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Evaluating eWALL: Assessing and enhancing older adults' acceptance of a prototype smart home technology

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Abstract

Among older adults, age-related physical and cognitive problems challenge the need to live independently in the home environment. For this purpose, recent smart home technologies aim to enhance the elderlies' health and Quality of life by monitoring behavior and health conditions in their home environment. However, still a lot of concerns are raised by end users regarding the monitoring of private data. The study assesses the current acceptance of the monitoring functions of a specific smart home technology, the eWALL, and identifies factors to enhance the acceptance. The eWALL technology is a large touchscreen that monitors the primary user at different interfaces: daily functioning, daily physical activities and daily sleep. Orientating at the key constructs of the UTAUT model (Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions) a small-scale usability testing with 11 participants (n=11, mean age = 72 years) was conducted and the User Experience Questionnaire (UEQ) was filled in. Content analysis was conducted and re-appearing topics were summarized. Performance expectancy for the Daily Functioning Monitoring was rather negative, whereas it was neutral for the Daily Physical Activity Monitoring and positive for the Daily Sleep Monitoring. Effort Expectancy was low for all monitoring functions; it was perceived as easy to use and to master. Answers for the Social Influence yielded mixed results; the majority was willing to share the information of the Daily Sleep Monitoring, but many participants refused to share the information of the Daily Functioning Monitoring. What concerns the Facilitating Conditions, the physical appearance, above all the size of the screen and the long standing interaction was seen as a barrier to use the technology. Quantitative analysis of the UEQ revealed a neutral general impression of the eWALL technology. Concluding it can be said that overall acceptance is neutral. However, the monitoring of private data is still perceived as a barrier to use the technology and the perceived usefulness was rather low. To enhance acceptance of the technology, the perceived usefulness should be raised by 1. Giving the end user more privacy control, 2. Make sure that no redundant information is displayed, 3. Make both the physical appearance as the content more flexible to customization.

Samenvatting

Onder ouderen, leeftijdsgebonden fysiek and cognitief verval belemmert de behoefte om lange zelfstandig thuis te wonen. Daarom streven tegenwoordige smart home technologieën daarna de gezondheid en levenskwaliteit van de ouderen door het monitoren van gedragingen en gezondheitssituate in hun huisomgeving te verhogen. Echter zijn er nog steeds veel zorgen wat betreft het monitoren van privé data. Dit onderzoek stelt de tegenwoordige acceptatie van de monitoring functionen van een bepaalde smart home technologie, de eWALL, vast en identificeert factoren om de acceptatie te verhogen. De eWALL technologie is een groot aanrakscherm dat toezicht houdt op de primere gebruiker aan verschillende snijpunten: dagelijkse bezigheden, dagelijkse fysieke activiteiten en de dagelijkse slaap. Georienteerd wordt aan de sleutelconstructen van het UTAUT model (Prestatieverwachting, Moeiteverwachting, Sociale Invloed en Faciliterende Condities), een kleinschalige usability testing met 11 deelnemers (n=11, gem. leeftijd=73 years) werd uitgevoerd en de User Experience Questionnaire (UEQ) werd ingevuld. Inhoudsanalyse werd uitgevoerd en herhaalde themen werden samengevat. Prestatieverwachtig was eerder negatief voor de dagelijkse bezigheden monitoring, waarentegen het neutraal was voor de dagelijkse fysieke activiteiten monitoring en positief voor de dagelijkse slaap monitoring. Moeiteverwachting was laag voor alle monitoring functies; het werd waargenomen als eenvoudig te gebruiken en te leren. Antwoorden voor de sociale invoed leverde gemengde resulaten op; de meerheid ging akkord met het delen van de informatie van de dagelijkse slaap monitoring. Veel deelnemers weigerden echter de informatie van de dagelijkse bezigheden monitoring te delen. Wat de Faciliterende Condities betreft werd de fysieke verschijning, vooral de grootte van het scherm en het lange staan gezien als een barrière om de technologie te gebruiken. De kwalitatieve analyse van het UEQ openbaarde dat de generele indruk van de eWALL technologie is neutraal. Concluderend kan gezegt worden dat de acceptatie in het geheel is neutraal. Het monitoren van privé data werd echter nog steeds gezien als een barrière om de technologie te gebruiken en de waargenomen utiliteit is eerder laag. Om de acceptatie te verhogen, zal de waargenomen utiliteit verhoogd worden door 1. De gebruiker meer privacy controle te geven, 2. Zeker te stellen dat geen overbodige informatie getoond wordt en 3. En de fysieke verschijning en de inhoud flexibeler te maken voor aanpassing.

Introduction

Nowadays society in Europe is economically well-posed and shows a far-reaching and high-quality medical coverage. Due to this, life expectancy has raised (Bunker, 2011). However, after the baby boom in the fifties, the birth rate has dropped, causing a demographic shift: Europe's population distribution will develop towards older ages in the next century; the number of elderly persons being 60 or older will be expected to more than double in 2050 (United Nations, 2013).

This demographic ageing poses major challenges for the society: elderly people face a decline in physical and cognitive function when they advance in age. And still, there are some diseases that can't be cured yet. This can have severe impacts on the Quality of life of the elderly and the economic well-being of many nations. As a natural consequence of aging, elderly people experience a loss of memory function and problems in perceptual reasoning and processing speed (Harada, Natelson Love & Triebel, 2013). Moreover, there is a notable increase in cognitive diseases among senior citizens, like mild cognitive impairments, dementia and Alzheimer's (Larson, Yaffe & Langa, 2013). Additionally, many suffer from chronic diseases like chronic obtrusive pulmonary disease (COPD) and cardiovascular diseases (Nazir, Al-Hamed & Erbland, 2007). Other common age-related physical limitations are the loss of muscle functions and audio-visual problems (Kalyani, Corriere, & Ferrucci, 2014).

As a result of this multimorbidity, the mobility and autonomy of people of higher age decreases (Tinetti, 1986). Both formal and informal caregivers can help to facilitate independent living as long as possible. However, caregivers face a heavy burden while caring for the patients. Van der Lee, Bakker, Duivenvoorden & Dröes (2014) conducted a systematic review identifying determinants for subjective caregiver burden, depression and mental health. On the patient's side, these were behavioral problems related with the disease. On the caregiver's side, coping, personality traits and competence were identified. Studies revealed that one prominent reason for the institutionalization of relatives is the family caregiver's own state of health and the need for more skilled care (Buhr, Kuchibhatla & Clipp, 2006). Furthermore, health insurance coverage is not always ensured (Ho, Collins, Davis & Doty, 2005). This situation negatively affects the caregiver's ability to provide care and the Quality of life for both sides. Another issue that influences the health of the patient is the incorrect use of medications prescribed by the doctor, especially by patients living alone, having predementia symptoms and taking different drugs (Barat, Andreasen & Damsgaard, 2001). Another possible consequence of the decreased mobility is a social isolation of older adults (Chan, Estève, Escriba, & Campo,

2008). Cornwell and Waite (2009) indicate that social isolation is strongly linked with low levels of mental health. These implications show us the need for new and innovative approaches regarding the long-term care and the enhancement of mobility of elderly people, both for the elderly themselves and for the national health systems, insurance companies, relatives and caregivers (Mihovska, Kyriazakos & Prasad, 2014).

New technologies are used as possibilities to close this gap. Possible solutions are recently developed in the form of smart caring home devices, equipped with state-of-the-art IT support and intelligent monitoring. Nowadays, there are already several smart home technologies used in the homes of elderly people. Major targets are improving comfort, dealing with medical rehabilitation, monitoring mobility and physiological parameters, and delivering therapy (Chan et al., 2008). Main means of interaction take place between the technology and the primary user. Different fixed installations allow the elderly to be in voluntary interaction with the technology: for example, sensor networks or cameras are installed at different places in the user's home and provide a feedback loop: by supplying the system with information from different locations, an individual user profile is created. These data can be summarized and displayed to the user, for example by showing the daily action or behavior (e.g. Noguchi, Mori & Sato, 2002). Thereby, tailored advice can be applied by notifying the user about medication or other prescribed treatment at specific moments. User are reminded to take action and can voluntarily choose to do so. Other interventions that use a feedback loop are video-based indoor human gait recognition technologies. They record the gait behavior and analyze the data to create individual gait patterns. By generating warnings when abnormal gait is identified, it attempts to promote and preserve independence and health (Zia Uddin, Kim & Jeong, 2011). Another approach is the mobile follower: a set of telepresence robots are currently used that follow the elderly around the home and provide social, physical and cognitive support (e.g. Bevilacqua, Cesta, Cortellessa, Orlandini & Tiberio, 2014). In conclusion, smart caring home technologies could prevent the occurrence and aggravation of age-related complaints because of its more sensitive and immediate measuring, compared to external assessments. Different smart home technologies were already tested and evaluated by primary end users. The results yielded an overall positive attitude toward new technologies (Demiris et al., 2004).

However, there are some drawbacks. Smart home technologies face ethical issues since they record the behavior of the end user and gather thereby private data. This sensible data is sent to different institutions, like the hospital, the physician or nurse's office, or to a telehealth monitoring center (Chan et al., 2008). Qualitative research made by Courtney (2008) revealed

that privacy can be a barrier for older adults' adoption of smart home technologies. However, smart caring home technologies are not possible to work without monitoring. Research done by Wild, Boise, Lundell & Foucek (2008) examined elderly's views towards unobtrusive monitoring technology. They detected four dominant themes: maintaining independence, detecting cognitive decline, sharing of information and the trade-off between privacy and usefulness of monitoring. It seems that as long as elderly perceive the data that was gathered from them as useful, they accept the technology.

It is thus of essential importance to further examine and understand the factors that influence the acceptance smart home technologies. Additional research has been conducted on the acceptance of new technology. One prominent model is the Unified Theory of Acceptance and Use of Technology (UTAUT), which integrates eight user acceptance models into an encompassing theory (Venkatesh, Morris, Davis, & Davis, 2003). They see the intention to use a new information technology and the actual use as strong predictors of individual acceptance. By conducting longitudinal studies, they derived three constructs that can explain more than 70 percent of the variance of the intention to use a new system: performance expectancy (PE), effort expectancy (EE) and social influence (SI) (See figure 1.). A fourth determinant was derived that is a direct determinant of usage behavior, namely Facilitating Conditions (FC).

