityCoach application, an activity sensor (FitBit) and a Scale. Appendix A shows the hardware components used in this research. The FitBit captured physical activity and decoded it into steps. The SmartScale measured the weight and calculated the BMI of participants. Both the FitBit and SmartScale transmitted the data to the ActivityCoach application which served as a feedback device. A manual was given to the participants which

contained in detail how to use the technology. In addition with another research purpose a first interview scheme was used to capture the current health status and the perception of the elderly towards technology that aims in monitoring and/or improving general health. This will not be analyzed in this report. In this study a second interview scheme is used to evaluate the new version of the ActivityCoach application. The interview scheme, which can be found in Appendix B, was developed in collaboration with two other researchers. In a one hour session the relevant aspects that should be asked in the second interview were determined. A short pilot test was done to identify possible issues. The interviews were recorded with voice recorders. Afterwards the interviews were transcribed and coded.

Design

The design of this study is composed of quantitative data by the measurement devices and of qualitative data by a semi-structured interview. The first thru fifth research question will be answered by analyzing the answers regarding the second interview scheme. The last research question will be answered by analyzing the quantitative data captured by the FitBit.

Procedure

The execution of this study consisted of three phases. First of all a meeting was scheduled to conduct the first interview and to explain the technology. This took up to one and a half hour. Following this, participants were instructed to use the technology for four weeks, including instructions to use the ActivityCoach to check their physical activity and weight. Every evening they had to answer six short questions in regard to their wellbeing. The answers were given on a seven-point scale in the ActivityCoach. During this second phase participants were given the possibility to contact the researchers by any difficulties with the technology. In addition, they were asked to be prepared for a second interview regarding their experience and evaluation of the technology at the end of the four weeks. In the third phase a second meeting was scheduled to return the technology and to conduct the second interview. This took up to half an hour.

Analysis

The qualitative data were analyzed with ATLAS.ti. Answers were categorized through a top-down approach by the researchers. On the basis of the first five research questions, five families were defined, namely the overall perception, the functional perception, the visual perception, the subjective experience and the missing information. Within these families answers were given specific codes. The answers regarding the overall perception were coded in vivo, i.e. answers were coded literally. Answers regarding the functional perception were coded as ‘most important’ or ‘least important’. Answers regarding the visual perception were

also coded in vivo. The family ‘subjective experience’ consisted of four subgroups, namely goal of steps, weight/BMI, activity perception, and wellbeing questions. Regarding the first subgroup, answers were coded as ‘too high’ or ‘okay’. Answers in the second subgroup were coded as ‘useful’ or ‘not useful’. Answers regarding the activity perception were coded as ‘become more active’ or ‘same level’. In regard to the fourth subgroup answers were coded as ‘more aware’ or ‘no value’. The family ‘missing information’ wes coded in vivo. The quantity of participants regarding each code is presented in table 2, 3, and 4. The in vivo quotes are reported in the text. The actual physical activity of participants, which is the average of steps per day, is displayed in figure 1.

Results

Qualitative Data

Overall perception

Regarding the first research question, all participants reported that they had a positive experience with the used technology. One user said the ActivityCoach did function as menace in order to get more active (“*for me it was really something that serves as a threat*” – User 06). Another participant compared the ActivityCoach with a personal trainer (“*it really keeps an eye on you like a personal trainer”* – User 08). One respondent emphasized that the own health status becomes ever-present through the use of the application (“*you get really confronted with the facts*” – User 18). Almost every participant reported that the ActivityCoach functioned as a stimulus to become more active (e.g. “*it really stimulates*” – User 02). Another respondent reported that even his/her spouse got stimulated to go for a walk with him/her because of the technology (“*because of this I even got my [husband/wife] to walk, [he/she] never walked, so now [he/she] walks with*” – User 07). One participant realized the advantages of the ActivityCoach because of the experience with it (“*but I have to say as well, because I experienced it now, it became clear how good this is*” – User 08). Another participant even said that he/she got somewhat addicted to the technology (“*you are getting a little bit addicted to it*” – User 19).

