Evaluating the acceptance, usability and perceived potential effect of the ‘Fit at work’ intervention.

An intervention to persuade office workers aged 55 years and older into adopting a healthier physical activity pattern during working hours.

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Date:	16-06-2016

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Abstract

Older people, specifically in the age of 55 years and older, are an important risk group with regard to the development of mental and physical problems (e.g. memory problems and stiffness). Office workers in this age group are specifically vulnerable for these problems, since they often sit a lot during the day. Regular physical activity can reduce the mental and physical problems, slow down the declines of the ageing process and increase the overall work performance. Within the European PEARL project, Roessingh Research and Development (RRD) has developed an intervention in the form of a smartphone application, called 'Fit at work', to persuade office workers into adopting a healthier physical activity pattern during working hours. The application provides physical activity suggestions based on two primary goals, namely: 1. to motivate older office workers to be at least 30 minutes physical active during the workday, and 2. to prevent them from sitting 45 minutes in a row. In this study, the acceptance, usability and potential effect of 'Fit at work' was evaluated with 8 office workers aged 55 years and older during a two week period. To assess the acceptance and usability, questionnaires and interviews (based on the TAM model) were conducted with each individual participant. The potential effect was assessed by means of the Experience Sampling Method (ESM), whereby a short digital question was asked after each physical activity suggestion, and by the use of physical activity data from the Modulus of the Accelerometer output (IMA) from the Promove3D. All data was analyzed on individual level by means of n-of-1 analysis. Outcomes showed that all participants accepted the intervention, perceived it as easy to use, and had the intention to use the intervention. Group effects were perceived, but individual models show no potential effects. There was no direct relation between intention and behavior for the individual participants, which could have different explanations (e.g. inappropriate behavioral intention question, mediating variable). Conducting a larger trial to find out for which people the intervention might work or not, so looking at the characteristics of people, may result in finding individual effect. In addition, adaptations (e.g. lower the frequency of the physical activity suggestions, shorter suggestions) in the intervention are necessary, which are in line with the suggestions of the office workers.

Keywords: Physical activity, 'Fit at work' intervention, Technology Acceptance Model, Acceptance, Usability, Potential effect, ESM.

Introduction

Population ageing is a global trend and refers to the rise of the proportion of the population above 60 years (United Nations, 2015). Due to population aging, the amount of older people in the work sector will increase. From 2001 till 2014 the amount of employees aged between 55 and 65 years old has doubled to 68% (Hertog & Verweij, 2014). To compensate the trend of population ageing in Europe, the time people have to work will gradually prolong. In the Netherlands, this prolonging will be up to 67 years in 2021 (Rijksoverheid, 2016).

In the aging process people face several mental and physical problems, such as memory problems, physical stiffness, fatigue and learning problems (Hildebrandt, Chorus, & Stubbe, 2010; Willey et al., 2016). In 2007, one out of five of the people aged between 55 and 80 years old experienced physical declines (CBS, 2008). In addition, mental and physical declines resulting from the aging process are specifically common among older people who sit a lot during the day, like office workers (Hildebrandt, Chorus, & Stubbe, 2010). The sedentary time at work is probably the main contributor to the overall sedentary time during the day (Cocker et al., 2016). In addition, sedentary time is associated with an increased risk of all-cause mortality and chronic diseases, such as diabetes and cardiovascular diseases (Wilmot et al., 2012). Bernaards et al (2014) stated that on a national level up to 930 million euros can be saved each year if employees become more physically active at work.

The universities of Amsterdam (VU), Maastricht, Groningen, Utrecht, and the Dutch organizations RIVM, TNO and NOC NSF formulated a set of physical activity recommendations to stay physical fit (Kemper et al, 2000). These recommendations are age specific. People aged 55 years and older should at least perform 30 minutes of physical exercise of moderate to vigorous intensity for at least five days per week (Department of Health, 2004). However, 32% of the employees in the Netherlands does not meet these recommendations. A majority of this group are office workers (Bernaards, et al., 2014). This strengthens the need to help office workers to increase their level of physical activity during working hours. Additionally, research shows that physical activity has a positive effect on work performance and quality of work (Pronk et al., 2004; Proper et al., 2002; Proper & van Mechelen, 2008).

From this perspective, several physical activity interventions have been developed for office workers in general. According to Anderson et al. (2009) there are three different approaches to intervene in the daily working lives of office workers: the informative approach, including the use of informative and educational strategies, such as leaflets and flyers.; the behavioral approach, including the change of the psycho social determinants of exercise by for example counselling.; and environmental changes, for example by sit-stand tables (Anderson et al., 2009; Seghers, 2012). These intervention approaches are all aimed to increase the physical activity behaviour of the employees to improve their health and their productivity level at work (Pronk & Kottke, 2009). In general, the scientific evidence on the potential effect of physical activity interventions at work is limited. This because, the effectiveness of these interventions is often not tested due to bad research designs (Proper et al., 2003). Multi strategies interventions (a combination of informative, behavioral, or environmental interventions) are indicated to be the most effective approach to promote physical activity at work, because it becomes easier to make a healthy choice when different strategies are offered to make this possible (Anderson, et al., 2009; Proper et al., 2003).

Due to the physical and mental problems that arise with physical inactivity in office workers aged 55 years and older, and because of the non-availability of existing physical activity interventions that specifically target this age group, there is a need for new physical activity interventions. The European Project PEARL (Platform for Ergonomic and Motivating Age friendly Workplaces) develops and deploys ICT-based motivating and ergonomic age-aware and age-friendly workspaces for office workers aged 55 years and older (PEARL, 2014). Within the scope of this project, Roessingh Research and Development has developed an intervention, called ‘Fit at work’. This intervention aims, to persuade older office workers (aged 55 years and older) into adopting a healthier physical activity pattern during working hours.

An technology based application is developed, which gives the office workers physical activity suggestions during work.

Based on research, it is known that new technology will not simply be accepted and used by people. The process of technology acceptance is influenced by different factors. A study of the literature was conducted to study how the acceptance and use of the technological 'Fit at work' intervention by office workers could be assessed. This literature research showed that the Technology Acceptance Model (TAM) of Davis (1989) is a suitable model to explain technology use. The substantiation of this literature study can be found in Appendix 2. The TAM model is a widely accepted reliable and valid model that predicts the acceptance or adoption of new technologies by end-users (Davis, 1989; King & He, 2006). The central determinants of the TAM model are the Perceived Ease of Use (PEU), which refers to the individuals belief that using a particular system would be free of effort, and the Perceived Usefulness (PU), which refers to the individuals belief that a particular system would enhance the work performance. The PEU and PU are influenced by relevant external determinants and have an influence on the Behavioral Intention (BI) to use a technology (Davis, 1989). For the research model in this study, the external determinants Prior Experience (PE), the earlier experience in using a particular system, and Self-Efficacy (SE), an individual's perception of the degree of difficulty to perform the target behavior, were added to the original TAM model. This because these determinants have a relation with the PEU and are indicated as relevant external variables in the acceptance of eHealth technologies regarding physical activity (Lee et al., 2013, Park et al., 2014). This resulted in the research model in Figure 1, which will be used as a theoretical bases to assess the acceptance of the 'Fit at work' intervention by office workers in the age of 55 years and older. The relations in the research model are studied before and there was found that all of these determinants have a (in)direct influence on the Behavioral Intention (BI), as indicated with the straight line (Figure 1)(Lee et al., 2013).

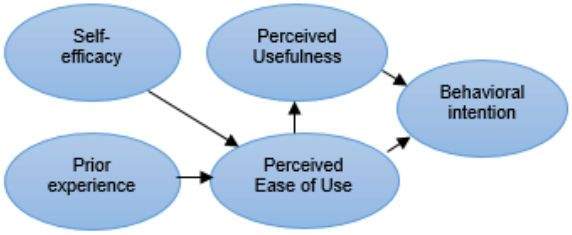

Figure 1. Research model 1 in this study.

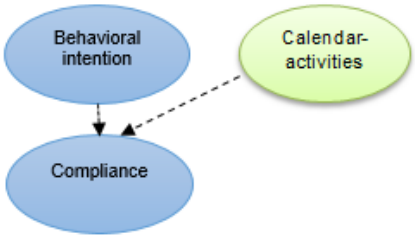

Figure 2. Research model 2 in this study.

Besides, literature stated that intention will not always lead to actual behavior (Sheeran, 2002). Therefore it is important to assess the relation between the BI and Compliance with regard to the physical activity suggestions. Hereby Compliance refers to the degree in which participants actually follow the provided physical activity suggestions, which becomes visible in the participants' physical activity levels. In addition, it is expected that the Calendar-activities of an office worker will also have an influence on the Compliance. This because it is expected that an office worker is not capable of following a physical activity suggestion, when he has an appointment at the time a suggestion is given. For this reason the determinant Calendar-activities is added to the model. The model is represented in Figure 2, which is a new research model, so the relations in this model were not studied before.

The primary objective of this study is to study the 'Fit at work' intervention on its acceptance, usability, and potential effect by office workers aged 55 years and older. To effectively research this objective, both research models were studied. First, the factors influencing the behavioral intention (BI) to use the 'Fit at work' intervention as stated by TAM (Figure 1). This was qualitatively assessed by means of questionnaires and interviews. Second, the two factors that influence the compliance with the physical activity suggestions provided by the 'Fit at work' intervention as stated in Figure 2. Third is, the actual compliance with the physical activity suggestions of the older office workers. The second and third part were quantitatively analysed for each individual participant by means of n-of-1 analysis. The hypothesis is that the BI and the Calendar-activities regarding the physical activity suggestions have a positive relation with the Compliance with the provided physical activity suggestions (Figure 2).

Methods

'Fit at work' intervention

The 'Fit at work' intervention has two main goals, namely: to motivate older office workers to be at least 30 minutes physically active per a day, and to prevent them from sitting 45 minutes or longer in a row. The intervention consists of three components. First, an Android application which provides physical activity suggestions, based on time gaps in the agenda, current physical activity behaviour and a personal predictive physical activity model. The personal predictive physical activity model makes predictions about the activity of the participant at each moment of the day, based on previous recorded data during the baseline period. The personal predictive model predicts the average activity course during the day, and how active the participant will probably be during and around the calendar-items. Second, a dedicated portal, on which participants can monitor their own physical activity in combination with their calendar-activities. Third, a movement sensor, to track the physical activity of the participants. Physical activity suggestions could be received at three moments. First, in an adjoining appointment. Second, in an appointment. Third, no appointment or outside an appointment. The office workers digitally registered their Calendar-activities prior to the use of the 'Fit at work' intervention. In general, the amount of physical activity suggestions participants receive vary, depending on the amount of physical activity of a particular participant. A suggestion could for example be delivered every 45 minutes, based on the second goal of the intervention. A more detailed description of the 'Fit at work' intervention can be found in Appendix 1.

Study design and procedure

The study design was an one group experimental pre- and post-test study. In total it took two working weeks per participant. First, participants were screened for participation by means of purposive sampling by which a set of in- and exclusion criteria are used, which are explained in the 'study population' section. An overview of the whole study procedure is provided in Figure 3. Participants who were eligible for participation followed a pre-test (baseline measurement) for one working week in which they did not

receive any physical activity suggestions (T1, Figure 3). During this period, they only wore a movement sensor to track their physical activity, which was used as input for the intervention provided in the second week. After the pre-test (baseline measurement), the participants used the 'Fit at work' intervention for one working week. Hereby the participants received physical activity suggestions on smart phone provided by the researcher (T2, Figure 3). These suggestions were delivered based on the two goals of the intervention.