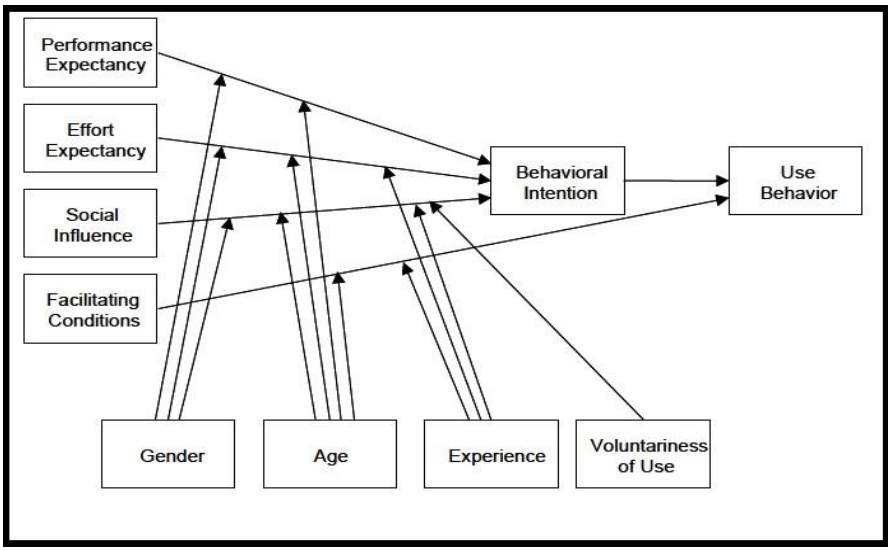

Figure 1. The key constructs of Behavioral Intention (Performance Expectancy, Effort Expectancy and Social Influence) and Use Behavior (Facilitating Conditions), moderated by the variables Gender, Age, Experience and Voluntariness of Use.

Explained in detail, performance expectancy can be equated with the perceived usefulness of a technology. If an individual judges a technology to be helpful in attaining his or her aspirations, the performance expectancy increases. Studies of the perceived acceptance of a technology have consistently led to the result that when people perceive the technology as useful, the acceptance increases (Holden and Karsh, 2010; Jimison & Sher, 2008; Venkatesh, et. al., 2003). Further, effort expectancy can be equated with the perceived ease of use of the system, what is positively correlated to technology acceptance (Thakur, 2013; Wills, et al., 2008). What is very important to note here is the moderating variable of age. According to Plude and Hoyer (1985), increased age can influence the effort expectancy due to difficulties in processing complex stimuli and keep attended to the system. There is also a gender difference; for women, effort expectancy tends to be a greater determinant for usage behavior. The third determinant, social influence, is defined by Venkatesh (2003) as the degree to which an individual perceives that important people believe he or she should use the new system. Here, theory suggests that women tend to be more sensitive to social expectations, social influence is thus a stronger indicator for women to develop a behavioral intention. Further, the effect of social influence tends to be higher for older people since they place a greater value on affiliation needs (Rhodes, 1983). The moderating effects of both gender and age decline with experience (Morris & Venkatesh, 2000). The fourth variable, Facilitating Conditions, is a direct determinant of use behavior. It is defined as the degree to that the individual thinks that organizational or technical support is existing to facilitate to use the product. An international testing of the UTAUT model revealed a correlation of 0.79 with use behavior (Im, Hong & Kang, 2011)

In order to improve the elderly's acceptance of smart home technologies, it is therefore of great benefit to examine how people score on the four above mentioned constructs. The results should indicate what is important to the user and how the score on these factors can be enhanced.

This study will thus have the following focus:

How do elderly people score on the four constructs that determine behavioral intention and usage behavior - Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI) and Facilitating Conditions (FC) - when they use the monitoring functions of the eWALL technology and how can the results be enhanced?

Methods

2.1 Design

To attain a number of encompassing answers, an explorative usability testing was conducted. This user-based product evaluation provides direct information about how real users use a system and is therefore the most fundamental usability method (Nielsen, 1994). It involves systematic observation under controlled conditions. By creating realistic situations it is observed how people use and think about the system in direct interaction. One frequently used way to obtain information is the think-aloud method. In this user-based method, the participant is asked to verbalize his or her thoughts and feelings during interaction with the system and explain his or her behavior. This method yields a very direct and unbiased source of data because the contents of the working memory are almost simultaneously expressed in words (Ericsson & Simon, 1993).

This task-based, qualitative method was combined with a quantitative approach, consisting of two questionnaires. First, the User Experience Questionnaire (UEQ) was used (See Appendix D). It allows a fast evaluation of the end users' impression and measures user experience quickly and immediate (Laugwitz, Held & Schrepp, 2008). It consists of 24 bipolar items that can be rated on a Likert scale ranging from 1 to 7. Six factors were measured in the questionnaire: Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty (see table 1). Studies with the German and English version of the questionnaire revealed a satisfactory level of reliability and internal validity (Laugwitz et al., 2008). Second, the Post-Questionnaire asked demographic information like the age, profession and education and determined their pre-existing experience with different kinds of technology: smartphone, mobile internet, mobile phone, PC or laptop and tablet PC (See Appendix E).

Table 1

Six factors of the User Experience Questionnaire with a short description

Factor	Description
Attractiveness	General impression towards the product. Does the user like or dislike the product? This is a pure valence dimension (does not provide reasons for acceptance / rejection of the product)
Perspicuity	It is possible to use the product fast and efficient? Does the user interface looks organized?
Efficiency	It is easy to understand how to use the product? Is it easy to get familiar with the product?
Dependability	Does the user feel in control of the interaction? Is the interaction with the product secure and predictable?
Stimulation	Is it interesting and exciting to use the product? Does the user feel motivated to further use the product?
Novelty	Is the design of the product innovative and creative? Does the product grab users' intention?

2.1. Participants

In total, 11 participants were recruited. Their average age was 72 years, ranging from 63 to 87 years, 6 were male and 5 were female (n=11, mean age=73 years). 3 people had a university degree (WO), 3 a higher professional education (HBO) and respectively one had VWO, HAVO, MBO and ULO (Pre-University Education, Senior General Secondary School, Vocational Training and Extended Lower Education, resp.). Nine participants had a Dutch nationality, whereas 2 came from Germany (See table 2)

Table 2

Data of Post-Questionnaire, showing demographic data (mean age, gender, nationality, education)

M Age	Gender		Nationality		Education					
72 years	Male	Female	Dutch	German	WO	HBO	VWO	HAVO	MBO	ULO
	6	5	9	2	3	4	1	1	1	1

Note. WO = University degree; HBO = Higher Professional Education; VWO = Pre-University Education; HAVO = Senior General Secondary School; MBO = Vocational Training, ULO = Extended Lower Education

As an inclusion criterion was set that that the participants were at least 55 years old and could imagine to use the technology in their daily life. For recruiting the participants, two sources were used: 7 participants were volunteers coming from "Stichting 55+", a charity for people older than 55 that aims to enhance social and cultural welfare based on voluntary work. A press report was published in their journal, asking for people who are interested to contribute as co-workers in the eWALL project. People could leave their Email address and subsequently, a flyer was sent to them informing content and aim of the study (See Appendix A). Subsequently, they were invited to the Roessingh Research and Development (RRD) to be informed about the project and the procedure. Four other people were recruited from private sources by researchers involved in the project.

2.2. The eWALL

In the study it was worked with a specific kind of smart caring home technology, namely the eWALL. This device provides monitoring and coaching for elderly with chronic diseases with the aim of prolonging active independent living. It has been developed in a collaboration between several universities and research centers across Europe. It provides interaction with the elderly at different interfaces. The eWALL consists of three parts: (1) the sensing installation for the end user, (2) the cloud infrastructure and (3) the front-end feedback, containing the primary user main screen (Bara, Cabrita, Op den Akker & Hermens, 2015). Further information about the project can be found on www.ewallproject.eu. The main means of interaction for the primary user is the large touch screen (See figure 2.).

Figure 2. Main screen in active mode.

It is equipped with different features that intend to promote the health and Quality of life of the elderly and to keep them independent and mobile for as long as possible. The primary user main screen is a large interactive touch screen that is mounted on the wall and has a diameter of 42”. This screen is switched on constantly and provides the user with different kinds of information: the indoor temperature and humidity, the weather forecast, daily appointments and a frame where relatives can share their pictures. The features displayed on the eWALL are adjustable and create a unique user profile by taking into account different parameters: the therapy prescribed by the doctors, the current state of health and further interaction patterns with the technology. Presented on the main page in the form of four books, four features are equipped with a monitoring function.

Firstly, the application “My Activity” (Daily Physical Activity Monitoring, DPAM) monitors all physical activity the end user makes and presents his or her progress clearly. By giving feedback, this feature intends to promote the fitness and movability of the user (See figure 3).

Figure 3. Daily Physical Activity Monitoring (DPAM). It can be chosen between different measures: steps, kilometers and calories. The day is split in blocks of two hours. On the right, daily time summaries of the different kinds of activity are shown. In the row below the days are displayed. The color of the blocks gives feedback: the greener the color of the day is, the more the end user was physical active. A daily goal of 10 000 steps is set.

The second application is called “My sleep” (Daily Sleep Monitoring, DSM) and monitors the sleep of the user. Users can see the duration of their sleep, the amount of sleep interruptions and the sleep efficiency. This can be displayed either in text format or in the graphical form. (See figure 4. and 5.)

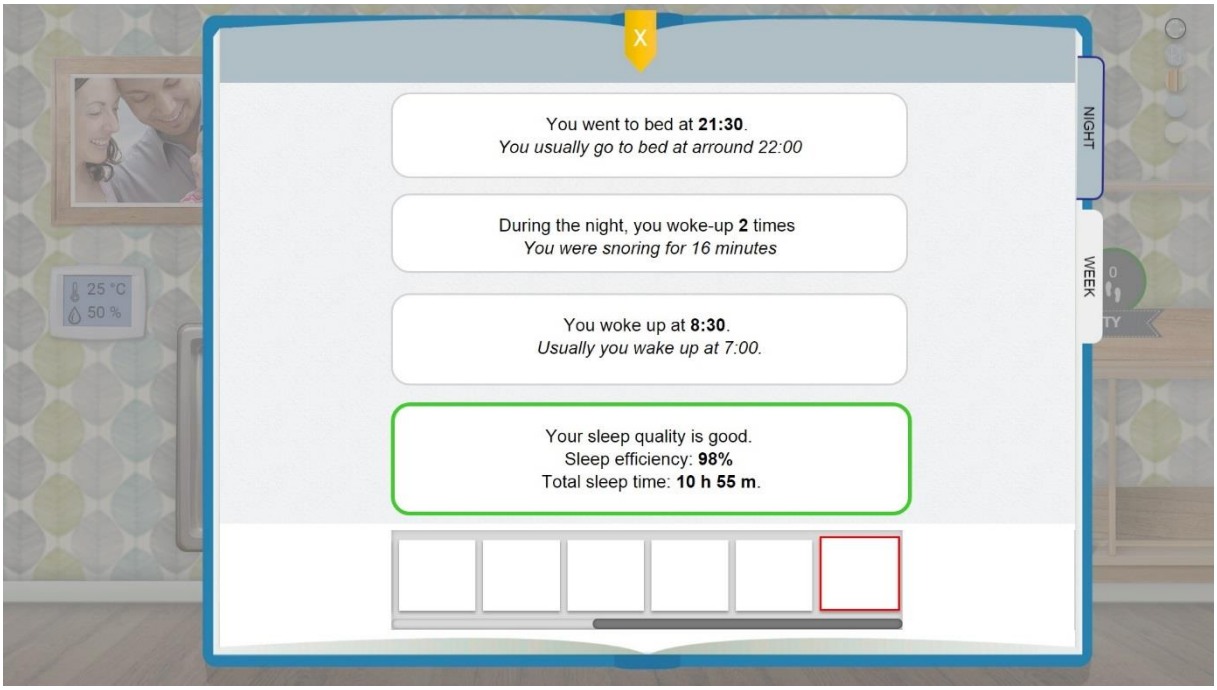

Figure 4. Daily overview of the Daily Sleep Monitoring (DSM). The application calculates the usual time the primary user goes to bed and wakes up and compares it with the daily behavior.