Functional perception

Regarding the second research question, all eleven participants reported that the steps per day and the overview of the week were the most important functions of the ActivityCoach. Screenshots of the interface of these functionalities can be found in Appendix C. Four participants identified the wellbeing questions as the least important function.

Another two respondents mentioned the weight and BMI graphs as the least important function.

Table 2 Number of respondents on the functional perception of the ActivityCoach

Functions	Subgroups	Number of respondents
Most important	-steps per day & week overview	11
Least important	-wellbeing questions	4
	-weight/BMI graphs	2

Visual perception

Regarding the third research question, all participants reported that the design of the ActivityCoach is distinct and good readable. One participant mentioned that the application could be more colourful.

Subjective experience

In regard to the fourth research question, the subjective experience was divided in four subgroups. Regarding the goal of 7500 steps per day, four participants reported that it was too high to reach. Six participants reported that the goal was doable. One of them who is diagnosed with COPD mentioned that in the beginning the goal seemed too high but during the four weeks it was doable and he/she even increased the goal for himself/herself ("*in the beginning I thought this well, but now it doesn't seem too much (...) It was a milestone to get there. And when I got there, I said to myself now I want an eight. And when I got it, I wanted to get to 8.5*" – User 07). One participant reported that he/she never looked at the goal.

Ten participants reported that the measurement and feedback function of their weight and BMI was useful. Only one participant reported that it was reasonable but not useful for himself/herself ("*it would be wise, but useful is something*" – User 01). It is noticeable that participants with diabetes and rheumatism experienced this function as very useful (see discussion for further explanation).

Five participants perceived themselves as getting more active through the use of the ActivityCoach. Six participants reported that their level of activity stayed the same during the four weeks. One of them reported that his/her activity level would have been increased but because of an injured sciatic nerve he/she was not able to perform his/her normal level of activity ("*under normal conditions, yes*" – User 08). Another respondent who perceived his/her level of activity as constant, mentioned that he/she would have increased his/her level of activity if he/she would not have reached the goal of steps ("*if I would not have reached*

the average of 7500, then maybe I would have done more in order to reach it" – User 16). One participant was very aware of his/her low level of activity in comparison to his/her peer group ("*I think I am so minimal as it could be*" – User 18), yet he/she perceived himself/herself as getting more active through the ActivityCoach.

Regarding the wellbeing questions, four participants reported answering the questions had an added value for them. Six participants reported that it had no added-value. One of them reported that he/she responded always with the same number because the answers were always the same ("*but every time it is the same, then you are doing the same every time*" – User 01). Another said it would have had an added value if a result in any form would have been provided ("*with things like that, I have to see the results after months or a quarter*" – User 20). In reply to the suggestion of an overview of the wellbeing answers, one respondent said that this would be indeed handy (original: "*that should be handy*" - User 07).

Table 3 Number of respondents on the subjective experience with the ActivityCoach

Subjective experience	Subgroups	Number of respondents
Goal of steps	Too high	4
	Okay	7
Weight/BMI	Useful	10
	Not useful	1
Activity perception	More active	5
	Same level	6
Wellbeing questions	More aware	4
	No added value	7

Missing information

Regarding the fifth research question, nine participants reported that they did not miss anything. Given some suggestions five of them reported that the distance would be an interesting function. Two of them were also interested in their burned calories. An overview of a longer period of time was found to be interesting by another two participants in response of the possibility. Of their own volition, two participants mentioned their medical information as one requirement that should be integrated in the ActivityCoach. One participant, who was diagnosed with rheumatism a couple of weeks in advance to this research, mentioned that he/she would like to receive elementary information about heart rate, blood pressure, and sugar level, to react upon abnormalities soon enough ("*heart rate, blood pressure, and sugar level (…) elementary business where you often say like this is something you find out too late*" – User 20). The other participant reported that he/she would like to receive tips or warnings regarding his/her way of living ("*if I could see that I am doing well or not so well during my*

lifetime (…) in the same sense of beware of, do more this or do more that or hold onto this" – User 01).