In addition to the intervention, the Experience Sampling Method (ESM) was used, which is an ambulatory monitoring method through which information can be obtained regarding the participants feelings, thoughts, actions, context and/or activities (Csikszentmihalyi, Rathunde, & Whalen, 1997). The ESM was hereby build into the intervention, whereby the following confirmative question was asked after a physical activity suggestion was provided: "Are you intended to follow the physical activity suggestion?" The question was answered with either 'yes' or 'no'. After the participants used the intervention and ESM for one working week (intervention period), the post-test was conducted. This test consisted of a questionnaire and an additional interview based on the TAM model, including questions regarding their acceptance towards the 'Fit at work' intervention. The format for the questionnaire and interview can be found in Appendix 3 and 4. An important point with regard to the pre- and post-test is that they were not identical, they were two independent measurements. So, the differences between the pre- and post-test were not studied.

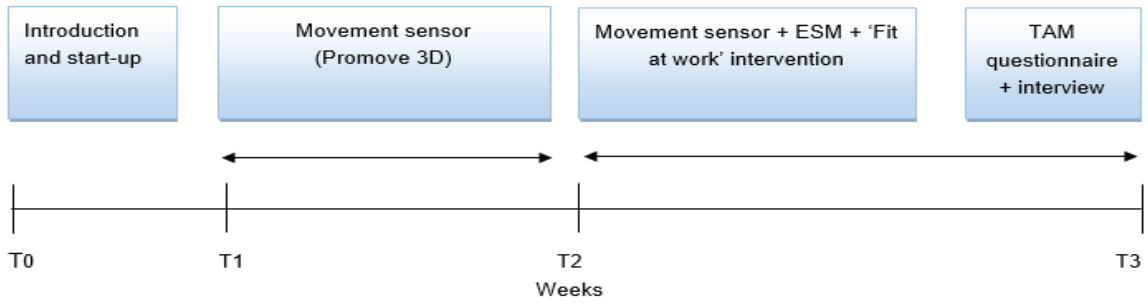

Figure 3. Overview of the study procedure.

Study population

The target group of this study is due to feasibility reasons extended to office workers aged 50 years and older instead of 55 years and older. Eight office workers were selected by purposive sampling to take part in this study. The following inclusion criteria were set: 1. office workers (using a computer for their work), 2. 50 years and older, and 3. working for at least three days (24 hours) a week. In addition, the exclusion criteria: 1. physical impairments that did not allow adequate use of the 'Fit at work' intervention (e.g. paralysis or walking problems), 2. refusing to sign the informed consent.

Table 1 represents the characteristics of the sample. 10 office workers were asked for participation, whereby 2 of them were excluded because they did not work at least three days. The sample consisted of 8 office workers aged 50 years or older, including 7 males and 1 female.

Table 1. *Characteristics of the sample (n = 8).*

Demographics	
Age (years)	
Mean	54
SD	4.1
Range	50 to 62
Gender (n)	
Male	7
Female	1
Profession (n)	
Buyer	2
System administrator	1
System analysist/developer	1
Software developer	1
Lab/office worker	1
Financial director	1
Administrative assistant	1
Amount of working years (years)	
Mean	23
SD	11.5
Range	7 to 38
Experience of physical problems (n)	
Yes	2
No	6

Measures

Acceptance and usability

The Behavioral Intention (BI) to use the 'Fit at work' intervention and factors influencing the BI

The acceptance and usability was assessed by means of the questionnaire and interviews. The BI to use the 'Fit at work' intervention was assessed by a validated questionnaire based on the TAM (T3, Figure 3) (Lee et al., 2013), which was adapted to the focus of this study (Appendix 3). The determinants, as mentioned in research model 1 (Figure 1), Behavioural Intention (BI) regarding the use of the 'Fit at work' intervention, Perceived Ease of Use (PEU) and Perceived Usefulness (PU) of the intervention, and Prior Experience (PE) and Self-Efficacy (SE) regarding the use of mobile applications, were each measured with three different questions per determinant to assess the opinion of the participants regarding the different determinants in relation to the 'Fit at work' intervention. The scores on the TAM questionnaire were assessed with a five point Likert Scale (ranging from 1. strongly disagree till 5. strongly agree). The

questionnaire was pre-tested with fellow students to determine if the different questions were understood as they were intended. It appeared this was the case, so the questionnaire was not adapted afterwards.

Additionally, there was a semi-structured interview to obtain additional information with regard to the answers given in the questionnaire (T3, Figure 3). The answers that were notable (so extremely high or – low scores) were further questioned in the additional interview.

Potential effect

The Behavioral Intention (BI) and Calendar-activities when a physical activity suggestion was provided.
The BI with regard to the given physical activity suggestions of the 'Fit at work' intervention was assessed by the use of the ESM question ("Are you intended to follow the physical activity suggestion?") (T2, Figure 3). This question was asked after each physical activity suggestion.

The Calendar-activities were assessed by scores varying from 0 to 2 (0. no appointment, 1. in appointment, 2. adjoining appointment).

Physical activity with regard to the physical activity suggestions and the 'Fit at work' intervention
First, the physical activity with regard to the provided physical activity suggestions was necessary to assess the compliance rate. This compliance rate with the physical activity suggestions was assessed by the use of the Integral of the Modulus of the Accelerometer output (IMA) from the Promove 3D movement sensor, which is a method for measuring physical activity (T1 and T2, Figure 3). The IMA was measured in counts per minute (10^{-3} m/s$^{2.}$), and based on turn-rate, acceleration and magnetic field intensity. To distinguish physical activity from physical inactivity, a cut-off point needed to be established (Boerema et al., 2016). This cut-off point between physical activity and physical inactivity was set at 1000 counts per minute (10^{-3} m/s^2). The amount of physical active minutes was used as unit of measurement.

Second, the physical activity with regard to the use of the 'Fit at work' intervention. The physical activity of the participants during their work days (7 a.m. – 7 p.m.) in the baseline and intervention week was therefore used. The total amount of physical activity during these weeks was assessed in IMA counts per minute (10^{-3} m/s$^{2.}$).

Data-analysis

The statistical part of this study was done with the software program IBM SPSS Statistics 22 and the open source McKnight time series software package. Descriptive statistical methods were used for the relevant outcome measures, such as the mean, (inter-quartile) range, and the standard deviation. The level of significance in this study was set at $\alpha < 0.05$.

Acceptance and usability

The Behavioral Intention (BI) to use the 'Fit at work' intervention and factors influencing the BI

The scores on the TAM questionnaire were presented for all participants together by descriptive statistical methods, namely mean, standard deviation and range, to display an overview of the overall opinions.

In addition, the interviews were first transcribed before qualitative analysis. After this, a coding tree was developed based on the different determinants of the research model. The descriptive analysis mentioned by Baarda, de Goede and Teunissen (2009) was used for the analysis of the interviews. Hereby the determinants were presented in labels. These determinant labels were further defined into sublabels including the frequencies of positive and negative answers with regard to the determinant. The sublabels derived from topics discussed during the interviews. Additionally, quotes were used to strengthen the statements.

Potential effect

The Behavioral Intention (BI) and Calendar-activities when a physical activity suggestion was provided.
The answers on the ESM question ('yes' and 'no') were counted for each participant separately. To clearly visualize the data for each individual participant, graphs were made including the answers on the ESM question for each physical activity suggestion. Descriptive statistics were used to support the graphs. With regard to the Calendar-activities, it appeared there were no adjoining appointments. Therefore the Calendar-activities were assessed by just two scores (0. no appointment, 1. in appointment), and represented by descriptive statistics.

Physical activity with regard to the physical activity suggestions and the 'Fit at work' intervention
First, the physical active minutes prior to and after a physical activity suggestion were analysed for each participant separately, with an analysed time period of approximately 10 minutes before and after a physical activity suggestion was given. To visually represent the data for each individual participant, graphs were made including the physical active minutes (based on the cut-off point) after each physical activity suggestion. Descriptive statistics were used to support the graphs.

Second, the difference between the physical active minutes prior to and after a physical activity suggestion were determined for all participants together by the use of a paired t-test. In this way there was assessed whether there was a positive difference in physical active minutes after a physical activity suggestion was given. To generally assess if there was a positive difference in mean IMA scores before and after the use of the 'Fit at work' intervention, the difference between the mean IMA scores during the pre-test (baseline) week and the intervention week was also determined by the use of a paired t-test. Furthermore, after conducting these paired t-tests, for both tests the effect of the differences will be assessed. This will be done by calculating the mean difference and dividing this number by the mean standard deviation. According to Cohen (1992), there are small (.20 – <.30), moderate (.30 - <.80) and high effect sizes (> .80).

Third, before testing the relation between the BI and Calendar-activities in relation to the Compliance with the physical activity suggestions, the SPSS Forecasting analysis tool was used to assess autocorrelation (serial dependency) in the different data series. Autocorrelation is a tool for finding repeating patterns and refers to the correlation between values at different points of time (Rabe-Hesketh,

2014). The outcomes were assessed to detect any significant different time lags exceeding 95% confidence intervals. The relation between the BI and the compliance with the physical activity suggestions, and the relation between the Calendar-activities and the compliance was analysed for each participant separately by means of statistical n-of-1 analysis (Figure 2). The n-of-1 analysis is an analysis whereby multiple measurements are analysed which are taken within an individual for a certain period of time (Barlow, Nock, & Hersen, 2009; Morgan & Morgan, 2001). The n-of-1 analysis was conducted by using the open source McKnight time series software package. The software can be used for the analysis of small sample interventions, and assesses small numbers of data points in the total measurement period (McKnight, Mckean, & Huitema, 2000). A full model was tested in which, 1. the score on the ESM question., 2. the Calendar-activities when a physical activity suggestion was given (see 'intervention' section), and 3. the physical active minutes after a physical activity suggestion was provided., were included. This was done to assess the relationships of both the score on the ESM question and the Calendar-activities (independent variables) in relation to the physical active minutes after a physical activity suggestion was provided (dependent variable).

Full models were applied whereby a lag 1 autocorrelation was taking into account for each of the models assessed. In all cases there was no significant autocorrelation, which is the reason why a lag 1 autocorrelation was applied.

Results

Acceptance and usability

The Behavioral Intention (BI) to use the 'Fit at work' intervention and factors influencing the BI

The scores of the TAM questionnaire are presented in Table 2. As shown in the table, all of the mean scores on the questions are ranged between 3 and 4 (3 = Neutral, 4 = Agree). Hereby, the highest overall mean score is for the determinant Self-Efficacy (*M* = 3.92, *SD* = 0.29) and the lowest overall mean score for Perceived Ease of Use (*M* = 3.46, *SD* = 0.29). However, the mean differences between the highest and lowest score are small. When considering the mean scores per question (Table 2) then the highest score is accounted to question 10 regarding Self-Efficacy (*M* = 4.13, *SD* = 0.35) and the lowest to question 9 regarding Perceived Ease of Use (*M* = 3.00, *SD* = 1.07). However, this response rate has to be taken with notice since the response range is between 1 and 4 (1 = Strongly disagree, 4 = Agree). This large response range can also be found for question 4 regarding Perceived Usefulness and question 13 regarding Prior Experiences.