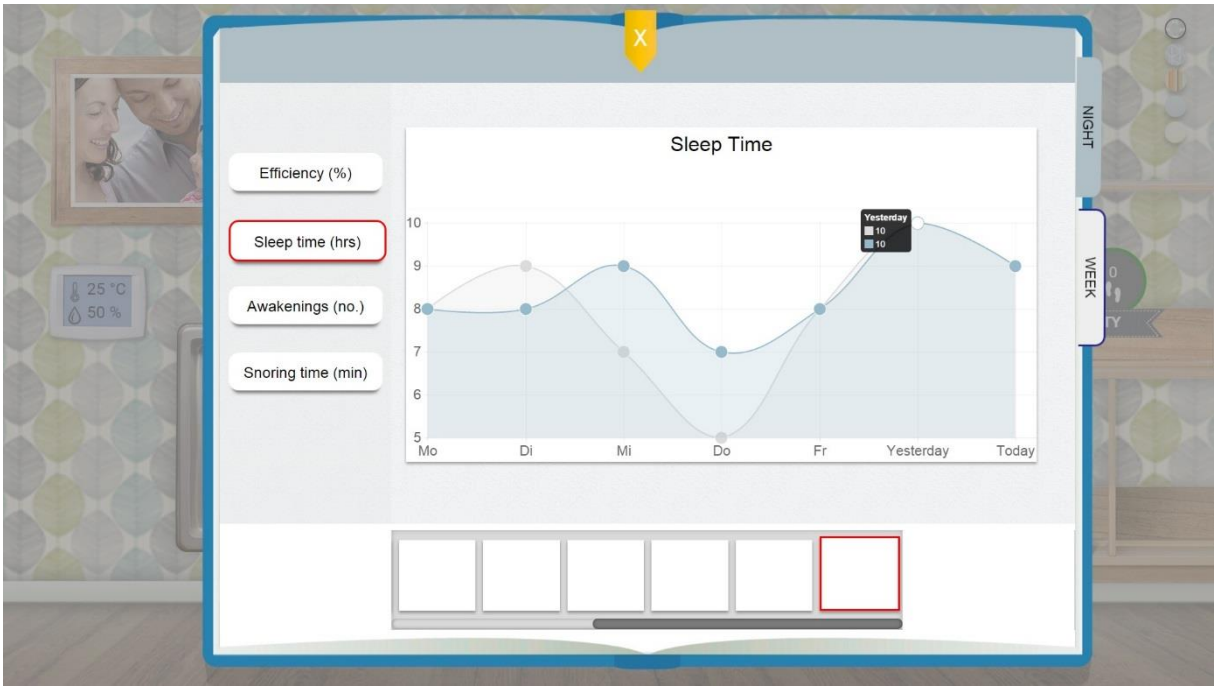

Figure 5. Graphical weekly overview of the DSM. Sleep efficiency, sleep time, awakenings and snoring time can be displayed. Daily behavior is compared to the usual behavior.

The third application “My health” measures medical parameters like the heart rate, the oxygen saturation level and the blood pressure. The fourth application “My daily life” (Daily Functioning Monitoring, DFM) records various daily activities of the end user: daily routines like grooming, outdoor activities, housework, resting and entertainment (See figure 6)

Figure 6. Display of the Daily Functioning Monitoring (DFM). All different indoor activities and their duration are shown. In the row below the user can choose between different days.

In the study the focus was laid on functions that monitor the patient, especially on the Daily Functioning Monitoring, Activity Monitoring and Sleep Monitoring. They monitor the different kinds of behavior of the user and give feedback on a daily and weekly basis.

2.3 Procedure

The testing took place in the Roessingh Research and Development Center (RRD) in Enschede, The Netherlands. A testing lab was provided; a small room with other testing devices and the eWALL, which was mounted on a tripod.

During the preparation phase, the participants were picked up at the entrance and accompanied to the testing room. After arriving in the testing room, the participants were asked if they would like to have a hot drink. While going to the coffee machine, small talk was made

with them to warm them up. Then the eWALL was presented and purpose and procedure of the study were explained. Additionally, it was clarified that they can utter every kind of criticism. After that, the participants were given the opportunity to ask questions and were then asked to sign an Informed Consent. Subsequently, the testing phase begun (User Plan Dashboard and Research Protocol can be found in Appendix C and D).

Part (1)

In the first part, a structured interview was conducted. To create a realistic user experience, the entered data was from a persona named Michael that showed behavioral patterns of the typical target group. Participants were asked to approach the screen. They were instructed to focus on specific parts of the technology and asked to answer questions about them. During this, they could interact with the eWALL and were asked to think aloud. To yield results about the three determinants Performance Expectancy, Effort Expectancy and Social Influence, specific questions were asked. (See table 3).

Table 3

Questions assessing Performance Expectancy, Effort Expectancy and Social Influence

Evaluated construct	Question
Performance expectancy (PE)	Which of this information is (the most) useful for you?
Effort expectancy (EE)	How easy is the handling for you?
Social Influence (SI)	Could you imagine sharing this data with your family? How about with your nurse and doctor?

Two researchers were present throughout the entire testing phase. One of them explained the study, asked the questions included in the protocol and encouraged the participants to think aloud. The second researcher had the task to observe the behavior of the participant like standing interaction and touch behavior.

Part (2)

In the second part, people were asked to sit down and answer the User Experience Questionnaire (UEQ) and the Post-Questionnaire. After they were finished, it was checked if they completed all questionnaires and didn't forget to tick any items.

2.4. Analysis

2.4.1. Qualitative Analysis

The testing phase yielded 11 interviews that ranged roughly from 30 minutes to one hour. These interviews were transcribed and translated. An inductive analysis was conducted and a coding scheme was developed. To attain codes that measure the four constructs correctly, it was firstly oriented at items coming from the different theories included in the UTAUT model. These were rephrased in terms that can be applied to the eWALL technology and used to code all answers of the three questions named above. If no code agreed with the answer, a new code was created and so, more codes emerged from the answers of the participants. The factor Facilitating Conditions was measured by different answers; both from the observations and from the answers of the other questions. By holding to this procedure, 32 codes were created in total; 11 for measuring Performance Expectancy, 8 for measuring Effort Expectancy, 7 for Social Influence and 6 for Facilitating Conditions. (See Appendix G)

2.4.2. Quantitative Analysis

For the User Experience Questionnaire, different values were calculated: individual scores on every item, mean scores of the six dimensions, scale means per person, standard deviations and the Cronbach's Alpha for measuring the internal consistency. Furthermore, the results were set in relation to a benchmark that was derived from a benchmark data set from 163 studies.

Results

3.1 User Experience Questionnaire

The analysis of the user experience evaluation revealed no big differences between the six scales. They all had a mean score of about 1. The internal correlation of the scales was measured in terms of the Cronbach's Alpha-Coefficient. The score ranged from 0.6 to 0.78, with a mean value of 0.73. Though there is no generally accepted rule of how big the value of the coefficient should be, many researchers see a value of >0.7 as sufficient (e.g. Kline, 1999). According to this, the internal consistency of the six scales is acceptable. Only the factor "Dependability" shows a slightly lower value of 0.6.

Table 6

Mean, Standard deviation and Internal Correlation in terms of Cronbach's Alpha of the User Experience Questionnaire (UFQ)

Scale	Mean	Std. Dev.	Internal Correlation (Cronbach's Alpha; M=0.73)
Attractiveness	1.08	1.11	0.75
Perspuity	1.14	1.45	0.78
Efficiency	1.18	1.13	0.7
Dependability	0.93	1.32	0.6
Stimulation	1.2	1.25	0.78
Novelty	0.89	1.37	0.76

The measured scale means were set in relation to the existing benchmark values. Figure 7 shows the distribution of the benchmark scores and the mean of this sample on all six factors of the UEQ. The mean score on each factor can be ranked on one of five graduations of acceptance (from positive to negative): Excellent, good, above average, below average and bad. It reveals that the scale means for the factors "Perspicuity", "Efficiency", "Stimulation" and "Novelty" can be classified as being "above the average". The sample mean for the factors "Attractiveness" and "Dependability" are ranked as being below the average.

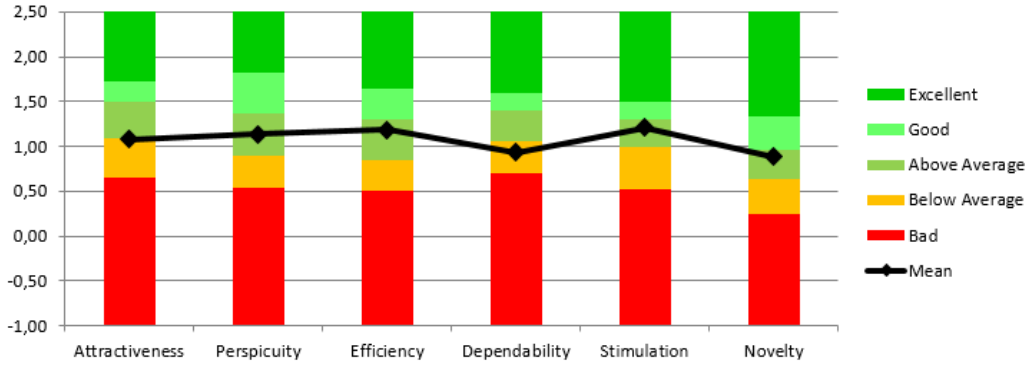

Figure 7. Scale means of the six factors of the UEQ in relation to benchmark values.

A look at the individual scores revealed that the scores of participant 4 and 10 deviate from the scores of the other persons. Participant 4 had the highest score of 3 on the factors attractiveness, perspicuity, efficiency, stimulation and novelty and was therefore noticeable above the average. The scores of participant 10 were negative on all dimensions and therefore strikingly lower than the sample mean.

3.2 For eWALL in general

The distribution of the most named answers for the constructs Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions for the general impression is displayed in Table 4.