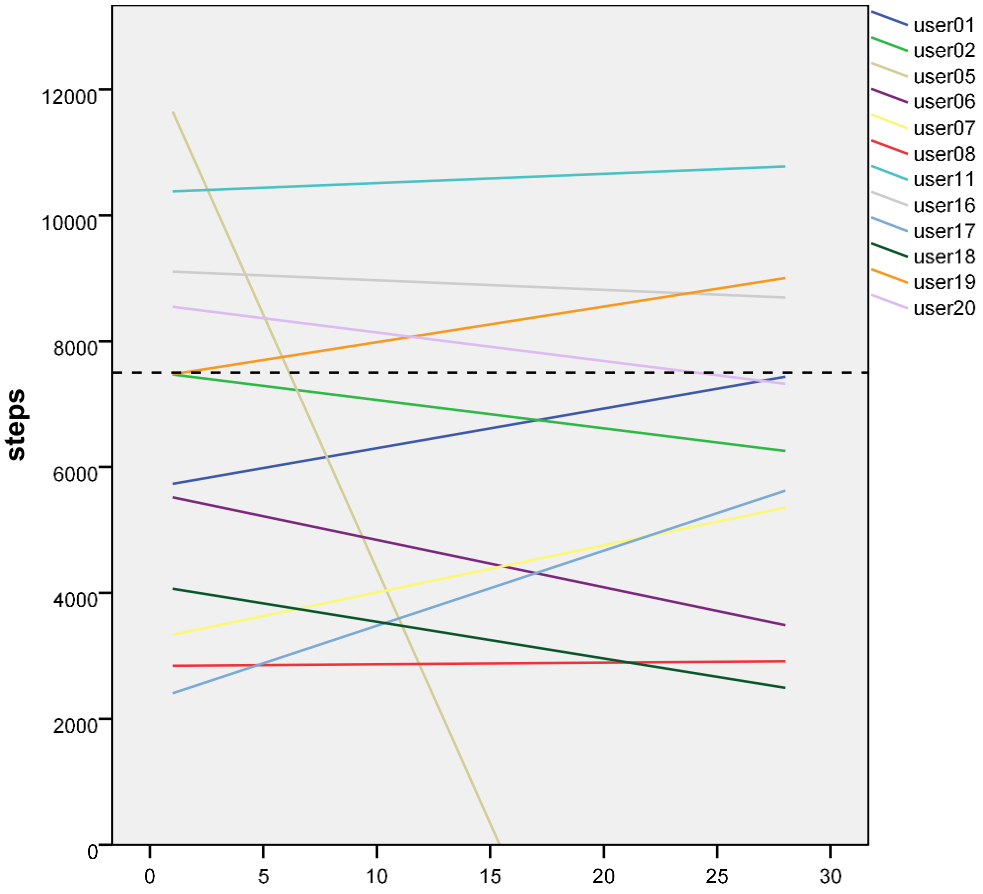
Table 4 Number of respondents on missing information in the ActivityCoach

Missing information	Number of respondents
Nothing	9
Distance	6
Calories	2
Monthly/annual overview	2
Medical information	2
Tips/warnings	1

Quantitative Data

In regard to the sixth research question, figure 1 shows the average line of each participant regarding their steps per day during the four weeks. The dotted line is drawn by 7500 steps. User 11 and 16 were the most active ones during this study. User 08 was the least active one. It can be seen that four participants became more active during the period in which they used the technology. User 01 started with 5800 steps per day and finished with 7500 steps per day. User 07 started with 3800 steps per day and finished with 5700 steps per day. User 17 started with 2200 steps per day and finished with 5800 steps per day. User 19 started with 7500 steps per day and finished with 9000 steps per day. Three participants had the same level of activity during the research period. Two of them were the most active ones who are clearly above the dotted line. The other participant whose activity stayed the same was the least active one with an average of 3000 steps per day. Four participants seem to become less active during the four weeks. User 02 started with 7500 steps per day and finished with 6100 steps per day. User 06 started with 5800 steps per day and finished with 3800 steps per day. User 18 started with 4000 steps per day and finished with 2300 steps per day. User 20 started with 8300 steps per day and finished with 7500 steps per day.