Table 2. *Scores on TAM questionnaire of office workers (n=8).*

	Question	M	SD	Range
Behavioral Intention (BI)				
1.	I will strongly recommend others to use the 'Fit at work' intervention.	4.00	0.00	4 - 4
2.	I intend to use the 'Fit at work' intervention in the next few months.	3.75	0.46	3 - 4
3.	I intend to use 'Fit at work' intervention to assist my exercising during work.	3.75	0.46	3 - 4

	Overall score	3.83	0.31	
Perceived Usefulness (PU)				
4.	I believe using the 'Fit at work' intervention enhances my effectiveness in my exercising during work.	3.75	0.89	2 - 5
5.	I believe the 'Fit at work' suggestions contents are informative.	3.83	0.52	3 - 4
6.	I believe the 'Fit at work' intervention is a useful exercising tool in encouraging physical activity at work.	4.00	0.53	3 - 5
	Overall score	3.71	0.65	
Perceived Ease of Use (PEU)				
7.	I find the 'Fit at work' intervention to be easy to use.	3.88	0.35	3 - 4
8.	I find that interacting with the 'Fit at work' intervention does not demand much attention.	3.50	0.54	3 - 4
9.	I find it easy to combine work and the use of the 'Fit at work' intervention.	3.00	1.07	1 - 4
	Overall score	3.46	0.65	
Self-Efficacy (SE)				
10.	I am confident of using the 'Fit at work' intervention even if there are no manuals for reference.	4.13	0.35	4- 5
11.	I am confident that I can overcome any obstacles when using the 'Fit at work' intervention.	4.00	0.00	4 - 4
12.	I am confident of using different mobile applications to be more physical active.	3.63	0.52	3 - 4
	Overall score	3.92	0.29	
Prior Experiences (PE)				
13.	I enjoy using smartphone apps.	3.63	0.92	2 - 5
14.	I enjoy using smartphone apps regarding physical activity.	3.50	0.76	2 - 4
15.	I am comfortable using smartphone apps regarding physical activity.	3.63	0.74	2 - 4
16.	I am comfortable using smartphone apps.	3.63	0.74	3 - 5
	Overall score	3.59	0.75	

Sixteen topics resulted from the questionnaires and interviews with the participants, which were divided into positive and negative topics. Table 3 represents the topics whereby positive comments were mentioned including the frequencies and some substantiating quotes. The topics with the negative comments are represented in Table **4** in a similar manner.

In general, positive comments were given during the interviews (Table 3). Especially the timing and content of the physical activity suggestions were often positively experienced. In addition, most participants thought that the intervention has a high simplicity and did not demand much attention. Furthermore, almost all participants mentioned the intervention creates awareness and works in a motivating way to become physical active during working hours. Therefore, all of the participants would recommend the interventions to others. Six of them would use the intervention themselves on the long run. However, two participants (male participant C and G) stated that they are already active enough during working hours and therefore did not see the personal added value from using the intervention.

There were also a few negative comments mentioned (Table 4). One participant (male participant F) commented on the timing of the physical activity suggestions and said the times the suggestions were sent could be extended to for example every two hours. Another participant (male participant G)

commented on the length of the suggestions. He thought it would be more effective to formulate them as short as possible.

Table 3. *Positive comments discussed during the interviews and corresponding quotes.*

Topic	**Positive comments *(n)***	**Corresponding quote(s)**
General		
Fun factor	3	*'I like to have insight in my activity pattern. It makes you aware of your physical activity in a fun way.'*
Awareness	7	*'The intervention creates awareness and works in a motivating way.'* *'The intervention made me aware I needed to be physical active, so even when I did not receive suggestions. However, I am also a very active person myself.'*
Content of the physical activity suggestions	8	*'The suggestions were formulated in a clear way'*
Timing of the physical activity suggestions	8	*'The timing was fine, since I did not receive suggestions during scheduled appointments'*
Behavioral Intention (BI)		
Recommendation of the intervention to others	8	*'I would recommend the intervention to people that are not really active themselves since it creates awareness'*
Behavioral intention of the user	6	*'Yes I think I would like to use the intervention again. Maybe not constantly, but during certain periods.'*
Perceived Usefulness (PU)		
Usefulness of the tool	5	*'I found the physical activity suggestions useful.'*
Motivation to be physical active	5	*'Yes the intervention works in a motivating way. You become aware of the fact that you for example sat down for too long.'*
Perceived Ease of Use (PEU)		
Simplicity of the intervention	7	*'I am not a technician, but this is just easy to use. Understandable and user friendly'*
The degree of attention	2	*'The intervention did not demand much attention.'*
Self-efficacy (SE)		
Use of the manual	8	*'I did not use the manual since it was not very difficult to use the intervention.'*
Adherence		
Adherence to the physical activity suggestions	4	*'If possible, I tried to become active after I received a suggestion.'*

Table 4. *Negative comments discussed during the interviews and some corresponding quotes.*

	Negative comment (*n*)	Corresponding quotes
General		
Online portal	4	*'Due to busyness at work, I did not have the time to look at the online portal.'*
Clothing	1	*'It is not possible to wear all kinds of clothes when you have to wear these systems. A skirt is for example not an option with this sensor.'*
Content of the physical activity suggestions	1	*'The suggestions are a bit long, I think, it would be more effective to formulate them as short as possible.'*
Timing of the physical activity suggestions	3	*'It is simply not possible to become physically active after each 45 minutes.'*
Activity pattern	2	*'Due my busy schedule it is simply not possible for me to become more active then I already am now.'*
Behavioral Intention (BI)		
Behavioral intention of the user	2	*'I am already aware of the fact that I need to be physically active.'*
Perceived Usefulness (PU)		
Usefulness of the tool	1	*'Since I am already active, the intervention is not very useful for me.'*
Perceived Ease of Use (PEU)		
Simplicity of the intervention	1	*'The systems did not always worked the way it should, so the use of the intervention was not very simple for me.'*
Adherence		
Adherence to the physical activity suggestions	2	*'Often I received suggestions at an inconvenient time, for example when I was in an unscheduled conversation'* *'Due to my busy schedule it was often not possible to became active immediately, so I answered no.'*

There were also a few suggestions mentioned with regard to the intervention (Table 5). Almost all participants said it would be easier and less obtrusive when the movement sensor would be integrated into the smartphone, so you only have to carry your own smartphone in order to use the intervention. One other participant (male participant A) suggested to add a game element to the intervention, for example to compare your results with colleagues/others. In addition, two participants (male participant A and D) also had some technical problems (e.g. lost connection with the movement sensor, not received a signal when a physical activity suggestion was given) with the equipment and mentioned that it is highly important to make sure that the provided equipment works as it is intended. Additionally, one participant (male participant B) mentioned that the week-page could be improved, since only the activity levels of the previous day became visible instead of the entire week. Remarkable was also the fact that only one of the participants (male participant F) had used the online portal. The other seven participants did not use the portal, because they simply did not had enough time or did not saw the added value of the portal.

Table 5. *Suggestions for the improvement of the 'Fit at work' intervention discussed during the interviews.*

	Answers *(n)*	**Corresponding quotes**
Suggestions		
Integration	5	*'It would be easier and less obtrusive when the systems would be integrated into one system.'*
Social aspect	1	*I would like to compare myself with other colleagues.'*
Week-overview	1	*'It would be better when I could see my activity levels for the entire week instead of just the previous day. '*
Switch-button	1	*'I suggest to improve the switch between the day and week button, since this was a bit unclear'.*

Potential effect

The Behavioral Intention (BI) and Calendar-activities when a physical activity suggestion was provided.

For each participant a graph is made including the answers on the ESM question for each physical activity suggestion and the total amount of 'yes' scores. The graphs of male participants B and F are shown in Figure 4 and Figure 5, because these were two of the most remarkable ones. The graphs of the other participants can be found in Appendix 5. The lowest percentage of 'yes' scores after a provided physical activity suggestion was for participant B with 6.7%. This is also in line with his comment in the interview: 'Due to busyness it was often not possible to become active immediately, so I answered no'. The highest percentage of 'yes' scores was for participant D with 77.8%, who mentioned: 'The activity suggestions were useful'. In general, the amount of physical activity suggestions also varied among the participants, indicated with a range from 3 till 25 provided suggestions. Just 3 suggestions were delivered to participant E, who mentioned: 'The intervention made me more aware I needed to be physical active, so I became more physically active even when there were no received suggestions. However, I am also a very active person myself'.

With regard to the Calendar-activities, participants A, B, D, E and H had no appointments or only received physical activity suggestions outside appointments. The percentages of the participants that did receive a suggestion during an appointment were relatively low (participant C: 26.3%, participant F: 24%, participant G: 20%).

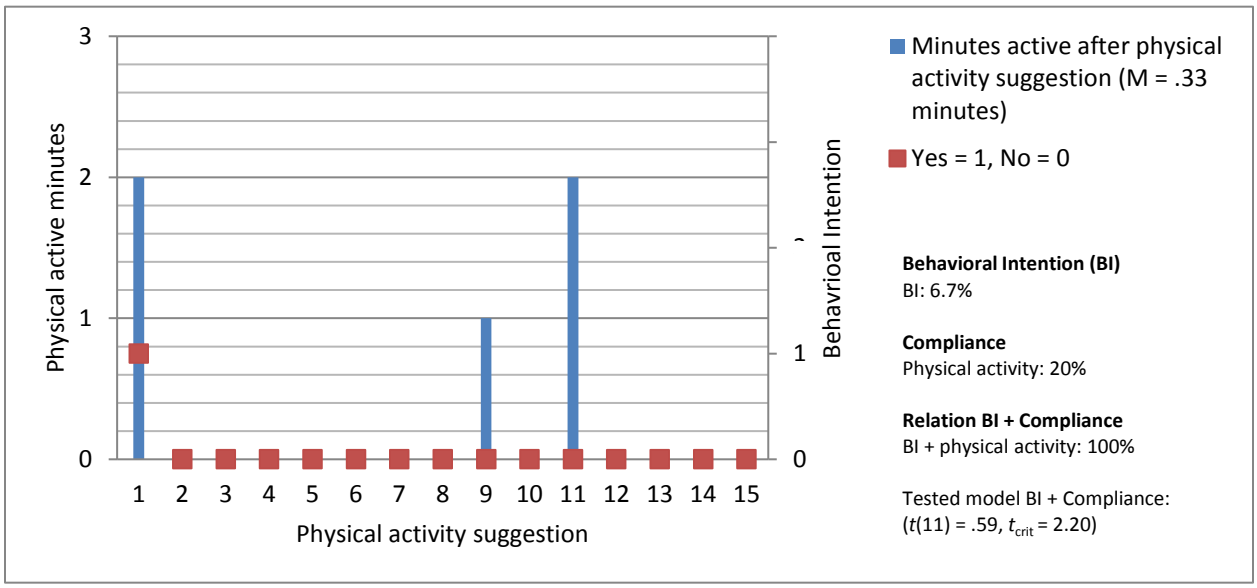

Figure 4. The Behavioral Intention and Compliance with regard to the given physical activity suggestions for participant B.

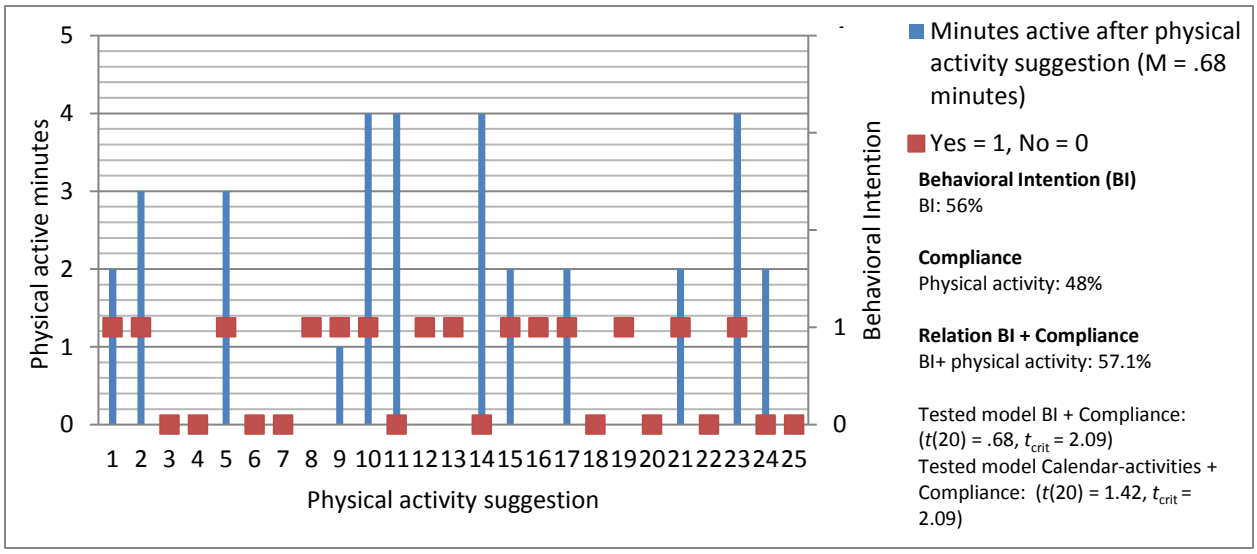

Figure 5. The Behavioral Intention and Compliance with regard to the given physical activity suggestions for participant F.