Table 4

Answers General Impression

Construct	Answers			
Performance Expectancy	Useful feature: higher quality (n=8)	Useless feature: no identification (n=8)	Stimulating feature (n=2)	
Effort Expectancy	Easy to master (n=9)	Shows understanding (n=7)	High complexity (n=7)	Low complexity (n=5)
Social Influence	Monitoring concern (n=7)			
Facilitating Conditions	Physical complaint (n=7)	Too much control of technology (n=5)	Experience with technology (n=3)	

3.2.1. Performance Expectancy

Most participant (n=8) thought of the system as useful in enhancing the Quality of life for different reasons. One stated that it is a useful tool for caregivers: *"That's kind of handy of course. If you are already in the house and you live alone or with two, and you need help, that caretakers could see as well, what you did and what you didn't do."* However, eight participants stated that the technology had no benefit for them at the moment. They couldn't identify with the presented functions because they didn't feel as part of the target group. For example, one participant said: *"I don't know yet. But I think that I still don't need this. But if the doctors say that I need this I will try."* Three participants also said that the monitoring function has a positive effect: it was perceived as stimulating to live healthier and to move more. As an example, a participant said: *"Well, except for the old-fashioned furniture I know that I'll be stimulated to move more and to eat healthier, these are two things of big importance to be able to go on living."*

3.2.2. Effort Expectancy

Nine participants perceived the technology as easy to master in general; this was the most salient topic. Mostly, one exposure to the technology was enough to understand how to handle it. The participants also thought that it is easy for other people to learn to handle the technology, as long as they would see the use of it. One participant said about this: *"To learn to handle it, this is a question of training. Someone would have to deal with it for a while, maybe you have to change this or that, giving this another shape. But it's possible. It's possible. Everyone can do this. It has to be useful for you. Then you also want to learn this."* Several people showed understanding of the eWALL (n=7): they understood the features and objectives of the technology and could explain the functions of the different parts. For example, a participant explained: *"Yes, under "health" you can find your own health, under "sleep" die possibilities of or problems with sleep and under "activity" you can see if you have problems with your daily physical activity or if you can move normally. "My day" [day history] is clear, that are the plans for the day, what you are doing during the day."* Some people remarked that the main screen was clear and plain (n=5). However, as a first impression some said that the main screen showed a high complexity (n=7) because it addressed quite a lot of topics; for example, one participant stated: *"Yes, it is a little bit busy. Too much...too much things side by side."* However, another five participants made remarks about the low complexity of the main screen. For example, one participant said: *"Yes, it is simple. Simple and you can see very fast what you can do and what you cannot do. Some possibilities."*

3.2.3. Social Influence

There were a lot of monitoring concerns among the answers (n=7). One person stated: *"I think...that it is...also good. But it doesn't need to control so much that I have no privacy any more. Privacy is important to me."* Another one said: *"The only thing that would bother me is the total surveillance. It would really bother me if I would be monitored the whole day. Sometimes I would like to do something that is of nobody's concern."*

3.2.4. Facilitating Conditions

Seven participants complained about the physical appearance of the screen: they perceived it as too big, said that standing for longer periods is exhausting, were afraid of the radiation and were not willing to mount it at home because they already had a TV or because it would not fit with the rest of the interior. For example, one participant said: *"Okay. And you have to do this with the finger? Because then immediately you get, people are...different people have problems with their eyes. And if you have to stand so close in front of this…"* Another salient topic (n=5) was that the technology was perceived as exercising too much control. This came apparent in the fact that the screen couldn't be switched off, that it monitored the behavior constantly. As an example, one participant declared: *"I would like to have it, but I would like to have the results on my computer and then I decide if I forward them. And then I also want to have the possibility to say that I can't do this anymore and that it will be forwarded to someone I choose then. And what concerns the rest, I don't want it to be viewed from third parties."* Three participants remarked that they already have experience with technology and handling the technology posed therefore a smaller problem for them. For example, a participant said: *"But I'm working with screens a lot, so I'm used to handle technology."*

3.3 Daily Functioning Monitoring

The distribution of the most named answers for the four constructs Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions for the Daily Functioning Monitoring is displayed in Table 5.

Table 5

Answers Daily Functioning Monitoring (DFM)

Construct	Answers			
Performance Expectancy	Useless feature: no identification (n=4)	Useless feature (n=4)	Useless feature: no interest (n=3)	
Effort Expectancy	Shows understanding (n=7)	Easy handling (n=5)	Misinterpretation (n=4)	
Social Influence	Shareable with doctor (n=7)	Shareable with family (n=6)	Monitoring concern (n=4)	Privacy concern (n=4)
Facilitating Conditions	Too much control of technology (n=2)			

3.3.1. Performance Expectancy

Regarding the performance expectancy, all participants (n=11) made remarks about the perceived uselessness of the DFM. Four participants said that they have no use of the function because they still know what they did during the last days and don't need it to be displayed in an overview; they didn't show identification. For example, one participant said: *"Well, not [of use] for me at the moment. I still know what I did yesterday."* Another one said: *"I think that it's not useful at the moment. Not for me. But maybe, if you're some years older and your memory is less active, it will be very interesting."* Four other participants also perceived the DFM as useless because they didn't see which kind of advantage this function offered. Three more signaled no interest. A participant said about this: *"You know, if you're getting old this is not thrilling any more. Really not. You do things that you want to do and you don't do the things that you don't want."* However, two participants said that the function is useful, for example because showering is monitored and many older people tend to forget to take a shower.

3.3.2. Effort Expectancy

Most participants (n=7) showed understanding of the daily functioning monitoring function. For example, one participants explained: *"Well, I see something like an agenda and it's today and here I can go forward."* Likewise, five participants said that the function is easy to handle. However, four participants misinterpreted the overview: they first thought that it is a day planning and that they are supposed to fill it in by themselves. For example, one participant said: *"Ah, that's why there are the eight minutes! No, I thought that I had to fill it in by myself what I did on Tuesday."*

3.3.3. Social Influence

The majority of participants (n=7) had no problem with sharing the daily physical activity monitoring information with their doctors. Equally, six participants said that they were also willing to share the information with their family. One participant said about this: *"Yes. Yes, because it is really important. Or with your children for example, who come by once per week. Or, if you are really limited, that a caregiver like a housework aid can see how you structured your day and what you roughly did. This makes a big difference that you can track it."* However, respectively four participants uttered monitoring and privacy concerns regarding sharing this information. For example, one participant said that the data is privacy sensitive because you can't control who has access to his data. One participant explained: *"No, that doesn't interest me at all and I also had to track this for Het Roessingh, but I don't want this at all. That is of nobody else's concern. Do you understand?"* Likewise, four participants didn't want to share this information with the doctor. As an example, a participant said: "*No. He has to decide over my health or sickness. Only if it's relevant for your health. If it's necessary you have to do it."*

3.2.4. Facilitating Conditions

Two participants complained that the technology exerts too much control. As an example, one said*: "It doesn't have to be that you force people to do things that they actually don't want. You have to take care of that if you do this. I think."*

3.4 Daily Physical Activity Monitoring

The distribution of the most named answers for the four constructs Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions for the Daily Physical Activity Monitoring is displayed in Table 6.

Table 6

Answers Daily Physical Activity Monitoring (DPAM)

Construct	Answers			
Performance Expectancy	Useless feature (n=5)	Stimulating feature (n=5)	Useless feature: no interest (n=5)	Useful feature: higher quality (n=4)
Effort Expectancy	Shows understanding (n=7)	Lack of understanding (n=7)	Easy handling (n=6)	
Social Influence	Shareable with family (n=9)	Shareable with doctor (n=7)	Not shareable with doctor (n=3)	
Facilitating Conditions	Too much control of technology (n=1)	Better alternative available (n=1)	Missing explanation (n=1)	

3.4.1. Performance Expectancy

There was a rough equivalent of answers saying that the particular function is useful or useless. On the one side, nine remarks were about the usefulness: five people said that the function is stimulating to improve their fitness. One participant said about this: *"Yes, yes. Because then it is nice. Then you get action. They you say 'Oh, I have to work off my program.'"*. Four more people saw the function as useful in enhancing the quality of life because physical activity is very important. As an example, one participant stated: *"Physical activity is the best for the people, so if you make them aware of this and explain that they are themselves responsible for that, it is really good. Physical activity is just the best."* On the other side, respectively five people said that the function is useless and of no interest for them. Many participants remarked that there is too much information. For example, the calories were considered as redundant and the information was presented too detailed. One participants said about this: *"I don't think that... yes, there are people who are very conscious about this sort of thing, they will zoom in on this I think. With calories and activity. Others will probably say: well, nevermind. At least from the people I know, in average it's not like they would want to learn about that I think."*

3.4.2. Effort Expectancy

More than half of the participants (n=7) showed understanding of the specific function. It became apparent, though, that this function was slightly more complex and more difficult to understand that the other parts. Different difficulties could be observed by seven participants: the total amount of steps couldn't be found and the overview was too detailed and complex to be understood right away. One participant said for example: *"I would not know what I can do here...yes, I would say like...calories burned. What can I do with that? Is it too much, too little, too fat, too thin?"* Another one perceived the interface as too detailed: *"Well, I think it is too much. That is all this? These are hours. Oh, these are blocks of time. When you accomplished it. Is this interesting to know? Not for the user. I think, of you have three blocks it is enough. One in the morning, one at noon and one in the evening."* Six people perceived the handling as easy, tough. One participant said about this: *"Yes, it is handy. It can be done easily."*

3.4.3. Social Influence

Most participants (n=9) were willing to share the information with their secondary caregivers. They perceived it as important that the doctor can see the information in order to give better instructions and diagnoses. One participant said about this: *"Yes, because it's really important. You go to a doctor when you don't feel good or when you think that there's something wrong with you. Then you have to provide information."* Seven participants were willing to share it with the family as well, because the information was seen as a reason to talk about. For example, a participant said: *"Yes, of course. Yes, you show this. It is nice, it is a reason for conversation."* However, three participants didn't want to share this information with their doctors. One said about this: *"I would share it with my family. But not with my doctor. He doesn't need to know how much I walk."*

3.4.4. Facilitating conditions

Three participants made remarks about facilitating conditions. One said that only he himself wants to control when to see it and when not and not the technology. Another indicated that she already has a comparable app on her smartphone that she rather uses. The third one complained that an explanation is missing and therefore the participant don't know if he did it good or bad.

3.5 Sleep monitoring

The distribution of the most named answers for the four constructs Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions for the Daily Sleep Monitoring is displayed in Table 7.