Figure 1 Average steps of each participant in a period of four weeks



Discussion

In this study, qualitative and quantitative data collection methods were combined in order to test the usability of the new version of the ActivityCoach, a smartphone application that aims to encourage its users to become more physically active. Eleven participants used the application in combination with a step counter and a SmartScale for four weeks. In the premises of Roessingh Research and Development, participants were interviewed before and after the four weeks of using the ActivityCoach. This study evaluates a second interview which focused on the overall, functional and visual perception as well as on the subjective experience and missing information from the users' point of view. In addition, the actual impact of the application regarding physical activity was analysed.

The main findings related to the usability of the application are as follows. The accuracy and completeness with which users could monitor their physical activity within the application was valued. The effort users had to invest to monitor their physical activity was at

a minimum and therefore contributed to the ease-of-use. Participants adopted a very positive attitude towards the application and admired the comfort it produced.

Overall perception

In general, the users were satisfied with the ActivityCoach application. Participants valued the ease-of-use and the purpose of the application. On the basis of the second interview, we can conclude that almost all of them perceived the ActivityCoach as a stimulus to get physically active. This fact was surely desired but not expected because most of the participants were not used to smartphones. Prior to the technology-use-phase, a couple of participants reported their concerns about their ability to handle a smartphone and the application as required. In a different study, researchers found that younger adults do have a higher affinity to technology when compared to older adults (Moeller, Goedde, & Wolters, 2008). However they emphasise that older adults do not have a lower affinity in general, but that their scores may vary substantially. It would be a fatal mistake to assume that all older adults are technophobes. Affinity to technology is affected by a complex set of cognitive and social psychological factors (Czaja et al. 2006). In our study, it was great to see the progress some participants made in regard to their own attitude towards their ability to the ActivityCoach application with a smartphone. Hence, at the end it does not matter how older adults score on affinity to technology, as we saw, they learn how to use the technology.

Functional perception

One of the reasons people participated in this study was to get to know their level of activity. Therefore, it is not surprising that all participants rated the functions ‘steps per day’ and ‘week overview’ as the most important ones. From the user’s perspective, we can conclude that the ‘wellbeing questions’ is the least important function in the application. On the basis of the second interview, it can be stated that one reason is the missing representation of given answers and another is the missing perceived benefit for the users. Participants also reported that their motivation to think carefully about the answers decreased during the study because the application asks always the same questions. Moreover, some participants reported that they tended to give always the same answers. It is likely that the answers are influenced through a moderacy bias. On a seven-point scale users prefer to give middle range responses (Van Herk, Poortinga, & Verhallen, 2004). In order to avoid possible biases and a decreased motivation, variation of questions should be taken in consideration.

Visual perception

All participants valued the clear and distinct design of the application. Since the four screens of the ActivityCoach application are similar and easy designed, it was not surprising

that no participant reported complaints. On the basis of the interview, it can be stated that as long as the clarity of an application is assigned, older adults put not much value upon the design. In regard to a more complex and varying design, assertions cannot be made on the basis of this study.

Subjective experience

Goal of steps

When looking at our sample the average of steps/day per participant ranges between 2200 and 10500. Up until now there is no commonly accepted guideline for the number of steps older adults should take per day. Literature reports that with healthy older adults steps are ranging from 2000 to 9000 steps per day and with special population from 1200 to 8800 steps per day (Tudor-Locke et al, 2010). It is therefore not surprising, that some participants experienced the goal set to 7500 steps per day extremely difficult, while others reached it with no difficulty every day. On the basis of given answers, it can be stated that the combination of seeing an imposed goal and having an overview of one's own performance, had a positive effect on the motivation of some participants to be physically active.

As seen in this study, some participants adjusted the goal of steps on their own. A possible variation in a follow-up study could be to automatically adjust the goal. It would be interesting to see how users adapt their level of activity if the goal is heightened after specific levels are reached. Surely, the goal should not exceed the ceiling of the recommendation for the target group, except a user is willing to perform a higher goal if that is not contradictory to the personal state of health.