Physical activity with regard to the physical activity suggestions and the 'Fit at work' intervention

The physical active minutes after each physical activity suggestion is displayed in the graphs (Figure 4, Figure 5, Appendix 5) together with the percentage of physical activity and the average minutes of physical activity. The lowest percentage of physical activity after a provided physical activity suggestion was for participant B with 20%. This is also in line with his comment: 'Often I received suggestions at an inconvenient time, for example when I was in an unscheduled conversation'. The highest percentage was for participant H with 66.7%, who mentioned in the interview: 'The timing was fine, since I did not receive suggestions during scheduled appointments'. Furthermore, participant B had the lowest number of active

minutes after a provided physical activity suggestion (*M* = .33 minutes). The highest number of active minutes was for participant H (*M* = 1.11 minutes).

Furthermore, as can be seen in the different graphs, it is remarkable that some participants did not always become physically active within ten minutes even when they answered the ESM question with 'yes' (Figure 4, Figure 5, Appendix 5). The lowest percentage of physical activity together with a 'yes' score on the ESM question was for participant C with 27.3%. The highest percentage was for participant B and E with 100%.

Next, for all participants together was analysed if there is a positive difference in physical active minutes before and after a physical activity suggestion was provided. Under the applied level of significance (*p* = .05) there is a significant increase in mean active minutes after a physical activity is provided (*M* = .30, *SD* = .33) compared with before (*M* = .77, *SD* = .33) for this group of participants (*t*(7) = -2.68), *p* = .03). The calculated effect is high (*ES* = 1.42). However, the mean active minutes after a suggestion (*M* = .77) is still below a value of 1. In addition, there was investigated whether there is a positive difference between the mean IMA scores during the baseline week and intervention week. Under the applied level of significance (*p* = .05) there is a significant increase in total mean scores during the intervention week (*M* = 266.74, *SD* = 80.42) compared with the baseline week (*M* = 232.04, *SD* = 83.96) for this group of participants (*t*(7) = -2.73, *p* = .03). However, the calculated effect is moderate (*ES* = .42).

Finally, for each participant the model was tested. The results are displayed in Table 6, but also in the graphs of the participants (Figure 4, Figure 5, Appendix 5). Since participant A, B, D and H only received physical activity suggestions outside appointments or had no appointments at all, the variable calendar-activities was excluded from these models. For participant A, B, D and H, the model shows there are no significant relationships over time, based on the t-value in relation to the critical t-value, of the score on the ESM question ('yes' or 'no') in relation to the physical active minutes after a provided physical activity suggestion. As there were no significant relationships, the hypothesis was disconfirmed for these participants. For participant C and F the model shows there were no significant relationships over time of the score on the ESM question or the Calendar-activities in relation to the physical active minutes after a provided physical activity suggestion. The hypothesis was for that reason also disconfirmed for these participants. Since participant E received only 3 physical activity suggestions, there was no model tested for this participant. In addition, the model was also tested for participant G. However, the model could not been performed in the program due to a too discrete response rate, which indicates that there was less variety in answers.

Table 6. *Results of the tested models for all participants (n = 8).*

	***t* (Behavioral Intention)**	***df* (Behavioral Intention)**	**t_{crit} (Behavioral Intention)**	***t* (Calendar-activities)**	***df* (Calendar-Activities)**	**t_{crit} (Calendar-activities)**
Participant A	-.70	15	2.13	-	-	-
Participant B	.59	11	2.20	-	-	-
Participant C	1.93	14	2.15	.41	14	2.15
Participant D	.98	8	2.31	-	-	-
Participant E	-	-	-	-	-	-
Participant F	.68	20	2.09	1.42	20	2.09
Participant G	-	-	-	-	-	-
Participant H	-.29	5	2.57	-	-	-

* If the t-value is above the critical t-value there is a significant result.

Discussion

This study was aimed at evaluating the 'Fit at work' intervention by assessing the acceptance and usability of office workers aged 55 years and older, and to study the potential effect on physical activity levels during the working day.

With regard to the acceptance and usability, almost all participants judged the 'Fit at work' intervention as positive. However, while some participants judged the intervention to be effective in increasing physical activity during work, and perceived it easy to combine work and the intervention, others were less positive regarding these aspects. From the interviews it became clear that some participants think that the intervention is less effective in a work setting, because it is often hard to become physical active at work due to busyness, unforeseen appointments and phone calls. On the other hand, all participants would recommend the intervention to others since it creates a sense of awareness and works in a motivating way to become physical active during working hours. In addition, participants were positive regarding the timing, content, and simplicity of the intervention. Almost all participants were also intended to use the 'Fit at work' intervention themselves, because of the aforementioned reasons. Next to their experiences, they also mentioned a few suggestions for improvement, such as lower the frequency of the physical activity suggestions, shorter suggestions, integration of the movement sensor into the smartphone, the addition of a game element (e.g. comparison with colleagues), and resolving the technical problems.

After assessing the acceptance and usability, the potential effect of the physical activity suggestions was studied. The BI to adhere to a provided physical activity suggestion varied a lot between and within participants. A variation within and between participants was also seen with regard to the compliance (the physical active minutes after a provided physical activity suggestion). In general, the physical active minutes after a provided suggestion were relatively low. Remarkable was that some of the participants did not always become physical active even when they said they intended to follow the physical activity suggestion. This could be explained by the data from the interviews, since participants mentioned it was not always possible to become physical active due to organizational factors, even when they said that they were intended to follow the suggestion. Furthermore, there cannot be said something about the Calendar-activities in relation to the compliance, because almost all participants only received physical activity suggestions outside appointments or had no appointments at all. It appeared the 8 participants conduct a lot of independent work, so it could be that the Calendar-activities do play a role for people who work more together. Overall, a potential effect of the intervention was perceived on group level, but on individual level there were no resulting effects. With regard to the level of physical activity for all participants as a group, it appeared the use of the intervention resulted in more physical activity compared to the baseline week. Furthermore, on group level the amount of physical active minutes after a physical activity suggestion is also higher compared to before. However, on individual level, on average in less than 50% of the provided physical activity suggestions, immediate physical activity was measured. This indicates that the suggestions do not always immediately result in physical activity, but they do contribute to a general increase in physical activity of the participants. Apparently, not the specific suggestions, but the intervention in general increases the awareness of the participants, which results in

more physical activity. The hypothesis in this study was that the BI and the Calendar-activities regarding the physical activity suggestions have a relation with the Compliance with the provided physical activity suggestions. This hypothesis was disconfirmed for all individual participants.

In general, this study builds on previous findings. One important aspect is the intention-behavior gap, which is a topic of considerable contemporary studies. Most of the models that are used to assess physical activity suggest that BI is the main contributor of actual behavior (Davis, 1989). However, various studies indicate that the intention to become physical active will not always result in actual physical activity (Rhodes & de Bruijn, 2013; Sheeran, 2002; Sniehotta, Scholz & Schwarzet, 2005). In this study there could be a relation between intention and behavior, but not a direct one. When assessing the acceptance and usability, all participants had a positive BI regarding the use of the 'Fit at work' intervention, but at the end there were no resulting significant individual relations between the BI and the Compliance. However, on group level the physical activity increased. An explanation for this could be, that participants sometimes said not to become active, but did it anyway. In addition, the question asked to the individual participants to measure the BI could be inappropriate. The participants mentioned organizational factors (e.g. phone calls, unforeseen appointments) as important contributors for no compliance to the physical activity suggestions. These factors may influence the relation between intention and behavior. Furthermore, many different studies regarding physical activity are focused on group level (Anderson et al., 2009; Pronk & Kottke, 2009; Segher, 2012). This study provides another view by focussing on the individual level, whereby it becomes possible to obtain more specific information about the individuals' perception regarding the effectiveness of an intervention, in order to tailor an intervention more to the individual level (O'Lillie et al., 2011). In this study, the diversity between individuals regarding their intention to use the intervention and their compliance became visible. However, no clear causes of this diversity could be pointed out. In addition, by looking at the individual level, it became clear that finding effects on group level not guarantees effects on individual level. In general, this study is a contribution to the effectiveness studies regarding physical activity interventions at work, which is now still limited (Proper et al., 2003).

There are also some limitations in this study which should be considered in further research. First of all, the low amount of provided physical activity suggestions could have resulted in not finding relations between the BI and Calendar-activities in relation to the Compliance with the suggestions for the individual participants. It could be that there were no found relations due to a low power of the model as a result of few values. MCKnight et al. (2000) did not mention any guidelines regarding the number of values required for the individual analysis, but enlarging the number of values within an individual should be considered when conducting an evaluation study focused on individual participants. Second, the analysed time period of physical activity before and after a provided physical activity suggestion was set at ten minutes. However, a suggestion for further research could be to expand the analysed time period (e.g. fifteen minutes) in order to prevent missing physical active minutes. Third, the movement sensor did not always register the data due to connection problems. This resulted in missing values for the comparison of the baseline week and the intervention week, which was solved by working with mean week scores. Fourth, the developed research model for this study does not seem to fit, since there were no relations found between the different determinants of the model (BI, Calendar-activities, Compliance).

With regard to further research, organizational factors should be considered as a mediating variable between the intention and actual physical activity behavior of the office workers.

Overall, all participants accepted the ‘Fit at work’ intervention and had the intention to use it. However, it appeared this intention is not directly related to the physical activity behavior for the individual participants. The individual models show no potential effects, but a potential effect of the intervention on group level was perceived. Concluding, conducting a larger trial to find out for which people the intervention might work or not work, so looking at the characteristics of people, may result in finding individual effects. In addition, adaptations in the intervention are necessary, which are in line with the suggestions of the office workers.

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Appendix 1: ‘Fit at work’ intervention

The ‘Fit at work’ intervention is developed for office workers (aged 55 years and older) with the aim to persuade them into adopting a healthy physical activity pattern during working hours. The intervention consists of: 1. an Android application which gives physical activity suggestions (Figure 1), 2. a dedicated portal, on which they can monitor their own physical activity in combination with their calendar items (Figure 2), and 3. a movement sensor, to track their physical activity (Figure 3).

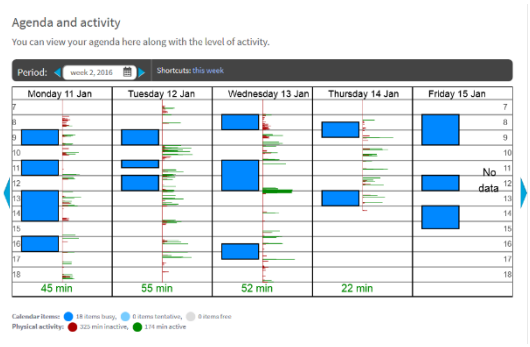

Figure 1. Android application *Figure 2.* Dedicated portal *Figure 3.* Movement sensor

Currently, the ‘Fit at work’ intervention is presented in an application and is installed on a smartphone. All participants will receive a smartphone with this application from the researcher when participating in this study. Eventually, the application will be downloadable via each Android phone, but this is not feasible for this study, since the ‘Fit at work’ intervention is still under development.