Table 7

Answers Daily Sleep Monitoring

Construct	Answers			
Performance Expectancy	Useful feature: better overview (n=6)	Useless feature: no identification (n=5)	Useless feature: no interest (n=4)	
Effort Expectancy	Easy handling (n=7)	Low complexity (n=5)	Shows understanding (n=5)	
Social Influence	Shareable with doctor (n=7)	Shareable with family (n=7)	Monitoring concern (n=2)	Not shareable with family (n=2)
Facilitating Conditions	Too much control of technology (n=3)	Experience with technology (n=1)		

3.5.1. Performance Expectancy

Concerning the sleep monitoring function, a lot of remarks (n=6) were about the perceived usefulness of the function: they said that the function gives a well-displayed overview of the sleep. This was viewed as useful because people tend to forget their long-term sleep history. For example, one participant said*: "Yes, this is very important, because sleep, this helps enormous. This is actually very relevant. And here you can check indeed how it was going in the long term. Because you don't know it anymore. [...] That's why it's so good to see it in short"* However, there were also five people who saw no use in the function because they either checked their sleep themselves, slept well or already knew how to deal with poor sleep. For example, a participant said: *"No. I can check this for myself - sometimes I sleep well, sometimes I sleep rather poorly. It doesn't need to be tracked."* Another four participants had no interest in the function for different reasons, for example because they could not see any interesting information. About this, one participant said: "No, that doesn't interest me. I always go to bed too late. I'm a night owl, I am no morning person."

3.5.2. Effort Expectancy

Most of the participants (n=7) perceived the feature as easy to handle. Five participants noticed the low complexity: they complimented the clear overview and the low information density. Another five participants showed understanding of the particular function. One remarked that the graphs that show the weekly course had quite a high complexity.

3.5.3. Social Influence

Most participants viewed the information as shareable with both family and caregiver (n=7, resp). One participant said about this: *"That's why it's so good to see it in short. And this of course is something I would share with my doctor. If it's really bad and I can show how long I already slept badly. And then you can see this. You can see the extent."* Two signaled a monitoring concern and another two said that they were not willing to share the information with their family. For example, a participant said: *"I am used to care for myself. I don't want to bother my children with that."*

3.5.4. Facilitating Conditions

One salient topic was the high control of technology. Three people said that they feel that the technology exerts too much control and that they want to choose self when to share things. For example, a participant said: *"See, I would like to have this, but then I want to have the results on my computer and I want to decide myself when I forward them."* One participant said that he already has a lot of experience with reading graphs and perceived the graphical weekly overview therefore as easier to understand.

3.6 Post-Questionnaire

Table 8 shows the answers of the participants on the Post-Questionnaire about experience with different devices. It reveals that all participants have experience with user technology, above all with the smartphone, mobile telephone and PC or laptop. They use them frequently and already for longer periods of time.

Table 8

Questionnaire asking about previous technology experience with smartphone, mobile internet, mobile telephone, PC / Laptop and Tablet PC (possession, use, frequency and duration of use)

	Do you have one?		Do you use it?		How often do you use it?					How long?
	Yes	No	Yes	No	>= once / hour	>= once / day	>= once / week	Less often	Never	Months / years
Smartphone	9	2	9	2	5	3	0	1	2	33 months / ~3 yrs
Mobile Internet	-	-	9	2	2	3	3	1	2	-
Mobile Telephone	10	1	10	1	5	3	1	1	1	86 months / ~7 yrs
PC / Laptop	9	2	9	2	1	7	1	0	2	198 months / 16.5 yrs
Tablet PC	7	4	7	4	1	4	2	0	4	34 months / ~3 yrs

The analysis of the Post-Questionnaire showed that the majority of participants were familiar with mobile devices: 10 possessed and used a mobile phone, 9 a smartphone and most of them used it once an hour. They already used a mobile telephone for roughly 7 years and a smartphone for 3 years in average. The function of mobile internet used nine participants. 9 people possessed a PC or Laptop and most used it at least once a day and for 16.5 years. 7 participants were also familiar with a Tablet PC; 4 of them used it at least once a day and for 3 years in average.

Conclusion and Discussion

The aim of the present study was to investigate the current acceptance of the eWALL technology, measured by the four core determinants of the UTAUT model Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions and the outcomes of the User Experience Questionnaire, and to give suggestions for improvement.

Results of the User Experience Evaluation, measuring the user impression of the product, were moderate. Four of the six factors were above the benchmark and two below. However, all were close to the benchmark and did not noticeable deviating from it. So it cannot be distinctly spoken of a high or a low acceptance. Likewise, since the sample mean of the "Attractiveness"-scale, measuring impression in acceptance / rejection dimensions, is very close to the benchmark, the general impression of the product is seen as neutral.

According to the answers on the four key constructs of use behavior, the following can be concluded:

Concerning the performance expectancy, eight of the eleven participants perceived the technology as useful in general. However, the analysis revealed that a lot of participants couldn't identify with the target group. They stated that they wouldn't use the eWALL, because in their momentary life situation, it didn't offer any added value for them. Most of them said that they don't need support or feedback to live more healthy or independently. They still had no memory problems or limitations with their physical activity. With seven of the participants, this had to do with the recruitment procedure: members of a charity were asked to participate as co-workers in the eWALL project and subsequently, further information was sent to their email address. The majority of these people came from a well-educated background, had a good pre-existing knowledge of technology and had little to no age-related problems. A level of experience with technology was even required because they needed an email address in order to receive further information. But even the four participants recruited from private sources showed no identification with the target group, because they also had little symptoms of age-related decline. This non-randomized sample selection can be seen as a limitation because it hampers the validity of this study and could widen the gap between those people who have access to care and those who really need it. The problem addressed could be explained with the inverse care law (Hart, 1971). Hart stated that: "The availability of good medical care tends to vary inversely with the need for it in the population served." In information technology times, the analogous "Inverse information law" is registered, that states that appropriate information

is the most difficult to attain for people who need it the most because they don't have the requirements for understanding and using health technologies (Rowlands & Nutbeam, 2013). This vicious circle has to be broken by assessing who really needs care and by testing the eWALL technology with them.

Furthermore, what concerns the three monitoring parts, it can be concluded that the Daily Functioning Monitoring (DFM) is seen as useless because it displayed too much redundant information. The Daily Physical Activity Monitoring was seen partly as useless and partly as useful, because it both was perceived as stimulating to be more active, but also as too complex to see the important information right away. Perceived as mostly useful was the Daily Sleep Monitoring. The information displayed there was seen as very relevant to health and offered good overview of the long-term development of sleep. Escourrou and Rehel (2000) reviewed the needs and costs of sleep monitoring and concluded that there is a clear need of ambulatory sleep monitoring. Furthermore, home sleep studies with sleep-recording devices are considered to be a good form of diagnosing sleep apnea (Golpe, Jiménez & Carpizo, 2002). So literature support the evidence that sensor-based sleep monitoring is a useful tool in enhancing health.

Most participants had a positive effort expectancy. They perceived both the eWALL in general and the three monitoring parts as easy to learn and handle. Initial understanding or handling problems vanished in almost all cases after one exposure. However, the selection bias of the participants could have had also influence on the effort expectancy: almost all people showed pre-existing experience or expertise with technology. So, handling a new kind of technology obviously posed no big problem for them because they were familiar with this kind of systems. Like stated previously, the deviating score of participant 10 could was striking: this participant showed both mostly negative scores on the UEQ and gave a lot of negative answers in the interview. Having a look at the person's answers of the Post-Questionnaire, it becomes clear that little experience with technology is existing. This could indicate a link between experience and acceptance. Venkatesh (2003) and colleagues review the role of experience in different technology acceptance models and derive experience as a moderating factor of Effort Expectancy. Moon and Hwang (2016) studied the effects of the UTAUT model and indicate that users with experience of smart health care services have a higher degree of effort expectancy and intention to use the technology than those without. So, people with experience tend to accept the technology more.

Concerning the social influence, the willingness to share personal data varied with the kind of monitoring function. More people were inclined to share the information of the sleep monitoring function with both family and caregiver. The results of this paper reproduced the findings from Wild et al. (2008): the trade-off between privacy and usefulness of monitoring is a dominant theme for many elderlies. This can also be seen in the analysis of the technology: the more useful the function was perceived, the more inclined the participants were to share the information. What can be concluded here is that people's concern to share their data will decrease when they see the use of doing it. This issue is very important because it is intended that nurses and doctors use the technology as a support for providing care, giving diagnoses and transcribing treatments. It can be used to provide information of the behavior of the patient. However, causes of this behavior always have be inquired in direct social contact. Studies indicate that high social support, satisfying social relations and high levels of control achieve raised well-being (Schulz & Decker, 1985). Human warmth and personal interaction should therefore always be included to ensure the psychological and social well-being.

Answers given for the last determinant, facilitating conditions, revealed that the physical appearance of the eWALL for mostly negative: the standing interaction was perceived as exhausting. The size of the screen was also viewed as too big to get a good overview. This is an important remark, for a lot of elderly people have problems with standing for longer periods due to muscle function loss and are suffering from audio-visual problems (Kalyani et al., 2014).

Now, what implications do these findings have? How are they applicable to everyday life and how do they contribute to the existing and future research in this field?

In general it can be said that the eWALL is on a good way. The overall attitude towards the eWALL was moderately positive and the technology was accepted in many parts. To enhance the acceptance, especially in regard to the monitoring function, it is recommended that some adjustments will be made:

What concerns the Daily Functioning Monitoring part, two suggestions can be made: either the extent of monitored data of the Daily Functioning Monitoring should be diminished, or the function should be made more useful. Either way, an individualized daily functioning overview should only display and monitor health-relevant information and no redundant data. Furthermore, what concerns the monitoring function of the eWALL, the acceptance is expected to raise if more privacy control is given: for example, by giving the possibility to switch out the eWALL and to choose what is monitored and what remains a part of their privacy. Other studies

also address the need of a balance between the enhancement of the quality of life and its dominance: it should be controllable but still be open to adapt to human behavior and habits (Friedewald, Da Costa, Punie, Alahuhta, & Heinonen, 2005). Since it is one of the primary aims of the eWALL to keep the end users' autonomy, it is thus advisable to focus on this.

Similarly, both for the sake of diminishing monitoring concerns and for practical reasons, the eWALL should be made more flexible what concerns the content and the physical appearance. Since a lot of people complained about the size of the technology, it should be given the option the use the eWALL software on a touchscreen or to use it with a remote control. To enhance the users' control, an on / off button is advisable as well.

Overall, the content of the eWALL should be displayed as simple as possible, ideally without distracting details. User should be able to understand the meaning of the information intuitively and clearly. The interface Daily Physical Activity Monitoring should be simplified by displaying less blocks and less numbers. Likewise, it should be considered to focus on just one measure to display the activity, for example to show only steps or kilometers.

A possible limitation of this study is the choice of the theory: the UTAUT model sets four constructs that influence user acceptance. What is missing in the model are the influence of aesthetics and economics or the hedonic experiences. Other authors have also realized this gap and proposed the extended UTAUT2 model that adds three constructs to the existing model: hedonic motivation, price value, and habit (Venkatesh, Thong & Xu, 2012). Venkatesh et al. (2012) could prove a good predictive value of the added variables on behavioral intention. However, the UTAUT2 is relatively new and therefore still very open to improvements and is quite complex. For reasons of straightforwardness and practicability, it was therefore not applied in the study.