Weight/BMI

The evaluation of the second interview revealed that the monitoring of weight is important for older adults with common age-related diseases. In the Netherlands, usually a patient with diabetes or rheumatism has to maintain a logbook of the course of their weight (Reumafonds, (n.d.). The general practitioner (GP) asks these patients to hand in the data every four weeks. The ActivityCoach could serve as a transmitter regarding these data. On the one hand, this would simplify the communication between patient and GP, and, on the other hand, it would increase the reliability of the data. To consider the possibility to transmit personal data to a medical institution can lead to an ethical issue. In our modern day, insurance companies are promoting lower dues if customers reveal their personal data. In the end of 2015, Germany released an E-Health-law in order to ensure a secure communication between patients, practitioners and industry (Bundesministerium fuer Gesundheit, n.d.). It might well be that anytime soon insurance companies will increase their dues if people do not

live up to a mandatory health status. It raises an ethical question about self-reliance which discussion goes beyond the scope of this paper. Nevertheless, the relevant participants perceived the monitoring of their weight as very useful and as a simplification measure.

Activity perception

When comparing the actual amount of steps taken by the participants and the perception of their level of activity, it can be found that five users had an accurate perception of their level of activity. Three of them stayed and perceived themselves at the same level. The other two perceived themselves as getting more active, which can be also seen in the quantitative data. In contrast, six participant did not had an accurate perception of their actual level of activity. Two users perceived themselves at the same level of activity, but in fact had an increased one. Three other users perceived themselves as getting more active, but were actually getting less active. Another participant who was getting less active too, was very aware that her level of activity was at a minimum, yet she perceived her level of activity as constant. Our main interest lies not in enabling older adults to achieve an accurate perception of their own physical activity, but as we saw in our study the visualization of an inadequacy of physical activity, serves as a stimulus for older adults to engage in physical activities.

The detection of barriers and the comprehension of causes why older adults do not engage in physical activity may help developing the ActivityCoach in that sense that the number of users meeting the recommendations could be increased (Dunn, Marcus, Kampert, Garcia, Kohl, & Blair, 1999).

Wellbeing questions

As aforementioned, most participants did not perceived an added value through answering the wellbeing questions. Nevertheless, four participants became more aware of their own wellbeing and valued the experience of it.

Only in recent days, wellbeing is seen as a major factor when looking at health in general. Especially in regard to older adults, mental health in the sense of wellbeing is nearly mentioned (Paap, Bode, Lenferink, Terwee, & Van Der Palen, 2014). On the basis of our study, we can conclude that older adults tend to put not much value on a review of their wellbeing. Similar conclusion can be found in a study from Borglin, Edberg and Rahm in 2005. Older adults put much value to continue their lives as healthy as possible and to do so every day, every moment.

In the further development of the ActivityCoach, it is advised to provide a relation between physical activity and wellbeing. It could serve as a motivational factor when older adults are confronted with the benefits from physical activity in relation to their mood.

Missing information

As most of the participants did not miss any critical information it can be stated that a fundamental part of our concept of usability is achieved. On the basis of the second interview it can be stated that older adults are very interested in the distance they walk or cycle. Therefore, this aspect could be integrated in the application.

As requested by two participants, showing users the progress of their activity regarding a longer period of time (e.g. providing a graph of the last month) could increase self-perception and also the motivation to maintain their process.

Another aspect that was mentioned by two participants refers to medical information or rather personally tailored information that should be added. Specific information about e.g. heart rate, blood pressure, or sugar level has main importance among the target group. Heart diseases, hypertension or diabetes can be detected or even prevented earlier if the monitoring of the relevant information takes place (WHO, 2015). If in fact an application could provide tips and warnings tailored to the specific user, the ActivityCoach could partly function as an electronical GP.

Impact of ActivityCoach on physical activity

When looking at our sample, four participants had an increased level of physical activity during the four weeks of technology use. We found that older adults get motivated to maintain their physical activity when they meet the recommendation guidelines. Some of the participants even increased their level of activity because they wanted to achieve a higher goal. Therefore, we can conclude that the representation of a recommended goal contributes to the aim of maintain and/or improve physical activity by elderly. Different studies also conclude that when mobile applications provide feedback to the user, the level of physical activity can be maintained or even increased (Hurling et al, 2007).