The Android application will be active during the work day of the participant. To make this possible the participant can fill in his/her work days. The application provides physical activity suggestions based on the two primary goals, namely: 1. to motivate older office workers to be at least 30 minutes physical active during the workday, and 2. to prevent them from sitting 45 minutes (or longer) in a row. To provide these suggestions in a smart way, the physical activity suggestions are based on three inputs: 1. the calendar-items of the participant, 2. the actual physical activity behaviour, and 3. a personal predictive exercise pattern. To efficiently and effectively provide these physical activity suggestions, the participants need to keep their Outlook or Google calendar up to date, as this information will be used to provide smart physical activity suggestions. Furthermore, the actual physical activity behavior of the participant will be measured by a movement sensor (Promove 3D), which the participant will receive from the researcher. This movement sensor needs to be worn on the hip to obtain the most reliable information. Additionally, the application uses a personal predictive exercise pattern, which makes predictions about the activity of the participant at each moment of the day. The model is based on previous recorded data of the participant. Therefore, the predictions will become more and more detailed after more data is obtained. The personal predictive pattern predicts the average activity course during the day, and how active the

participant will probably be during and around the calendar-items. The 'Fit at work' application is installed on a phone, therefore it is necessary to take the phone with you during the day.

In addition to the physical activity suggestion, the participants have the opportunity to monitor their own physical activity behavior via a dedicated portal (Figure). This physical activity pattern is provided in combination with their calendar items. On the portal, a week and a month view is provided. The calendar is displayed with blocks, in which the content of the item is shown. The minutes a participant was active is displayed in the graph with either a green (active) or a grey line (inactive). The amount of active minutes is displayed for each day at the bottom of the day in grey.

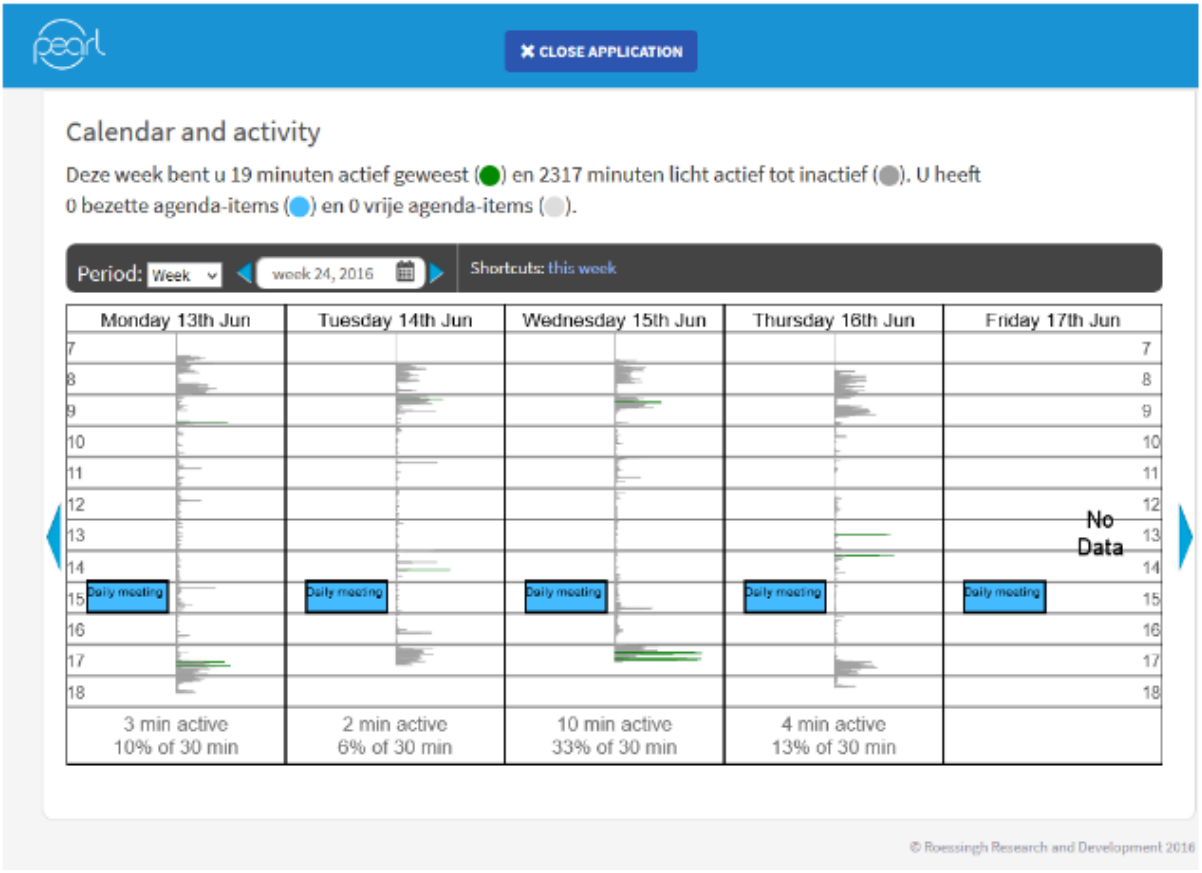

Figure 4. Overview of the dedicated portal.

Procedure

When starting up the Android application the home screen becomes visible (Figure 1) through which the physical activity of the participant is shown in combination with his/her calendar-items. As mentioned above, the participant receives the following two physical activity suggestions based on the two goals of the intervention (1. to motivate older office workers to extend their number of physical active minutes to at least 30 minutes a day, and 2. to prevent them from sitting 45 minutes or longer in the same position):

1. "This would be a good moment to be active, to work on your 30 minutes of physical activity for today."

2. “You have sat down for 45 minutes or longer now, it would be good moment to become active”.

To provide some guidance in what kind of activities could be done based on these two physical activity suggestions, a suggestion button, including suggestions for physical activities, is added into the intervention. When the user clicks on this button, a couple of specific activities will be mentioned relevant for that moment of the day. In this way some options are given for what kind of activities can be done (Table 1, Table 2). These options differ during the day, since some activities are time-bounded. In general, two general physical activity suggestions will be given with additionally the time-bounded suggestions. The user can choose which activity he/she likes to perform, since the activities are always a suggestion, so it is up to the participant if he wants to perform one of the mentioned activities or if he prefers something else. In Table 1 and Table 2 the different lists of activities are displayed which will be represented during the day under the suggestion button. These activities are created based on a combination of the results of a previous study within the PEARL project and also own input.

Table 1. *General physical activity suggestions.*

General physical activity suggestions
“Walk to a colleague instead of sending an e-mail.”
“Take the stairs instead of the elevator.”
“Get something to drink.”
“Use a small glass or cup.”
“Use the furthest coffee machine.”
“Use the furthest printer.“
“Use the furthest toilet.”

Table 2. *Time-bounded physical activity suggestions.*

Time-bounded physical activity suggestions	
Time	*Suggestion*
Whole day except between 12:00 PM - 14:00 PM	“Take a short walk during the coffee break.”
12:00 PM - 14:00 PM	“Take a lunch walk.“
12:00 PM - 14:00 PM	“Have lunch at a different location.”
End of the workday	“Go by foot or bike to work tomorrow.”
End of the workday	“Park your car tomorrow on the furthest parking lot.”

Appendix 2: Theoretical substantiation

Technology adoption models

A literature search is conducted to find a suitable adaptation model for the evaluation of the 'Fit at work' intervention. The database Scopus and PubMed were mostly used for this. The search strategy for relevant technology adoption models is displayed below in Table 1.

Table 1. *Search strategy for technology adoption models.*

Search term	**Number of relevant articles**
'adoption models' and 'eHealth technology'	52 articles on Scopus
'adoption models' and 'eHealth technology' and 'employees'	0 articles on Scopus
	1 article on PubMed
'adoption models' and eHealth technology' and 'exercise interventions'	0 articles on Scopus or PubMed
'adoption models' and 'technology' and 'employees'	280 articles on Scopus
➔ Addition: 'exercise'	
	8 articles on Scopus

To find out which adaptation models are commonly used within eHealth technology, there was sought on the terms 'adoption models' and 'eHealth technology'. The resulting articles were scanned on their titles and on the used adoption models. Based on this, the relevant abstracts were read, and after this only the real relevant articles were completely read. An adoption model that was often mentioned was the Technology Acceptance Model (TAM) or a variation on this model. To reduce the amount of articles and search more specific, there was then sought on the terms 'adoption models' and 'eHealth technology' and 'employees'. The adoption model used in the one resulting article was the Concerns-Based Adoption Model (C-BAM). This model was originally developed for the purpose of implementing change and innovations within a certain school system. In this article, this was the first time the model was used within eHealth technology in a rural nursing home setting. The results of the study suggest that the model could be useful, but there has to be done more research to make this more clear (Armer, Harris, & Dusold, 2004). Since the limited amount of research around this model in the field of eHealth technology, the model was eliminated for this research. There was then searched some other terms, but did not brought any resulting articles. Next, there was sought on the terms 'adoption models' and 'technology' and 'employees'. To limited this amount, the term 'exercise' was added. This The most often used model in the resulting 8 articles was the original TAM model, which was used in 4 of the articles. The results of the conducted studies in the articles supported the original TAM model as a useful basic model in the adoption process of technology (Hopp & Gangadharbatla, 2016; Park et al., 2014; Kim et al., 2010). Additionally some of these studies suggested the extension of the original TAM model with some relevant external variables (Park et al., 2014; Kim et al., 2010). Next, a further search was conducted specifically with regard to the TAM model.

TAM model

Based on the times the TAM model was mentioned in previous studies regarding adoption of (eHealth) technology, also among employees, there was specifically sought on the TAM model. The search strategy for the TAM model is displayed below in Table 2.

Table 2. *Search strategy for the TAM model.*

Search term	**Number of relevant articles**
'Technology Acceptance Model' and 'meta-analysis'	49 articles on Scopus
'eHealth technology' and 'perceived usefulness' and 'perceived ease of use'	3 articles on Scopus
'Technology Acceptance Model' and 'exercise interventions'	6 articles on Scopus 1 article on PubMed

General

There was sought on the terms 'Technology Acceptance Model' and 'meta-analysis'. This is how the meta-analysis of King and He (2006) of the TAM model was found. In this article was referred to the article of Davis (1989), the developer of the original TAM model, and to the article of Davis et al. (1989). The TAM model is a widely accepted reliable and valid measure that predicts the acceptance or adoption of new technologies by end-users (Davis, 1989; King & He, 2006). The central determinants of the TAM model are the perceived ease of use (PEU) and the perceived usefulness (PU). The accumulated body of knowledge regarding contingent decision behavior, self-efficacy and adoption of innovations provides theoretical support for the determinants PEU and PU as key determinants of behavior (Davis, 1989; Hill et al., 1987; Larcker & Lessig, 1980; Hauser & Simmie, 1981). The PEU and PU are influenced by relevant external determinants and have an influence on the attitude, intention and behavior to use a technology (Davis, 1989). The TAM model is an often used model to measure technology acceptance (King & He, 2006). The research of Davis et al. (1989) suggests the TAM model as a possibility of a simple and powerful model of the determinants of user acceptance and adaptation. The review of Holden and Karsh (2010) determines that variations on the TAM model like for example the UTAUT model of Venkatesh et al. (2013), which added different constructs to the original TAM model, are often seen as to broad and complicated in determining technology adoption since often not all the constructs actually have an influence on the acceptance or adoption. It is therefore better to specify to specific relevant determinants. King and He (2006) conducted a meta-analysis of 88 TAM studies and found that there is powerful large-sample evidence that the TAM determinants PEU and PU are highly reliable in predicting the intention and actual behavior regarding technology use and may be used in a variety of contexts. Since the intention is thought to be a reliable way of predicting the actual use, behavioral intention is often the only measured outcome. There was also found that PEU is a strong predictor of PU. This shows that the more a technology is perceived as easy to use, the more likely it will be perceived as useful (Davis et al., 1989; Kim, Park, & Morrison, 2008). The significant relationship between PU, PEU, and the behavioral intention and actual behavior is determined in several studies (Kim et al., 2010; Paré et al., 2006; Schaper & Pervan, 2007). These studies were referred to in the review of Holden and Karsh (2010).

TAM model and eHealth technology

To see if this was also the case for specifically eHealth Technology, there was sought on the terms ‘eHealth technology’ and ‘perceived usefulness’ and ‘perceived ease of use’. One of the resulting articles was the study of Dünnebeil et al. (2012). In this study determinants were identified within the TAM constructs that have the strongest evidence to determine the intention to use eHealth interventions. There was found that PEU is an extremely strong predictor of PU. With extremely strong is meant a significance level below 0.001. Also was found that PEU is extremely strong and PU is strong in predicting the intention and actual behavior regarding eHealth technology. With strong is meant a significance level below 0.01 (Dünnebeil et al., 2012). In this article is referred to the review of Holden and Karsh (2010). They reviewed studies whereby the TAM model was used as a model in the adoption of eHealth technology. Results in this study also indicate a direct significant association of PEU on PU in ten of the twelve studies involving these determinants. Additionally a direct significant association of PU on the intention to use eHealth technology was found in all investigated studies (Holden & Karsh, 2010).

TAM model and exercise interventions

To find if the TAM model is also useful in determining the adoption to exercise interventions, there is sought on the terms ‘Technology Acceptance Model’ and ‘exercise interventions’. One of the resulting articles was the article of Cranen et al. (2011). In this study the TAM model was used in the investigation of patients perceptions regarding a web-based eHealth service for instruction and monitoring of an exercise program. The results show a significant greater change on the constructs of perceived usefulness and perceived of use for the patients that used the web-based eHealth service. This indicates that the perception of patients regarding the usefulness of the technology and the effort to learn and use the technology were more positive after using the eHealth service (Cranen et al., 2011). Relations between the PEU and PU in relation to the behavioral intention and actual behavior can be assumed, but to really make statements about the intention and behavior Cranen et al. (2011) suggests the inclusion of a few relevant external variables to better predict the actual adoption of the eHealth technology. In this study just the original TAM model was used. Another study found was the study of Varnfield et al. (2011) that evaluated the usability and adherence to the Care Assessment Platform (CAP). The CAP is an integrated home-based cardiac rehabilitation (CR) model incorporating mobile phone and web applications and providing all of the important components of CR, such as physical activity and exercise training. The mobile phone modalities were found easy to use and preliminary results showed high usage rates and acceptance of the eHealth technology. The TAM model or any other model was not used in this study, but based on this there seems to be a relation between the determinant PEU and the actual usage of the eHealth technology. Also the study of McMahon (2016) was found. This study included the determinants PEU, PU and the behavioral intention of the TAM model to evaluate the experience of older adults with regard to a monitor to self-track their physical activity. There were significant differences indicated at 10 weeks and 8 months for the determinants PEU and the intention to continue using the self-tracker. The direct relationships between the determinants were not studied, but since there were found high levels of PU and PEU and behavioral intention, it could be that these high levels of PU and PEU in turn led to high levels of the behavioral intention. This since the relation of the determinants PU, PEU and behavioral intention is determined in the studies mentioned before regarding technology and eHealth technology (Davis et al., 1989; Dünnebeil et al., 2012; Holden & Karsh, 2010; King & He, 2006).

Based on the above mentioned literature there is ground that the TAM model is a useful model in the acceptance and adoption of eHealth technology. Also there is found that the TAM model is used with the evaluation of eHealth exercise interventions and could be useful. Next, there is sought more specific on relevant determinants which could be added to the original TAM model.

Addition relevant determinants

To gather more information about adoption of exercise interventions, other literature is consulted. The search strategy for the addition of relevant determinants is displayed below in Table 3.

Table 3. *Search strategy for relevant determinants*

Search term	**Number of relevant articles**
'Technology Acceptance Model' and 'prior experience' and 'self-efficacy'	18 articles on Scopus
'eHealth technology' and 'prior experience'	9 articles on Scopus
	23 articles on PubMed
'eHealth technology' and 'self-efficacy'	13 articles on Scopus
	4 articles on PubMed

Relevant determinants exercise and technology

In the book of Morrison and Bennett (2012) is mentioned that the Theory of Planned Behavior (TPB) is an often used model in explaining and predicting the intention and actual exercise behavior. It is a promising framework for the study of exercise because it includes beliefs about control of factors that would facilitate or inhibit carrying out exercise. In the book is referred to a meta-analysis of exercise behavior among healthy populations conducted by Hagger et al. (2002). In this meta-analysis the constructs of the Theory of Reasoned Action (TRA) and the TPB were analyzed in 72 studies about exercise behavior. The results of this meta-analysis indicate that the determinants self-efficacy and prior experience regarding exercising are important predictors for the intention to exercise (Hagger et al., 2002). Also, the review of Blue (1995) was found by the book of Morrison and Bennett (2012). Here 23 studies were analyzed and the results show that the determinant prior experience was again mentioned as an important predictor for the intention to exercise (Blue, 1995).

According to the TAM model, relevant external determinants can directly influence the PEU and PU and in this way indirectly the attitude, intention and behavior (Davis, 1989). The above literature about exercising based on the TPB suggests that the determinants self-efficacy and prior experience can be useful determinants with regard to exercising. Based on this, there is sought on the terms 'Technology Acceptance Model' and 'prior experience' and 'self-efficacy'. One of the resulting articles was the article of Lee, Hsieh and Chen (2013). This article applied the TAM model to determine the use of e-learning systems by employees in organizational organizations. The articles mentioned in the section below are found in the reference list of the article of Lee et al. (2013). The article of Park et al. (2014) was assessed earlier under the general section. With regard to employees four important variables are identified as they have a significant influence on the employees' PU and PEU. First, organizational support is significantly associated with PU and PEU. Lee et al. (2013) indicate that given the assistance and other resources from the top management, employees are more likely to believe that

technology is useful and easy to use. The significant association between organizational support and PU and PEU was also found in the study of Park et al. (2014). In this study the factors that affect employees' acceptance and use of teleconferencing systems for work-related meetings in business settings. Second, self-efficacy regarding technology use is positively associated with PEU. Employees with a high computer self-efficacy had higher expectations to use computers for the performance of their jobs (Lee et al., 2013). Park et al. (2014) again found also a significant relationship between self-efficacy and PEU in his study. Concluding, when people are confident that they can work with a certain technology, this will positively influence the PEU. However, when people are not confident that they can work with a certain technology, this will negatively influence the PEU (Kwon et al., 2007). Third, prior experience regarding technology use has a significant effect on PEU and PU. When people have prior experience with a certain technology, they are more likely to perceive the technology as easy to use and useful (Lee et al, 2013). Fourth, the determinant task equivocality has a significant effect on PU. Task equivocality refers to the level of ambiguity or confusion that occurs during the task (Daft et al., 1987). This is mainly the case for experienced older employees (Lee et al., 2013). According to Dishaw and Strong (1999) experienced older employees choose more often tools, like technologies, that accomplish their tasks more efficiently.

Relevant determinants eHealth technology

The study of Lee et al. (2013) suggests that the determinants organizational support, self-efficacy, prior experience and task equivocality have significant associations with the PU and PEU with regard to the adoption of technology among employees. The determinants self-efficacy and prior experience regarding exercising are also mentioned as important determinants with regard to adoption of exercising behavior (Hagger et al., 2002; Blue, 1995). Although, the exercise intervention in this study is aimed at eHealth technology. Therefore the literature was again used to search if these determinants are also mentioned in the adoption of eHealth technology. For the determinant prior experience there was searched on the terms 'eHealth technology' and 'prior experience'. One of the articles looked at the prior experience as an factor in the acceptance of an eHealth intervention among HIV and sexual health and indicated that it is an important determinant in the adoption of eHealth technology (Muessig et al., 2015). The study of Dünnebeil et al. (2012), which is mentioned earlier, indicated prior knowledge about eHealth technology as a moderate predictor of mainly PEU within the TAM model. With a moderate predictor is meant a significance level below 0.05. Cranen et al. (2011) also states that when patients do not have prior experience with innovative eHealth technology, offering patients a risk-free way to experiment and explore an eHealth technology can increase the development of accurate perceptions of use.

For the determinant self-efficacy there was searched on the terms 'eHealth technology' and 'self-efficacy'. After scanning, one article seemed relevant with regard to self-efficacy in the adoption of eHealth technology. In the study of Hoaas et al. (2016) self-efficacy regarding eHealth technology use seemed an important determinant in the long-term adherence of tele-rehabilitation for patients with chronic obstructive pulmonary disease. However, this was not tested within a certain adoption model. Self-efficacy is often captured under the term perceived behavioral control. In the review of Holden and Karsh (2010) perceived behavioral control (PBC) is defined in terms of self-efficacy and has a significant influence on the behavioral intention in all of the five studies which included the determinant. For the determinant organizational support was searched on the terms 'eHealth

technology' and 'organizational support' and 'adoption'. This resulted in 18 articles on Scopus. There was found that management support is a significant determinant in the acceptation of eHealth technology in selected public hospitals in Malaysia. However, the determinant management support was not tested in the TAM model but from an interactionist perspective. What is meant by interactionist perspective is that the direct influence of in this case management support on the acceptance of an eHealth technology was studied (Zailani et al., 2014). For the determinant task equivocality no eHealth technology literature could be found to substantiate this determinant. For this reason, the task equivocality determinant will be immediately excluded as an external determinant. Also the determinant organizational support will be excluded, since there could not be found relevant articles with regard to organizational support and exercise interventions. Besides the above mentioned external determinants, the study of Dünnebeil et al. (2012) also studied other external determinants that seem to have an influence on the PEU and/or PU within the TAM model, such as intensity of IT utilization, process orientation, importance of data security, documentation and standardization. However, in the literature these determinants could not be found as relevant determinants in relation to the adoption of exercise interventions.

Since the relevance of the determinants prior experience and self-efficacy in relation to the constructs eHealth technology, the TAM model and exercising is found, these determinants will be added to the original TAM model. Holden and Karsh (2010) stated in their review that it is better to use relevant substantiated determinants with regard to a specific study and since there are no more of these determinants found with regard to eHealth technology, exercise interventions and employees, there is chosen to just add these two determinants. The article of Lee et al. (2013) included both prior experience and self-efficacy regarding technology use as external determinants within the TAM model in the evaluation of e-learning technology among employees in organizational institutions. In contrast to the determinant prior experience, the influence of the determinant self-efficacy on the determinants PEU and PU is not investigated earlier within eHealth technology. There is only found a direct significant association between self-efficacy and behavioral intention with regard to eHealth technology (Holden & Karsh, 2010). However, the study of Lee et al. (2013) indicates a significant association between self-efficacy and PEU in their study regarding technology use among employees. There is awareness that this significant association is never tested within eHealth technology, but since de determinant self-efficacy would better fit the TAM model when it is placed as an external variable that influences PEU, the developed model of Lee et al. (2013) will be used in this study. Since the intention is thought to be a reliable way of predicting the actual use, behavioral intention will be the only measured outcome (King & He, 2006).

Addition of other relevant constructs

Besides the above mentioned TAM model with the extension of the two determinants self-efficacy and prior experience, other constructs could be relevant in evaluating the 'Fit at work' intervention. Compliance could be one of these constructs. There were not found any articles which added the construct compliance to the TAM model or any other model. The reason for this is probably that it is hard to define compliance. With regard to the 'Fit at work' intervention it is possibly relevant to add the construct compliance to the proposed TAM model. This to investigate the degree of compliance regarding the physical activity suggestions which will be given in the intervention. It is thought that the BI will have an influence on the compliance. This because it will be expected that when people are

intended to conduct the physical activity suggestions, the compliance will be high which will become visible in the higher physical activity levels.

The composed model

Based on the above presented literature, the TAM model seems a useful model for evaluating the acceptance and adoption of office employees with regard to this 'Fit at work' intervention. The described external determinants prior experience and self-efficacy regarding eHealth technology use are added to the original TAM model. In addition, the construct compliance is also added. Since behavioral intention is measured with regard to the use of the 'Fit at work' intervention, but also with regard to the physical activity suggestions, two research models are represented. A schematic representation of the two models is given below:

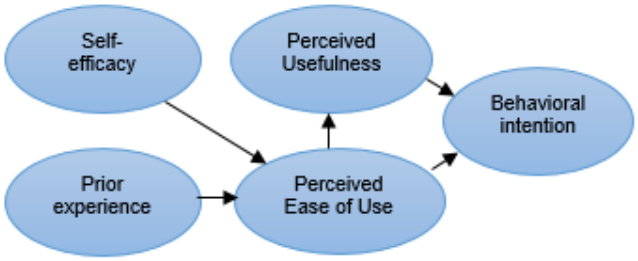

Figure 1. Research model 1 in this study.

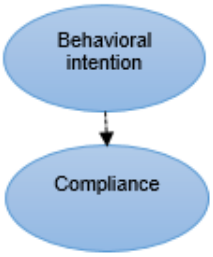

Figure 2. Research model 2 in this study.

In Table 1 the definitions of the different determinants are given. Table 2 and Table 3 represents the indicated relations in previous literature and the established hypothesis for this study based on the research models.

Table 1. *The definitions of the variables of the composed research models.*

Determinant	**Definition**	**Related adoption model**
Behavioral Intention	*An individual's motivation or willingness to exert effort to perform the target behavior (Davis, 1989).*	TAM (Davis, 1989)
Perceived Usefulness	*The degree to which an individual believes that a particular system will enhance his job performance (Davis, 1989).*	TAM (Davis, 1989)
Perceived Ease of Use	*The degree to which an individual believes that using a particular system would be free of effort (Davis, 1989).*	TAM (Davis, 1989)
Prior Experience	*Earlier experience in using a particular system (Lee et al., 2013).*	TPB (Ajzen, 2002)
Self-Efficacy	*An individual's perception of how easy or difficult it will be to perform the target behavior (Ajzen, 2002).*	TPB (Ajzen, 2002; Fishbein & Ajzen, 1975)

Compliance	*The degree to which participants properly follow the instructions or recommendations provided (Jin et al., 2008).*	Not studied before

Table 2. *The indicated relations in literature.*

Indicated relation	**Literature**
Self-efficacy has a positive relation with perceived ease of use.	(Lee et al., 2013)
Prior experience has a positive relation with perceived ease of use.	(Dünnebeil et al., 2012; Lee et al., 2013)
Perceived ease of use has a positive relation with perceived usefulness .	(Davis et al., 1989; Dünnebeil et al., 2012; Holden & Karsh, 2010; King & He, 2006; Kim et al., 2008)
Perceived ease of use has a positive relation with the behavioral intention.	(Davis et al., 1989; Dünnebeil et al., 2012; Kim et al., 2010; Paré et al., 2006; Schaper & Pervan, 2007)
Perceived usefulness has a positive relation with the behavioral intention.	(Davis et al., 1989; Dünnebeil et al., 2012; Holden & Karsh, 2010; Kim et al., 2010; Paré et al., 2006; Schaper & Pervan, 2007)

Table 3. *The established hypothesis for this study based on the research model.*

Hypothesis
The behavioral intention regarding the physical activity suggestions has a positive relation with the compliance regarding the physical activity suggestions.

Appendix 3: Questionnaire ‘Fit at work’ intervention

Demographics

Gender:	Male / Female
Age:	……..
Profession:	……..
Amount of working years:	……..
Experience of physical problems:	Yes / No

Behavioral intention (BI)		
1	I will strongly recommend others to use the ‘Fit at work’ intervention.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
2	I intend to use the ‘Fit at work’ intervention in the next few months.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
3	I intend to use ‘Fit at work’ intervention to assist my exercising during work.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
Perceived Usefulness (PU)		
4	I believe using the ‘Fit at work’ intervention enhances my effectiveness in my exercising during work.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
5	I believe the ‘Fit at work’ suggestions contents are informative.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
6	I believe the ‘Fit at work’ intervention is a useful exercising tool in encouraging physical activity at work.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
Perceived Ease of Use (PEU)		
7	I find the ‘Fit at work’ intervention to be easy to use.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
8	I find that interacting with the ‘Fit at work’ intervention does not demand much attention.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
9	I find it easy to combine work and the use of the ‘Fit at work’ intervention.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
	Self-Efficacy (SE)	

10	I am confident of using the 'Fit at work' intervention even if there are no manuals for reference.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
11	I am confident that I can overcome any obstacles when using the 'Fit at work' intervention.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
12	I am confident of using different mobile applications to be more physical active.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
Prior Experiences (PE)		
13	I enjoy using smartphone apps.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
14	I enjoy using smartphone apps regarding physical activity.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
15	I am comfortable using smartphone apps regarding physical activity.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree
16	I am comfortable using smartphone apps.	Strongly disagree / Disagree / Neutral / Agree / Strongly agree

Appendix 3: Vragenlijst ‘Fit op je werk’ interventie

Demografische gegevens

Geslacht:	Man / Vrouw
Leeftijd:	……..
Beroep:	……..
Aantal werkjaren:	……..
Ervaring van fysieke problematiek:	Ja / Nee

Gedragsintentie		
1	Ik zal anderen sterk aanbevelen om de ‘Fit op je werk’ interventie te gebruiken.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
2	Ik ben van plan om de ‘Fit op je werk’ interventie te gaan gebruiken in de aankomende maanden.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
3	Ik ben van plan om de ‘Fit op je werk’ interventie te gebruiken ter assistentie tijdens het werk.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
Waargenomen nut		
4	Ik vind dat het gebruik van de ‘Fit op je werk’ interventie leidt tot een verhoogd beweegniveau tijdens het werk.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
5	Ik vind de inhoud van de beweegsuggesties informatief.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
6	Ik vind dat de ‘Fit op je werk’ interventie een nuttig hulpmiddel voor het aansporen tot bewegen op het werk.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
Waargenomen gebruiksgemak		
7	Ik vind de ‘Fit op je werk’ interventie eenvoudig in het gebruik.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
8	Ik vind dat het gebruik van de ‘Fit op je werk’ interventie weinig aandacht vraagt.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
9	Ik vind het eenvoudig om mijn werk en de ‘Fit op je werk’ interventie te combineren.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
	Self-Efficacy (SE)	
10	Ik heb er vertrouwen in dat ik de ‘Fit op je werk’ interventie kan gebruiken zonder handleiding.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
11	Ik heb er vertrouwen in dat ik problemen met de ‘Fit op je werk’ interventie zelf kan oplossen.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens

12	Ik heb er vertrouwen in dat ik verschillende smartphone apps kan gebruiken om mijn fysieke gezondheid te verbeteren.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
Prior Experiences (PE)		
13	Ik vind het leuk om smartphone apps te gebruiken.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
14	Ik vind het leuk om smartphone apps te gebruiken die gericht zijn op het verbeteren van mijn beweegpatroon.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
15	Ik voel me comfortabel in het gebruik van smartphone apps die gericht zijn op het verbeteren van mijn beweegpatroon.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens
16	Ik voel me comfortabel in het gebruik van smartphone apps.	Sterk oneens / Oneens / Neutraal / Eens / Sterk eens

Appendix 4: Format interview ‘Fit at work’ intervention

General questions

- How did you experienced the use of the physical activity intervention?
- What did you liked about the physical activity intervention?
- What did not you liked about the physical activity intervention?
- What did you think about the content of the physical activity suggestion?
    - Did it fit to you own personal situation?
    - What did you think of the provided activity suggestions?
- How did you experienced the timing of the physical activity suggestions?
- How did you interpreted the question “did you performed other activities since you filled in this questionnaire about one hour ago?”?
- How do you think your activity pattern has changed by using the intervention?
    - Do you feel different?

Specific questions

Behavioural Intention

- I see your answer on question 1/2/3 regarding the Behavioural Intention to use the physical activity intervention. Why did you give this answer?

Perceived Usefulness

- I see your answer on question 4/5/6 regarding the Perceived Usefulness of the physical activity intervention. Why did you give this answer?
- Which functionalities of the intervention did you perceived as most useful?

Perceived Ease of Use

- I see your answer on question 7/8/9 regarding the Perceived Ease of Use of the physical activity intervention. Why did you give this answer?
- Which functionalities of the intervention did you perceived as most easy in use?
- How did you experienced the timing of the physical activity suggestions?

Self-Efficacy

- I see your answer on question 10/11/12 which was about the Self-Efficacy with regard to the physical activity intervention. Why did you give this answer?

Prior Experiences

- I see your answer on question 13/14/15/16 which was about the Prior Experiences with regard to the physical activity intervention. Why did you give this answer?

Closing question

- Do you feel that you have properly followed the physical activity suggestions given in the ‘Fit at work’ intervention?
- Do you have any remarks or advices regarding the physical activity intervention?

Appendix 4: Format ‘Fit op je werk’ interventie

Algemene vragen

- Hoe heeft u het gebruik van de ‘Fit op je werk’ interventie ervaren?
- Wat vond u leuk aan de ‘Fit op je werk’ interventie?
- Wat vond u minder leuk aan de ‘Fit op je werk’ interventie?
- Wat vond u van de inhoud van de beweegsuggesties?
    - Sloot dit voldoende aan op uw eigen situatie?
    - Wat vind u van de geboden activiteiten suggesties?
- Hoe heeft u de timing van de beweegsuggesties ervaren?
- Hoe interpreteerde u de vraag “Heeft u nog andere activiteiten uitgevoerd sinds u deze vragenlijst ongeveer een uur geleden heeft ingevuld?”?
- Hoe denkt u dat uw activiteitenpatroon is veranderd door het gebruik van de interventie?
    - Voelt u zich ook anders?

Specifieke vragen

Gedragsintentie

- Ik zie u antwoord op vraag 1/2/3 met betrekking tot de intentie tot het gebruik van de interventie. Waarom heeft u dit antwoord gegeven?

Waargenomen nut

- Ik zie u antwoord op vraag 4/5/6 met betrekking tot het waargenomen nut van de beweeginterventie. Waarom heeft u dit antwoord gegeven?
- Welke functionaliteiten van de interventie vond u het nuttigst?

Waargenomen gebruiksgemak

- Ik zie u antwoord op vraag 7/8/9 met betrekking tot het waargenomen gebruiksgemak van de beweeginterventie. Waarom heeft u dit antwoord gegeven?
- Welke functionaliteiten van de interventie vond u eenvoudig in gebruik?
- Hoe heeft u de timing van de beweegsuggesties ervaren?

Eigen capabiliteit

- Ik zie antwoord op vraag 10/11/12 welke ging over de eigen capabiliteit met betrekking tot de beweeginterventie. Waarom heeft u dit antwoord gegeven?

Eerdere ervaringen

- Ik zie je antwoord op vraag 13/14/15/16 welke ging over de eerdere ervaringen met betrekking tot de beweeginterventie. Waarom heeft u dit antwoord gegeven?

Afsluitende vraag

- Heeft u voor uw gevoel de beweegsuggesties van de ‘Fit op je werk’ interventie adequaat opgevolgd?
- Heeft u nog verdere aanvullingen, tips of adviezen voor de ‘Fit op je werk’ interventie?

Appendix 5: Graphs of the participants

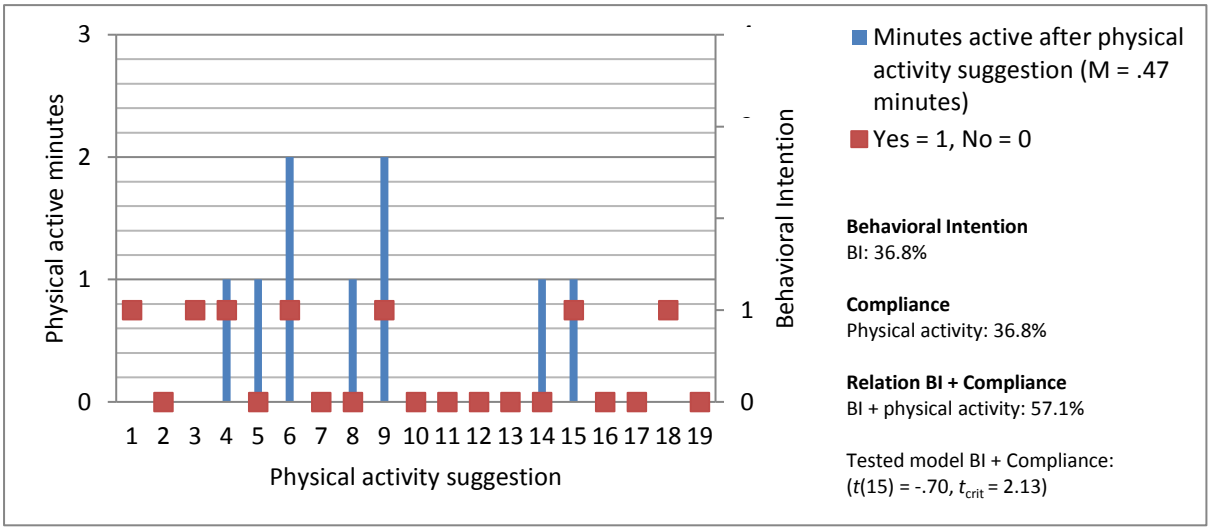

Figure 1. The Behavioral Intention and Compliance with regard to the provided physical activity suggestions for participant A.

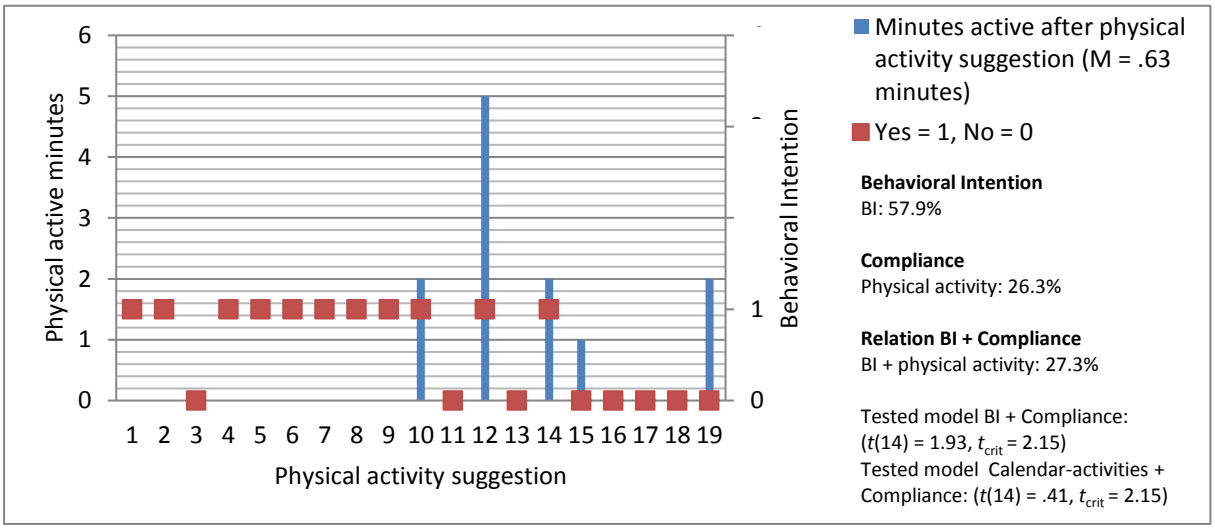

Figure 2. The Behavioral Intention and Compliance with regard to the provided physical activity suggestions for participant C.

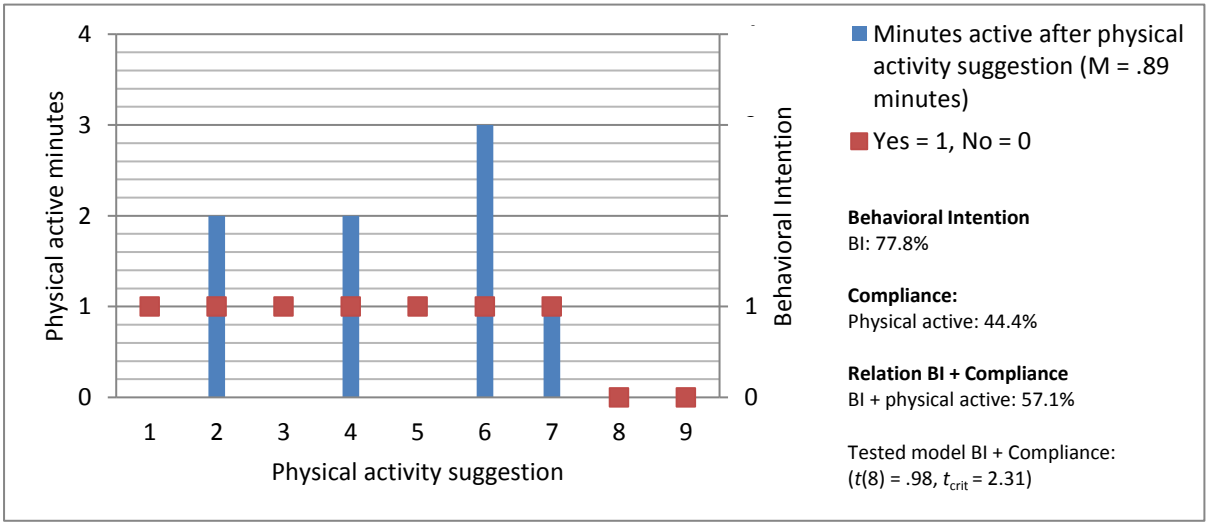

Figure 3. The Behavioral Intention and Compliance with regard to the provided physical activity suggestions for participant D.

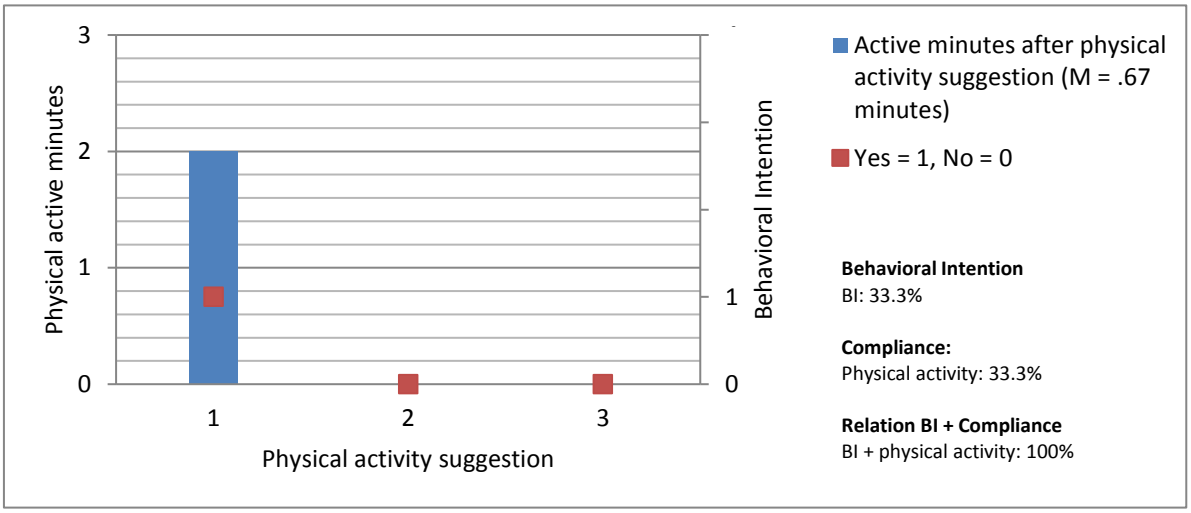

Figure 4. The Behavioral Intention and Compliance with regard to the provided physical activity suggestions for participant E.

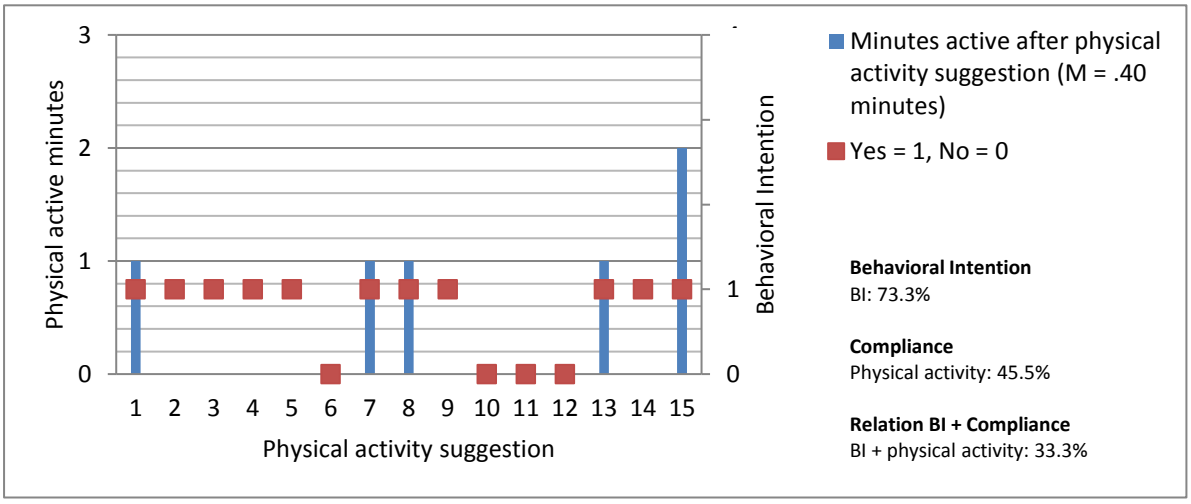

Figure 5. The Behavioral Intention and Compliance with regard to the provided physical activity suggestions for participant G.

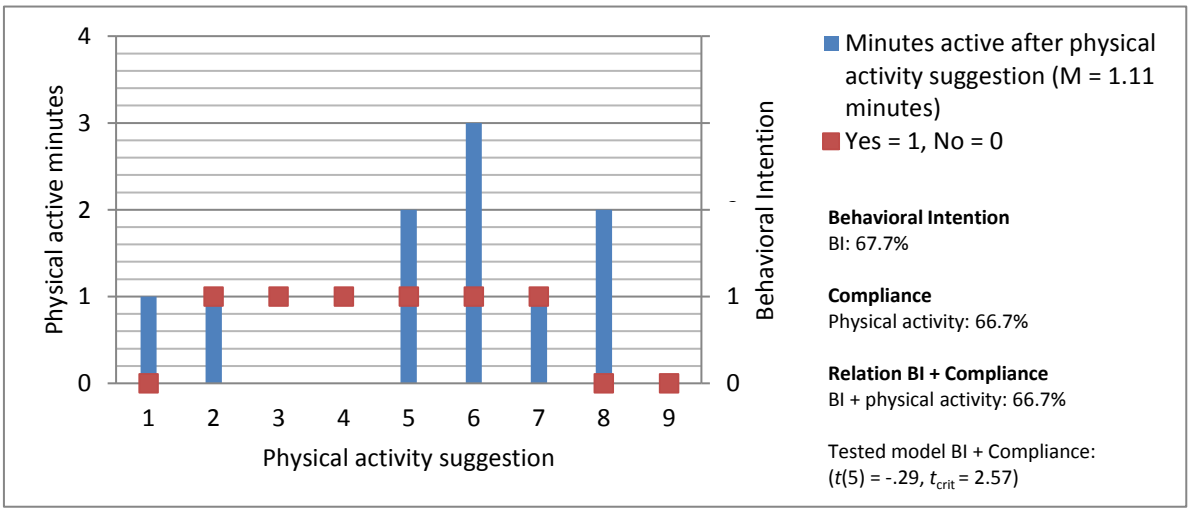

Figure 6. The Behavioral Intention and Compliance with regard to the provided physical activity suggestions for participant H.