Future research should also focus on conducting a usability testing with members of the target group: people with limited mobility due to age-related physical and cognitive limitations. By doing this, valid statements can be made about the acceptance of the eWALL technology and their actual chance of home adoption. It should be examined how much experience this group has with technology and in which way the interface can be simplified if it is too complex for them. It is also advised to implement the above mentioned amendments in the next prototype version of the technology to be able to confirm the findings of this study. Another way future research can pursue is to further examine what kind of monitoring data the end user really perceives as beneficial: is it useful to gather more data from the patient's sleep or health

parameters? Are information about the amount of time spent cooking really relevant? Future qualitative research could reveal more, for example by conducting interviews with both primary and secondary users to reveal their views towards what is relevant for healthcare to be monitored and what not.

What becomes apparent here is that there is a need for guidance by a legal and approved framework: where is the border between what is monitored and what not? How clearly defined is the trade-off between the monitoring of health-relevant data and the intrusion into the private sphere that became apparent with the answers regarding the Performance Expectancy and the Social Influence? This shows a shortcoming not only seen in this project, but also in the whole field of telemedicine. Koch (2006) reviewed literature in this field to give an overview of the state of the art. One major finding was that there is a need for an evaluation framework considering legal, ethical, organizational, clinical, usability and technical aspects. Steps should be undertaken by experts, leading figures and end users to ensure guidelines for future development and implementation.

Beside from all these conclusions, user acceptance of monitoring should always be seen in a time frame. What will happen if the younger generation age that is used to the transparency of social media? Studies reveal that even they are concerned with privacy and have little knowledge about their rights (Hoofnagle, Kind, Li & Turow, 2010). So for now, giving elderly people an unobtrusive and self-controllable aid will enable them to age in peace and respect.

The results indicate that elderly people in general accept the technology. However, there are still problems with the privacy of monitoring. To diminish these concerns and to enhance acceptance for the eWALL technology, it is advised to focus on the trade-off between usefulness and privacy. So usefulness should be promoted by giving more privacy control, displaying only health-relevant information and to keep the customization of the product flexible to the users. The product can be of high added value for society, especially for elderly people and the nursing sector because it has the potential to enhance the well-being of older adults and to be an effective alternative to hospitalization.

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Appendix

Appendix A. Invitation that was sent to the interested people via E-Mail

Informatie eWALL Gebruikerstest

Geachte Heer / Mevrouw,

U heeft aangegeven interesse te hebben om deel te nemen aan de eWALL gebruikerstesten. Graag informeren we u door middel van deze brief over het eWALL project, de inhoud van deze testen en het vervolg na deze testen.

Het eWALL Project: Het eWALL project is een grootschalig Europees project waar wij als Roessingh Research & Development (RRD) bij betrokken zijn. Het project richt zich op het ontwikkelen van een systeem dat in de thuisomgeving gebruikt kan worden door ouderen met en zonder gezondheidsklachten. Dit systeem geeft ouderen de mogelijkheid om hun gezondheidsstatus te monitoren en te trainen door middel van bijvoorbeeld beweegvideo's en spelletjes. Voor meer informatie over het eWALL project verwijzen we u naar de project website www.eWALLproject.eu. Deze website is in het Engels.

De eWALL gebruikerstesten: Op dit moment zijn we samen onze Europese partners het eWALL systeem aan het ontwikkelen. Om dit systeem af te kunnen stemmen op de wensen van de uiteindelijk gebruikers willen we graag uw mening horen over het huidige systeem. Dit doen we door middel van een gebruikerstest. Tijdens deze test zult u eerst, om het systeem te leren kennen, samen met de tester door u het systeem lopen. Vervolgens wordt u een paar vragen gesteld. U wordt uiteraard niet beoordeeld op hoe goed u met het systeem kunt werken. Voor ons zijn vooral uw mening en ideeën van belang. Voelt u zich dus vrij om vragen te stellen en opmerkingen te maken, want met alles wat u zegt helpt u ons om het eWALL systeem te verbeteren. Na het afronden van de vragen wordt u gevraagd om een korte vragenlijst in te vullen. Voor onze verslaglegging vragen wij uw toestemming voor het opnemen van het interview met een geluidsrecorder. De gegevens die gedurende de eWALL gebruikerstest over u verzameld worden, zullen anoniem en vertrouwelijk behandeld worden volgens (inter)nationale regels en wetten.
De interviews vinden plaats bij Roessingh Research and Development in Lab 3. Dit is aan de Roessinghsbleekweg 33b, 7522 AH Enschede. Een interview duurt ongeveer een uur.

Het vervolg...: de uitkomsten van alle eWALL gebruikerstesten worden gebruikt om het systeem te verbeteren en beter aan te laten sluiten bij de wensen van ouderen. Deze verbeterpunten willen we graag aan u voorleggen tijdens een latere gezamenlijke bijeenkomst. Heeft u interesse in deze bijeenkomst dan kunt u dat aangeven tijden de gebruikerstest.

Met vriendelijk groet,

Namens het eWALL project team van RRD

Srephanie Jansen – Kosterink (PhD)

Email: s.jansen@rrd.nl
Telefoon: 053-4875717
Bereikbaar op maandag, dinsdag en donderdag.

Appendix B. Informed Consent, asked to be read and signed by every participant

Toestemmingsverklaring

Titel van het onderzoek:

eWALL User Experience Testing

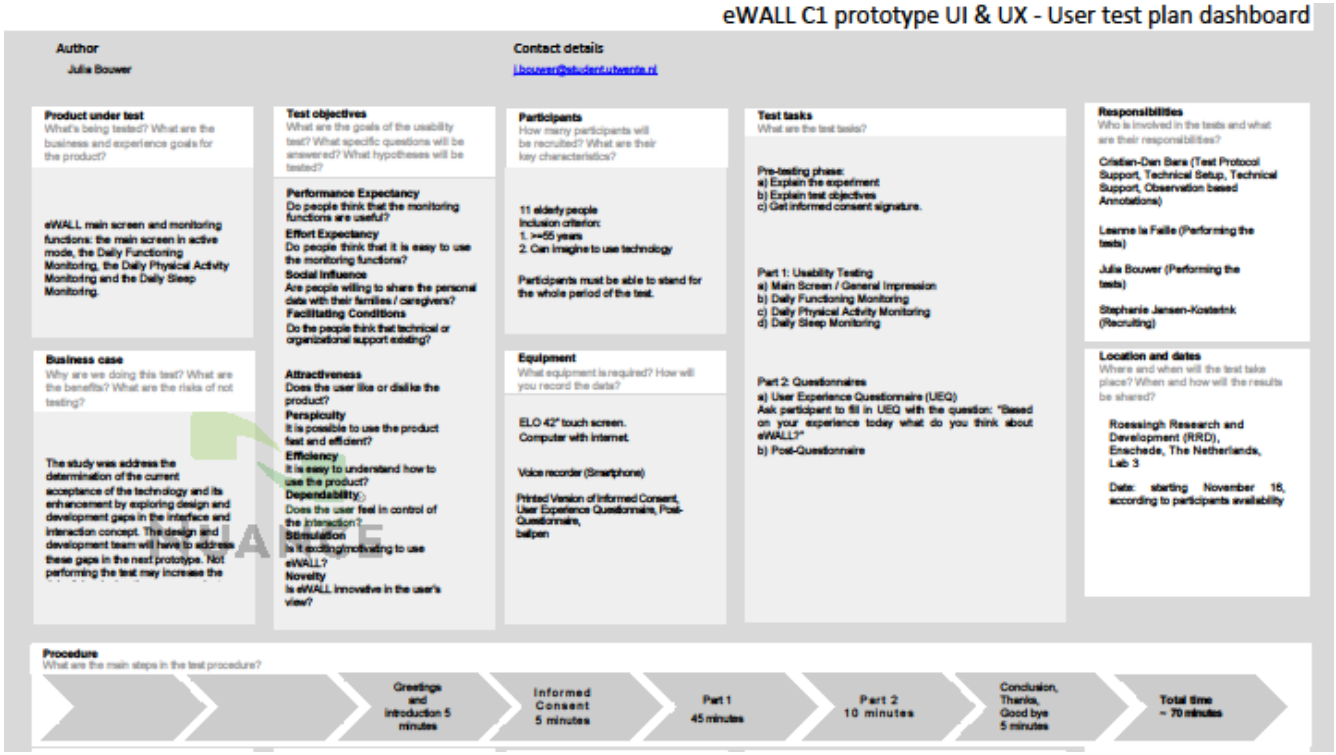
Ik verklaar dat ik de informatiebrief heb ontvangen en gelezen en naar tevredenheid over het wetenschappelijk onderzoek geïnformeerd ben. Ik heb voldoende tijd gehad om over mijn deelname na te denken en ben in de gelegenheid geweest om vragen te stellen. Deze vragen zijn naar tevredenheid beantwoord. Mijn deelname aan het onderzoek is vrijwillig en ik ben gedurende het gehele onderzoek in de mogelijkheid om op elk moment te stoppen, zonder opgaaf van reden. Mijn verzamelde gegevens worden gebruikt voor het beschreven doeleinde van het onderzoek en zullen met zorg aankomende tien jaar worden opgeslagen volgens de richtlijnen van Roessingh Research and Development. Ik geef toestemming dat de onderzoekers inzage kunnen krijgen in mijn onderzoeksgegevens.

Door dit formulier te tekenen geef ik toestemming voor deelname aan bovengenoemd wetenschappelijk onderzoek.

Naam deelnemer:	Plaats en datum:	Handtekening:
_____	_____	_____
Naam onderzoeker:	Plaats en datum:	Handtekening:
_____	_____	_____

Een kopie van het ondertekend toestemmingsformulier en de informatiebrief wordt aan de proefpersoon meegegeven.

Appendix C. User test plan Dashboard



Appendix D. Small Scale Evaluation Protocol, used during Usability Testing

Small Scale Evaluation Protocol

The checklist

Tasks	Check
1 WEEK BEFORE	
Explore the interface, try out all the scenarios proposed. It is necessary to have a first-hand experience with the system.	
Book the evaluation facility.	
Recruit end-users for specific dates and times.	
Ask one of your colleagues to be available during the study as the **observer**.	
Prepare and send instructions for the participants how to find the facility.	
Print **Informed Consent forms** (consider some extra copies in case participants request to take it home).	
Print the **questionnaires**.	
Print this protocol.	
Arrange **incentives** for participants.	
3 HOURS BEFORE	
Check the prototype and the camera if they work.	
Make sure informed consent and questionnaires are in place.	
Rehearse the protocol.	

Facilitator tips

- Make small talk with the participant to warm her up.
- Explicitly encourage each participant to **think aloud** about their actions on the tasks given.
- Listen and do not make any judgments. Just **nod your head** to show that you understand her.
- If you think of more questions, go ahead and ask them. The more feedback, the better.
- Dig below top-of-the-mind answers. **Find out why and how.**

Timeline

Time (in min)	Activity
5	Introduction
5	Informed Consent
50	Task based evaluation
5	User Experience Questionnaire
5	Post-questionnaire (Demographic Data, Technology Experience)
5	*Incentives/Sign reimbursement, thanks, goodbye!*
70-75	**Time total**

Introduction

- Thank them for participating
- Explain briefly what will happen within the next hour.
  (ein Interview & zwei kurze Fragebögen)
- Introduce shortly the project and the purpose of eWALL.
- Underline that we are not aiming to judge their opinions but want to evaluate our ideas:
- "Es gibt keine falschen Antworten. Sie können zu jeden Zeitpunkt Kritik äußern; dieses Produkt ist nicht von uns. Wir sind an ihren Gedanken und ihrer Meinung interessiert. Alles was sie sagen ist hilfreich und wertvoll für das Projekt. Je mehr sie an
  "Er zijn geen verkeerde antwoorden. U mag op elk moment kritiek uiten, dit product is niet van ons. We zijn geinteresseerd in uw mening en gedachten. Alles wat u zegt is behulpzaam en waardevol voor het project. Hoe meer u kunt bijdragen aan de evaluatie, hoe beter."
- Encourage them for thinking aloud. Example: pour & drink coffee
- Explain that everything is recorded and why an observer is present

Informed Consent

The participant receives an Informed Consent (IC) that must be read and signed by her/him in order to participate. If needed, please go through it with the participant to gain her/his trust.

Personas

Introduce Personas to demonstrate them a potential end user:

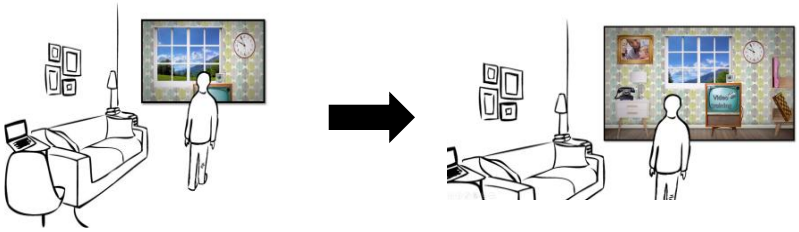
Persona:	*Michael, 67 jaar, man*	
Woonsituatie: ***Kenmerken:***	Woont thuis met zijn vrouw Maria in de stad. Hoge bloeddruk, Vergeetachtgheid, Sociale Angst, Gebrek aan motivatie, Isolatie, Ervaring met moderne technologie.	

Task-based Evaluation:

Task 1: Hoofdscherm

"Stelt u zich voor dat u het eWALL systeem thuis heeft en dat u in de woonkamer bent. U wilt gebruik maken van de eWALL, dus loop alstublieft naar het scherm."

[When they arrive in front of the screen, close enough to touch it, Press ENTER on your wireless keyboard -> the screen zooms out and shows the full screen.]



Questions:

Q1: Wat is uw eerste indruk?
Q2: Kunt u beschrijven hoe u de interactie met het scherm ervaart?
Q3: Kunt u zich voorstellen een scherm als deze in uw huis te hebben? Waarom wel/niet?
Q4: Wat verwacht u achter elk onderdeel van het scherm te vinden?

Observation:

O1: How does the user interact with eWALL? → Screen size, distance to the screen, standing interaction, active/passive mode, Does the user find out that objects launch representative information by touching it?

Task 2: Persoonlijke gegevens

"eWALL houdt boeken bij over uw leven. Het wil laten zien hoe gezond u leeft."

Questions:

Q5: Wat vindt u van deze functie?

Task 3: Daily Functioning Monitoring

"Open alstublieft het boek Mijn Dag."

Questions:

Q6: Wat is uw eerste indruk?
Q7: Kunt u vertellen wat u gisteren heeft gedaan volgens dit overzicht?
Q8: Vindt u het interessant om uw dagelijkse bezigheden bij te houden? Waarom wel/niet?
Q9: Welke informatie vindt u nuttig?
Q10: Hoe makkelijk vindt u de bediening?
Q11: Kunt u zich voorstellen zulke informatie met uw familie te delen? En met uw verzorger of huisarts?

Observation:

O2: How does the user interact with eWALL? → touch interaction, swipe functionality to see another day

Task 4: Daily Physical Activity Monitoring

"Laten we kijken naar uw boek over fysieke activiteit. Open het alstublieft en krijg te zien hoe actief u de laatste dagen bent geweest." *(Open the Activiteit book)*

Questions:
Q12: Wat is uw eerste indruk?
Q13: Leg uit wat u kunt opmaken uit het overzicht van vandaag.
Q14: Hoeveel stappen heeft u afgelopen dag gezet?
Q15: Vindt u het interessant om uw fysieke activiteit bij te houden? Waarom wel/niet?
Q16: Welke informatie vindt u nuttig?
Q17: Wat zou u verder nog willen weten over uw fysieke activiteit?
Q18: Hoe makkelijk vindt u de bediening?
Q19: Kunt u zich voorstellen zulke informatie met uw familie te delen? En met uw verzorger of huisarts?
Observation:
O3: Does the user find the way from the DFM to the DPAM?

Task 5: Sleep Monitoring
"Stel u wilt weten hoeveel uur u de afgelopen nacht geslapen heeft. Wat zou u dan doen?"

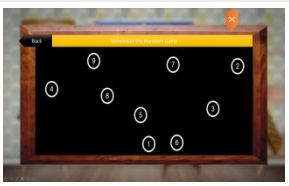
Q20: Wat is uw eerste indruk?
Q21: Leg uit welke info u hier kunt vinden.
Q22: Hoeveel onderbrekingen van de slaap zijn er te zien? *(alleen maar vragen als het nog niet bij de laatste vraag genoemd is)*
Q23: Vindt u het interessant om uw slaapgewoonten bij te houden? Waarom wel/niet?
Q24: Welke informatie vindt u het meest nuttig?
Q25: Wat zou u verder nog willen weten over uw slaap?
Q26:Hoe makkelijk vindt u de bediening?
Q27: Kunt u zich voorstellen zulke informatie met uw familie te delen? En met uw verzorger of dokter?

(Geef tussendoor reminders van hardop denken)

Task 6: Cognitive Training
"We gaan nu kijken naar een paar spelletjes die het geheugen trainen. Ga terug naar het hoofdscherm en open het schaakboard alstublieft." *(zonder een spelletje te openen)*

Q28: Wat is uw eerste indruk?
Q29: Wat verwacht u hier te kunnen doen?
Q30: Wat verwacht u achter elk onderdeel op het scherm te vinden?

Task 7: Playing Games
"Probeert u maar een paar spellen uit alstublieft."



Q31: Vindt u dit soort spellen leuk?
Q32: Kunt u zich voorstellen deze spelletjes thuis op een soortgelijk scherm te spelen? Waarom wel/niet?

Q33: Zijn er nog andere spellen die u hier zou willen zien?

Task 8: Physical Training

"Open alstublieft het video gymnastiekprogramma en start een video."

(Het video wordt kort voor het eind gepauseerd)

Q34: Wat is uw eerste indruk?

(laat de trainingsevaluatie zien)

Q35: Denkt u dat technologie een goed persoonlijk trainingsplan voor u zou kunnen opstellen, gebaseerd op zulke vragen*?

(* wijst naar de trainingsevaluatie)

Q36: Wat vindt u ervan om na elk video trainingsprogramma zulke beoordelingen te geven?

Q37: Wat vindt u van dit soort trainingsinstructies?

Q38: Zou u zelf zulke oefeningen uitvoeren als het aangeboden zou worden? Zo ja: hoe vaak?

"Nu is het interview bijna klaar; er is maar nog een onderdeel met algemene vragen."

Task 9: Algemene indruk / ervaring

"Tot slot heb ik nog een paar vragen over uw beleving van het system in zijn geheel."

Q39: Wat vindt u van dit systeem?

Q40: Nu dat u het heeft gebruikt, zou u dit systeem bij u thuis gebruiken? Waarom wel/niet?

Q41: Hoe makkelijk of moeilijk zou u het vinden om de eWALL te leren gebruiken?

Q42: Hoe makkelijk of moeilijk zou het zijn om eWALL te gebruiken in uw dagelijkse leven?

Q43: Wat vindt u van het uiterlijk van eWALL?

Q44: Vindt u eWALL leuk om te gebruiken? Waarom wel/niet?

Q45: Tot slot, als u de makers van eWALL advies zou kunnen geven voor de verbetering van het systeem, wat zou u dan zeggen?

Post interview/Questionnaire

- User Experience Questionnaire
- Demographic questionnaire

Appendix E. User Experience Questionnaire

Evaluatie van het product

Vul de onderstaande vragenlijst in om het product te beoordelen.

De vragenlijst bestaat uit paren van tegengestelde eigenschappen die van toepassing kunnen zijn op het product. De cirkels tussen de twee eigenschappen symboliseren de verschillende gradaties tussen de twee tegenstellingen.

Kruis de cirkel aan welke het meest overeenkomt met de indruk die het product op u heeft nagelaten.

Voorbeeld:

Aantrekkelijk	○ ⊗ ○ ○ ○ ○ ○	onaantrekkelijk

Dit antwoord betekent dat je het product dus aantrekkelijk vindt.

Probeer zo spontaan mogelijk de lijst in te vullen. Wacht dus niet te lang met uw keuze, zodat de antwoorden zo dicht mogelijk bij u oorspronkelijke indruk van het product liggen.

Soms zijn er misschien eigenschappen die niet helemaal overeenkomen met de eigenschappen van het specifieke product. Probeer dan zo goed mogelijk te antwoorden. Zorg er wel voor dat er op elke regel een cirkel aangevinkt is. *Let op: er is geen goed of fout antwoord; het is uw persoonlijke mening die telt!*

Gelieve nu het product te beoordelen door het aanvinken van één cirkel per regel.

	1	2	3	4	5	6	7		
Onplezierig	○	○	○	○	○	○	○	Plezierig	1
Onbegrijpelijk	○	○	○	○	○	○	○	Begrijpelijk	2
Creatief	○	○	○	○	○	○	○	Fantasieloos	3
Makkelijk te leren	○	○	○	○	○	○	○	Moeilijk te leren	4
Waardevol	○	○	○	○	○	○	○	Waardeloos	5
Vervelend	○	○	○	○	○	○	○	Prikkelend	6
Oninteressant	○	○	○	○	○	○	○	Interessant	7
Onvoorspelbaar	○	○	○	○	○	○	○	Voorspelbaar	8
Snel	○	○	○	○	○	○	○	Langzaam	9
Origineel	○	○	○	○	○	○	○	Conventioneel	10
Belemmerend	○	○	○	○	○	○	○	Ondersteunend	11
Goed	○	○	○	○	○	○	○	Slecht	12
Complex	○	○	○	○	○	○	○	Eenvoudig	13
Afstotend	○	○	○	○	○	○	○	Begeerlijk	14
Doorsnee	○	○	○	○	○	○	○	Vernieuwend	15
Onaangenaam	○	○	○	○	○	○	○	Aangenaam	16
vertrouwd	○	○	○	○	○	○	○	Niet vertrouwd	17
motiverend	○	○	○	○	○	○	○	Demotiverend	18
Volgens verwachting	○	○	○	○	○	○	○	Niet volgens verwachting	19
Inefficient	○	○	○	○	○	○	○	Efficient	20
Overzichtelijk	○	○	○	○	○	○	○	Verwarrend	21
Onpragmatisch	○	○	○	○	○	○	○	Pragmatisch	22

Ordelijk	○	○	○	○	○	○	○	Rommelig	23
Aantrekkelijk	○	○	○	○	○	○	○	Onaantrekkelijk	24
Sympathiek	○	○	○	○	○	○	○	Onsympathiek	25
Conservatief	○	○	○	○	○	○	○	Innovatief	26

Appendix F. Post-Questionnaire

Vult u alstublieft deze vragenlijst in over demografische/technologische informatie.

Hoe oud bent u?	_____ jaar
Wat is uw geslacht?	○ Vrouw ○ Man
Wat is of was uw beroep?	_____
Wat is uw educatieve achtergrond (bijv. basisschool, middelbare school, MBO, HBO of universiteit)? Als uw scholing niet in een van de bovenstaande opties staat, probeer deze dan anders te omschrijven.	_____

Bent u in het bezit van een smartphone?	○ Ja ○ Nee
Gebruikt u een smartphone?	○ Ja ○ Nee
Hoe vaak gebruikt u een smartphone?	☐ Minimaal een keer per uur ☐ Minimaal een keer per dag ☐ Minimaal een keer per week ☐ Minder vaak ☐ Nooit
Hoe lang gebruikt u al een smartphone?	_____ maand
Gebruikt u mobiel internet?	○ Ja ○ Nee
Hoe vaak maakt u gebruik van mobiel internet?	☐ Minimaal een keer per uur ☐ Minimaal een keer per dag ☐ Minimaal een keer per week ☐ Minder vaak ☐ Nooit

Bent u in het bezit van een mobiele telefoon?	○ Ja ○ Nee
Gebruikt u een mobiele telefoon?	○ Ja ○ Nee
Hoe vaak gebruikt u een mobiele telefoon?	☐ Minimaal een keer per uur ☐ Minimaal een keer per dag ☐ Minimaal een keer per week ☐ Minder vaak ☐ Nooit
Hoe lang maakt u al gebruik van een mobiele telefoon?	_____ maand

Bent u in het bezit van een PC/Laptop?	○ Ja ○ Nee
Maakt u gebruik van een PC/Laptop?	○ Ja ○ Nee
Hoe vaak gebruikt u een PC/Laptop?	☐ Minimaal een keer per uur ☐ Minimaal een keer per dag ☐ Minimaal een keer per week ☐ Minder vaak ☐ Nooit
Hoe lang gebruikt u al een PC/Laptop?	_____ maand

Bent u in het bezit van een Tablet PC (bijv. een iPad)?	○ Ja ○ Nee
Gebruikt u een Tablet PC?	○ Ja ○ Nee
Hoe vaak gebruikt u een Tablet PC?	☐ Minimaal een keer per uur ☐ Minimaal een keer per dag ☐ Minimaal een keer per week ☐ Minder vaak ☐ Nooit
Hoe lang gebruikt u al een PC/Laptop?	_____ maand

Appendix G. Coding Scheme

Measured Construct	Code	Description	Typical Quote
Performance Expectancy	Useful feature: higher QoL	Person regards this feature / information as useful / relevant in improving QoL (of target group)	That's kind of handy of course. If you are already in the house and you live alone or with two, and you need help, that caretakers could see as well, what you did and what you didn't do.
Performance Expectancy	Useful feature: better overview	Person regards this feature as useful because it provides a good and clear overview	I think that I sleep really badly. Probably that's right, maybe it's not right. And if you can visualize it in this way, it is really nice.
Performance Expectancy	Useful feature: Stimulating	Feature is useful because it stimulates to person to do some action	Well, except for the old-fashioned furniture I know that I'll be stimulated to move more and to eat more healthy, these are two things of big importance to be able to go on living.
Performance Expectancy	Useful feature: Interest	Person signals interest for feature / information	Well, it interests me to see what I do. What I do right and what I could change.
Performance Expectancy	Useless feature	Person regards the presented information / feature as useless / redundant / not relevant	But what's the use? Yes, sorry, I ask this, but it's not interesting to know how many hours you were outdoors. For me it has no use. I don't know what I can do with that.
Performance Expectancy	Useless feature: No identification	Person remarks that he / she has no use of	For me it's not so interesting because I

		feature because he / she doesn't need it yet, is not dependent on external help	don't have the impression that I need this already. ; Well, not for me at the moment. I still know what I did yesterday. For me it is of no use at the moment, that should be clear.
Performance Expectancy	Useless feature: Not representative	Person thinks that the particular function doesn't match the needs of the elderly (the target group)	What should I do with that? What kind of purpose do you have here? I need to have some use with that, like if I see that I think yes, I would like to know that.
Performance Expectancy	Useless feature: Hampering	The kind of feedback the systems is displays perceived is hampering, demotivating and is therefore refused	But if you do it like that, my punishment-days, I won't use it. I don't need to be punished, but the one who invented this thinks that he knows better than me.
Performance Expectancy	Useless feature: No interest	Person shows no interest in the presented information	Well, if I think about doing housework, how many minutes do I do this...yes. You know, if you get older it doesn't interest you any more.
Performance Expectancy	No interest: living in presence	Person wants to live in the presence and is therefore not interested in the past or future.	No, actually it doesn't interest me at all. Yesterday is over, i'm living now.
Performance Expectancy	Combination technology - caregiver	Feature / information is only useful if combined with expertise of caregiver / doctor	But well, the feedback will have to be with the family doctor or caretaker. So I can imagine, yes.
Effort Expectancy	Shows understanding	Person explains features of the eWALL, shows	Yes, under "health" you can find your own health, under "sleep" die

		understanding of the particular function	possibilites of or problems with sleep and under "activity" you can see if you have problems with your daily physical activity or if you can move normally. "My day" (day history) is clear, that are the plans for the day, what you are doing during the day.
Effort Expectancy	Lack of understanding	Person doesn't understand feature / information	Well, I think it is too much. That is all this? These are hours. Oh, these are blocks of time. When you accomlished it. Is this interesting to know? Not for the user. I think, of you have three blocks it is enough. One in the morning, one at noon and one in the evening.
Effort Expectancy	Misinterpretation	Person misinterprets things, but in fact thinks that he / she understood correctly	It is wednesday, so it's tuesday... yes. This way I can go back, yes okay. So it is not a schedule. It is a report. ; And then I came back at 10pm. Before that I have also been away, so you have to fill this in all by yourself. Yes, this would be really fun.
Effort Expectancy	Low complexity	The information is displayed in a simple, clear and easy manner, is not too complex	Yes, it is simple. Simple and you can see very fast what you can do and what you cannot do. Some possibilities.
Effort Expectancy	High complexity	The information is displayed in a	Yes, it is a little bit busy. Too much...too

		complex, difficult to understand manner	much things side by side.
Effort Expectancy	Easy handling	Handling of the (section of the) product is easy, simple, intuitive	Yes, the handling is really easy, there are big buttons and you can find and press them easily. I don't have the impression that you can do something wrong here.
Effort Expectancy	Difficult handling	Handling of the (section of the) product is difficult, not self-explanatory, and / or illogical, uncoherent	And then? I have to click on my own? Okay. And you have to do this with the finger?
Effort Expectancy	Easy to master	Person knows how to operate technology properly after one exposure (1x trial and error / first getting an overview), after that initial try operation problems disappear.	To learn to handle it, this is a question of training. Someone would have to deal with it for a while, maybe you have to change this or that, giving this another shape. But it's possible. It's possible. Everyone can do this. It has to be useful for you. Then you also want to learn this.
Social Influence	Privacy concern	Vulnerable data, person don't want it to be shared.	Yes, I did this for some time. But I'm a little bit sensitive with privacy.
Social Influence	Monitoring concern	Person feels violated in his / her personal space, don't want to be monitored.	...and one of the most important things, what I don’t see here at the moment: the on / off button. So that I can decide that I can switch off all this flickering.
Social Influence		To share this information (with doctor / caregiver), no	Yes, because it's really important. You go to a doctor when

	Shareable with (secondary) caregiver	privacy concerns are raised. Sharing is considered useful and important for increasing QoL.	you don't feel good or when you think that there's something wrong with you. Then you have to provide information.
Social Influence	Not shareable with doctor	Vulnerable data, person don't want it to be shared with doctor because it's not of his concern.	Also not [shareable with doctor]. The doctor sees that I eat too much, you don't need an extra machine for this.
Social Influence	Shareable with family	To share this information (with family), no privacy concerns are raised. Sharing is considered useful and important for increasing QoL.	Yes. Yes, because it is really important. Or with your children for example, who come by once per week. Or, if you are really limited, that a caregiver like a housework aid can see how you structured your day and what you roughly did. This makes a big difference that you can track it.
Social Influence	Not shareable with family	Vulnerable data, person don't want it to be shared with family because it's not of their concern.	No, I really won't bother them with that. I won't show this to my children, because they don't like it.
Social Influence	Concern of familiar control	Concern that family will only visit in order to control (with the aid of the eWALL)	If they visit you, they come for coffee and for a talk and not to control you.
Facilitating Conditions	Economic issue	Concerns about cost / benefit ratio, general costs of purchase	You have to mount it on the wall and you have to take the costs of purchase. And this is extremely expensive.
Facilitating Conditions	No implementation of doctor's	Remark that doctors will refuse to use the system due to lack of time, resources etc.	I think that doctors are not willing to lose a part of their income...they think

			that it will shrink their income if they use this systen.
Facilitating Conditions	Too much control of technology	Technology exercises too much control. Participant feels violated in his / her automony / self-determination and therefore refuses technology. He / she wants the control back.	I would like to have it, but I would like to have the results on my computer and then I decide if I forward them. And then I also want to have the possibility to say that I can't do this any more and that it will be forwarded to someone I choose. And what concerns the rest, I don't want it to be viewed from third parties.
Facilitating Conditions	Experience with technology	Remark that person already has existing knowledge of / expertise with technology	Well, I am used to that. Because I have an iPad, I already work with my hands.
Facilitating Conditions	Better alternative available	Refusal to use technology because there's a better alternative available. Alternative is better explained / displayed / accessible, more comfortable	Like I said before: if the eWALL should be for people who think this is easy, then fine. I would rather choose for a nice tablet that is more practical to me.
Facilitating Conditions	Complaint of physical appearance	Complaint of physical appearance or feature: size of screen, height of screen, touch function, radiation, other physical complaints	Okay. And you have to do this with the finger? Because then immediately you get, people are...different people have problems with their eyes. And if you have to stand so close in front of this...