However, four participants seem to become less active during the research period. These four participants contacted the researchers most frequently because their level of activity were not accurately shown in the ActivityCoach. During the second interview, it became clear that their motivation to wear the FitBit decreased because of several technology issues during the four weeks (see section ‘possible limitations’). Therefore it should be taken into consideration that the reliability of the quantitative data regarding these four participants is questionable.

In a different study from 2010, researchers integrated a virtual map of the home country of the participants in order to walk or cycle to specific destinations (Ahtinen, Huuskonen, & Häkkilä, 2010). They found that participants preferred viewing the physical

activity achievements by travelling virtually between cities or villages in contrast to see achievements as kilometres or steps. Moreover, they showed that social sharing and playfulness are two crucial factors for motivating physical activity. It would be interesting to see, if an adjustment of the ActivityCoach along these lines, would enhance the number of users who are getting more active.

Limitations

First of all, the switch to summer time during this study affected the usage of the application. During one weekend the FitBit did not transfer the data to the ActivityCoach, so the participants had no feedback overview of their level of activity.

Secondly, there were some synchronising problems between the FitBit and the ActivityCoach during this study. As a consequence, some participants could not use the ActivityCoach for a couple of days. During this difficulties, participants were instructed to wear the FitBit in any case, so the quantitative data could be captured. The reason for the synchronising problem remains unknown.

Thirdly, five participants managed to sign-off in the application. For that reason, they had to go to Roessingh and/or follow instructions on the phone in order to sign-in again. It is possible that these technological issues have led to a falsification of results because as mentioned before, those issues can lead to a decreased motivation of using the technology.

Conclusion

With this study we showed that older adults are willing to use the ActivityCoach to monitor their health and to coach them into a healthier lifestyle. With regard to a well-operating technology no negative responses were provided. However, when the technology did not function as promised, multiple respondents expressed their concerns. Therefore, we underline the importance to provide a well-functioning technology.

Our results show that the ActivityCoach fulfils the requirements in regard to effectiveness, efficiency, and satisfaction. Older adults acknowledge the benefit of the system. For active older adults who keep track of their level of activity, the tested application serves as a logbook. For inactive older adults it serves as a stimulus to engage in physical activity.

The main conclusion we can draw is that mobile applications which aim to monitor and/or improve the general health status must be tailored to the individual needs and wishes. The variation among the target group makes a one-size-fits-all approach impossible.

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Appendix A

Technology components

A Smartphone

B Charger

C Activity sensor

D Smartscale

Appendix B

2nd interview scheme

Functional perception

1. *Welke functies van de FitBit/ActivityCoach vindt u het meest belangrijk?*
2. *Welke functies van de FitBit/ActivityCoach vindt u het minst belangrijk?*
3. *Welke informatie zou u nog willen zien, die er nu niet in zit?*(bij geen antwoord, suggestie geven: afstand; calorieën; aantal minuten actief; overzicht van maand/jaar)

Visual perception (Colour, size of letter)

4. *Welke schermen van de applicatie bevallen u het meest?*
5. *Welke schermen van de applicatie bevallen u niet?*

Wanneer geen relevante antwoorden gegeven worden, deze vragen nog stellen om dieper informatie te krijgen:

6. *Wat waren voor u de grootste zwaktes tijdens de vier weken?*
7. *Wat waren voor u de grootste sterktes tijdens de vier weken?*

Subjectieve ervaring van de gebruiker

8. *Bent u door het gebruik van de FitBit/ActivityCoach lichamelijk actiever geworden?*
9. *Wat denkt u over het stappendoel per dag van 7500?*
10. *Wat vindt u ervan dat u met de Activity Coach uw gewicht en BMI bijhoudt? OF: Vind u het nuttig om u gewicht en BMI bij te houden?*
11. *Bent u bewuster geworden van uw welbevinden door het dagelijks antwoorden van de vragen?*

Doorvragen: Had het voor u een toegevoegde waarde of heeft het iets voor u opgeleverd?

Afsluitende vraag

Samenvatten wat er besproken is, de plus en minpunten van de applicatie enzovoort, vervolgens vragen:

12. *Wat vind u van de mogelijkheid/idee om u fysieke activiteit bij te houden met behulp van de mobiele applicatie?*

Appendix C

Most important functions: