Motivating and Assisting Physical Exercise in Independently Living Older Adults: A Pilot Study

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Abstract

**Purpose:** With age, people tend to reduce their reaction time, coordination and cognition power, which may lead to gait impairments, falls and injuries. To reduce this problem in elderly and to improve health, wellbeing and independence, regular balance and strength exercises are recommended. However, elderly face strong barriers to exercise.

**Objective:** We developed ActiveLifestyle, an IT-based system for active and healthy ageing aiming to improve elderly’s balance and strength. ActiveLifestyle is a proactive training application, running on a tablet, which assists, monitors and motivates elderly to follow personalized training plans autonomously at home, while integrating them socially. The objective is to run a pilot study to investigate i) the feasibility of the ActiveLifestyle system for assisting the autonomous, physical training of independently living elderly, ii) the adherence of the participants to the training plans, and iii) the effectiveness of the motivation instruments built into the system.

**Methods:** After three introductory meetings, 13 elderly adults followed personalized two-weeks strength and balance training plans using the ActiveLifestyle app autonomously at home. Questionnaires were used to assess the technological familiarity of the participants, feasibility aspects of the app, and the effectiveness of the motivation instruments. Adherence to the exercise plan was evaluated using the performance data collected by the app during the study.

**Results:** A total of 13 participants were enrolled, of whom 11 (85%) completed the study (mean age 77 ± 7 years); predominantly females (55%), vocational educated (64%), and their past profession requiring moderate physical activity (64%). The ActiveLifestyle app facilitated autonomous physical training at home (median=7 on a 7-point Likert scale), and participants expressed a high intention to use the app also after the end of the study (median=7). Adherence with the training plans was 73% (89% on the balance exercises and 60% on the strength exercises). Without the app, the participants did not feel motivated to perform exercises; with the support of the app they felt more motivated (median=6). Participants were especially motivated by being part of a virtual exercise group and by the capability to automatically monitor their performance (median=6 for both).

**Conclusions:** This study shows that the ActiveLifestyle app prototype has valuable potential to support physical exercise practice at home and it is worthwhile to further develop it into a more mature system. Furthermore, the results add to the knowledgebase into mobile-based applications for elderly, in that it shows that elderly users can learn to work with mobile-based systems. The ActiveLifestyle app proved viable to support and motivate independently living elderly to autonomously perform balance and strength exercises.
1. Introduction

Health status is an important indicator of quality of life among older persons [1,2]. Especially functional performance, chronic conditions, and diseases, which directly influence fitness, are related to the perceived health among middle-aged and older adults [2-4]. Chronic diseases are, furthermore, leading causes of death and disability in both developed and developing countries [5,6]. Inactivity is at the origin of several chronic diseases [7]. Regular physical activity or exercise substantially prevents the development and progression of most chronic degenerative diseases [8, 9, 10], is of benefit to frail and older persons, and is the only therapy found to consistently improve sarcopenia, physical function, cognitive performance and mood in both frail and non-frail older adults [11]. For older people, a sedentary lifestyle also increases the risk of falls, whereas physically active older people have a clear reduced risk of falls with injuries [12]. In summary, it is evident that to increase older adults quality of life and fitness, we need to encourage the elderly to become more physically active [13].

There are, however, a variety of barriers that make it hard for elderly to maintain or increase their physical activity level. Neighborhoods and communities may be poorly designed or perceived as being unsafe, thus preventing elderly from leaving home [14-15]. Older adults may also have trouble getting to specialized facilities (e.g., community center for the aged) and physical training programs offered in such institutions [14-15]. General health care professionals (e.g., nurses, family physicians) may lack the time or expertise to address problems of physical inactivity among their older patients, and often lack information about quality programs, training materials, and how to make referrals to community resources [16]. Furthermore, elderly often express the desire for training support at home [17].

To promote health, wellbeing, and functional independence of the elderly, the specialized healthcare professionals (i.e., sport medicine, gerontologists, physiotherapists and human movement scientists) strongly recommends physical training programs that especially focus on traditional components of exercise such as muscle strength and balance [18]. Home environmental interventions that are based on different forms of assistive technology devices have, in this context, the potential to overcome some of the barriers to start training and main-
tain physical independence for independent living elderly [19]. However, the effectiveness of such an approach has not yet been demonstrated to a large extent. Modern exercise equipment may not always be suitable for elderly individuals, who might be concerned about the intensity of training sessions and may rather express to have a preference for more traditional therapy approaches [20]. New treatments usually have to go through a series of phases to test whether they are feasible, safe and effective [21]. It seems, therefore, necessary to perform a pilot study to assess the feasibility of applying assistive technology devices in an elderly population with the aim to encourage performance of targeted physical exercise. Findings of such a study can inform a larger scale main Phase III study [21].

The objective of this study is to run a Phase II pilot study according the model for complex interventions advocated by the British Medical Research Council [22] with an iPad-based app (short for application) called ActiveLifestyle, a software for the autonomous physical training of strength and balance for independently living elderly. We specifically aim to investigate i) the feasibility of the ActiveLifestyle system ii) the adherence of the participants to the pre-defined training plans, and iii) the effectiveness of the motivation instruments built into the system.

2. Methods

2.1 The ActiveLifestyle app

The ActiveLifestyle app is pro-active software for active and healthy ageing that assists and monitors elderly during autonomous physical workout sessions at home [23][24]. The software has been designed taking into account usability aspects to avoid frustration of non IT elderly experts users, and persuasive strategies to motivate elderly users to keep a routine of physical exercises.
Figure 1. (a) and (b) illustrate the Chair stand exercise (Strength); (c) shows the One leg stand exercise (Balance).

Strength and Balance training plans are supported by the app. The Strength training should be done twice a week; it starts with 6 warm-up exercises, and is followed by 9 strength and 3 stretching exercises. There is a minimum number of sets (1-3) and repetitions (15-30) for each exercise. Some exercises also require the use of weights (2-6 kg). The Balance training should be done five days per week. Each session is composed of 3 exercises, in which the elderly repeatedly (1-3 times) holds a certain position for the duration of several seconds (15-30 sec). The training program follows best practices recommendations [25] and important training principles (e.g. is progressive in nature) [26]. The training procedure is illustrated in Figure 2 and in a video [27].
Figure 2: Main screenshots of the training plan procedure.

To motivate the elderly, the app supports *individual* and *social* motivation instruments [28].

*Individual* motivation strategies aim to convince someone to do something because it is inherently enjoyable for this person, independently of any social pressure. The app specifically supports:

- **Conditioning through positive and negative reinforcement:** that is, immediately offering a reward/praise after an expected behavior to encourage the behavior and to increase the probability that it happens again, or reprimanding whenever undesired behavior happened aiming to decrease the probability of a reoccurrence of the behavior. We use metaphors for positive and negative reinforcement, i.e., a flower that grows whenever a session is completed and that has a *mood status* that varies according to the per-
son’s daily compliance to the plan (see Figure 3.a), but the flower does not die or become ugly to avoid possible negative reactions on the users;

• Goal-setting: establishing specific, measurable, achievable, and time-targeted goals. In our case, we communicate the goal by anticipating the best achievable growth of the flower metaphor (see Figure 3.b);

• Self-monitoring: allowing people to monitor themselves and to modify their attitudes and behaviors. We show progress toward the goal by coloring the respective growth stage of the flower (Figure 3.b).

![Figure 3](image)

**Figure 3.** Individual motivation instruments based on a flower metaphor.

*Social motivation* strategies are built on social psychology, in which an individual’s social network (other trainees) is the source of motivation. For example, ActiveLifestyle uses:

• Comparison: allowing a person to compare similarities and differences between two or more parties, people tend to keep equality in their relationships. Whenever an old person completes a workout session, an automatic message is posted on a *Bulletin Board* to inform the training plan community (i.e., other users following the same training plans). The message also shows the status of the individual’s flower metaphor.
• **External-Monitoring:** allowing one party to monitor the behavior of another party to modify behavior in a specific way. In ActiveLifestyle, healthcare and IT experts have access to data about the persons’ performance and compliance toward the plan. The elderly users have access to their own flowers; however, they can also monitor the other flowers and consequently can monitor their progress toward the plan.

### 2.2 Sample

Participants were 70 years or older; able to walk independently with or without walking aids; able to follow instructions spoken in German, English, or Italian; and with no severe illness, cognitive impairment, progressive neurological diseases, stroke, severe cardiac failure, or high blood pressure.

### 2.3 Setting

Participants were recruited by convenience sampling from the “Informationsstelle fuer Altersfragen” in Wollerau, Switzerland. This institution, dedicated to deliver services and information related to ageing to the elderly population, issued 220 invitation letters, together with an information sheet outlining the research, inviting independently living elderly of the region to participate. Ethical approval for the study was obtained from the ETH Ethics Committee (EK 2011-N-64).

### 2.4 Interventions

During an initial meeting, all potential participants received information about the ActiveLifestyle app and about the study. Interested people filled a form and provided their personal contact data.

During a second meeting, participants were taught how to use the iPad and the app. To ease learning, user guides with written content, illustrations about the app and the iPad were provided.
During a third meeting, participants were taught how to perform the balance and strength exercises supported by the app. The same day, they also signed the consent form and replied health and technology familiarity questions. At the end of this meeting, participants received one resistance band, one Pilate’s ball, and one pair of ankle weights (2kg). iPads with 3G SIM-card were borrowed to the participants.

After these three meetings, the participants started a two-weeks balance and strength training autonomously at home. To settle possible remaining obscurities, an additional meeting was scheduled on the second day of the training period. Contact information of our team members was provided to all participants in case of further obscurities or problems.

At the end of the two-weeks training period, a final meeting was held to conclude the study and collect the material previously borrowed. At this time, the participants replied questions regarding the feasibility, perceived usefulness, usability, visual attractiveness, and the effectiveness of the motivation instruments of the app.

2.5 Outcome Measures

The criteria for success, an important part of a pilot study [21], were based on the primary feasibility objective and focused on recruitment, attrition and adherence to the exercise. Values for these parameters were compared with median rates in falls prevention interventions in community settings for clinical trials [29], in which recruitment of 70% of the residents that are eligible for the training session, a 10% attrition rate, and 50% adherence to the individually targeted exercises were deemed acceptable.

For recruitment, data for the total sampling for inclusion in the trials were taken to assess generalizability to all elderly individuals within the community. We measured the inclusion rate — i.e. the proportion of participants invited to participate who enrolled into the study — and distinguished between those who refused, did not respond or who were willing but excluded (volunteered but did not meet the study inclusion criteria).
For attrition, we measured the number of participants lost at final follow-up.

For adherence to the intervention we recorded engagement with the intervention, e.g., compliance with all 4 strength and 10 balance training sessions. The adherence was computed by ActiveLifestyle during the intervention and stored into a central database.

The effectiveness of the motivation instruments built into the system were determined on the basis of the participants’ feedback, collected with a 7-Point Likert Scale questionnaire at the end of the intervention (Table I).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Median (range)</th>
<th>Percentage Agreed</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ActiveLifestyle app facilitates the performance of strength and balance exercises autonomously at home.</td>
<td>7(6-7)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Use intention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would use the app again.</td>
<td>7(6-7)</td>
<td>100</td>
</tr>
<tr>
<td>I would recommend the app to my friends and family.</td>
<td>6(6-7)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Perceived usefulness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The videos assisted to properly perform the exercises.</td>
<td>7(6-7)</td>
<td>100</td>
</tr>
<tr>
<td>The sound alarm helped to remind me about the planned workout sessions.</td>
<td>4(3-7)</td>
<td>45.4</td>
</tr>
<tr>
<td>The calendar was useful to make me aware about which kind of workout session I need to perform every day.</td>
<td>7(6-7)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I usually don’t feel motivated to perform physical exercises, the app helped me.</td>
<td>6(3-7)</td>
<td>63.6</td>
</tr>
<tr>
<td>It was funny to me to carry out the strength and balance exercises.</td>
<td>6(3-7)</td>
<td>90.9</td>
</tr>
<tr>
<td>I like the pictures of the flower.</td>
<td>7(6-7)</td>
<td>100</td>
</tr>
<tr>
<td>I would prefer another picture instead of a flower.</td>
<td>5(2-7)</td>
<td>54.5</td>
</tr>
<tr>
<td><strong>Individual Motivation Instruments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt motivated when I saw the plant growing due to my performance.</td>
<td>6(4-7)</td>
<td>90.9</td>
</tr>
<tr>
<td>I felt motivated when I saw my progress on the bar.</td>
<td>6(4-7)</td>
<td>90.9</td>
</tr>
<tr>
<td>I felt motivated when I saw the emotional status of the flower.</td>
<td>6(4-7)</td>
<td>63.6</td>
</tr>
</tbody>
</table>
Social Motivation Instruments

It motivated me to be part of a training group and to know that other people did the same exercises.  
I usually compared my flower with others on the Bulletin Board.  
I felt motivated to perform the plan because I knew that I was being monitored.

Usability

The operation of the application was easy.  
I was able to use the app.  
I was able to write messages on the Bulletin Board.  
I was able to read messages from the Bulletin Board.  
I was able to send messages to a person (InBox).  
I was able to receive messages from a person (InBox).  
I was able to navigate through the messages posted on the Bulletin Board using the scroll.  
I felt nervous to use the app.  
The application worked without any problems.

Table I. Outcome data expressed by the participants on a 7-Point Likert Scale (range, 1-7; 1=Completely disagree - 7=Completely agree) at the end of the intervention period (n=11).

2.6 Statistical analyses

Descriptive statistics (Mann-Whitney U test) were used to assess baseline characteristics and analyze the questionnaires. All analyses were conducted using SPSS Version 18.0 (SPSS Inc., Chicago, IL, USA). Recommendations of items to include when reporting a pilot study [20] were followed for describing the results of this pilot.

3. Results

3.1 Participant Demographics

Detailed information about the participant demographics is summarized in Table II.
Intervention (n=11)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female gender, n (%)</td>
<td>6/11(54.5)</td>
</tr>
<tr>
<td>Mean/Median age [range] (years)</td>
<td>77.2/76 [70-85]</td>
</tr>
<tr>
<td>Vocational education, n (%)</td>
<td>7/11(63.6)</td>
</tr>
<tr>
<td>Moderately physical activity past profession, n (%)</td>
<td>7/11(63.6)</td>
</tr>
<tr>
<td>Health Questions, n (%)</td>
<td></td>
</tr>
<tr>
<td>Estimated good health</td>
<td>7/11(63.6)</td>
</tr>
<tr>
<td>Estimated middle balance</td>
<td>5/11(45.5)</td>
</tr>
<tr>
<td>Feeling daily pain</td>
<td>5/11(45.5)</td>
</tr>
<tr>
<td>Fell in the last six months†</td>
<td>0/11(0)</td>
</tr>
<tr>
<td>Leisure time walking at least twice a week</td>
<td>11/11(100)</td>
</tr>
<tr>
<td>Practiced some sport in the past</td>
<td>7/11(63.6)</td>
</tr>
<tr>
<td>Never practiced strength exercises</td>
<td>9/11(81.8)</td>
</tr>
<tr>
<td>Wanted to improve fitness</td>
<td>7/11(63.6)</td>
</tr>
<tr>
<td>Technology Familiarity, n (%)</td>
<td></td>
</tr>
<tr>
<td>Frequently use ATMs</td>
<td>9/11(81.8)</td>
</tr>
<tr>
<td>Don’t use books on tape or CD</td>
<td>5/11(45.4)</td>
</tr>
<tr>
<td>Sometimes use cellphones</td>
<td>6/11(54.5)</td>
</tr>
<tr>
<td>Don’t use digital photography</td>
<td>5/11(45.5)</td>
</tr>
<tr>
<td>Don’t use electronic book readers</td>
<td>5/11(45.5)</td>
</tr>
<tr>
<td>Don’t use GPS</td>
<td>5/11(45.5)</td>
</tr>
<tr>
<td>Don’t use automatic kiosks</td>
<td>6/11(54.5)</td>
</tr>
<tr>
<td>Use a computer</td>
<td>9/11(81.1)</td>
</tr>
<tr>
<td>Between 1-5 hours per week</td>
<td>4/11(36.3)</td>
</tr>
<tr>
<td>Use the Internet</td>
<td>9/11(81.1)</td>
</tr>
<tr>
<td>Between 1-5 hours per week</td>
<td>5/11(45.5)</td>
</tr>
</tbody>
</table>

Table II. Characteristics of the participants.

†A fall was defined as unintentionally coming to the ground or some lower level, excluding the consequence of sustaining a violent blow, loss of consciousness, or sudden onset of paralysis, such as during a stroke or epileptic seizure [30].

3.2 Feasibility of the ActiveLifestyle app

A total of 220 information letters were send. The first information session was held and visited by fourteen residents, who were all eligible and invited to participate. Thirteen residents con-
sented to join the study. This resulted in a recruitment rate of 7% for the total sample frame. The inclusion rate — fourteen invited to participate; thirteen enrolled — was 93%.

Eleven elderly individuals participated during two-weeks training plan, which resulted in a 16% attrition rate. Two individuals were lost; one was disappointed for not receiving the iPad after the second meeting and the other because Wi-Fi connection problems. For adherence to the intervention we had 73% compliance with all 14 trainings (89% for balance and 60% for the strength exercises). There were no reports on adverse events during the training.

3.3 Effectiveness of the ActiveLifestyle app

All participants affirmed that the ActiveLifestyle app facilitates the performance of balance and strength exercises autonomously at home. This outcome is attested by their high intention to use the app again or to recommend it to friends or family members (100%, range 6-7). Some of the participants verbally expressed their disappointment with the end of the training period and the impossibility to continue it in the near future (at the moment the app is not yet available on the market).

The participants expressed a high-perceived usefulness of the training plan videos. According to some feedbacks, the videos are “...absolutely great” and “...very helpful”, while others stated “I adjusted my posture based on them” or “the exercises were easy with the videos”. One explanation for such high approval can be derived from the fact that most of the participants had never performed strength exercises before (82%).

Differently from the Weekly Exercises Calendar — a menu option in which the user can check the planned workout sessions on a weekly basis — considered useful by all users, the sound alarm was useful only to a few users (46%).

3.4 Effectiveness of the motivation instruments

Most of the participants generally do not feel motivated to perform physical exercises, but they felt motivated with the ActiveLifestyle app (64%). According to the participants, it was fun
to follow the exercises with the app (91%). Their mood after doing the exercises was mostly relaxed (41%) or happy (25%).

The individual motivation instruments were very effective. Most of the participants felt motivated when they saw the flower growing or could monitor their progress toward the plan (91% for both). At the end of the study, we noticed that the participants really appreciated the flower metaphor. When filling the questionnaires, most of them made spontaneous comments saying that it was lovely, “tender and cheerful”, or “a sunflower is funny, it makes you happy”. However, one woman suggested a racing car instead of the flower. According to her, the car is a perfect metaphor, since it also needs to get warm to work properly. The same high motivation was not achieved with the mood status of the flower (64%).

The social motivation instruments also achieved good results. The majority of the participants felt motivated by being part of a training plan group (91%). “I’m happy to see others doing the same exercises, I’m not a single athlete”. The monitoring and the flower comparison were similarly effective (64%). One woman said “I need someone to push me!”’. Two participants checked their friends’ flowers on the Bulletin Board every day and whether they did the exercises. However, another woman said “Of course not, I’m not nosy!” but she also told us “my husband and I always looked at the Bulletin Board to see if there was something interesting to read”. The same participants also reported “…after two days I could reach the same level of my husband, it made me happy”. From such results, we understood that our participants felt motivated by being part of a social group and by knowing that other people are doing the same exercises and facing the same kind of problems (e.g., pain, difficulties to wear the ankle weights). It was however possible to notice their interest to know how others were doing and to compare their performance with themselves, which can be explained by the human tendency to keep equality (Herzberg’s equity theory [31]).

3.5 Usability

All participants were able to use the ActiveLifestyle app and agreed that it is easy to use. The scrolling and reading activities were performed by most of the participants. For instance, nav-
igate through the messages posted on the Bulletin Board using the scroll (91%); read the posts from the Bulletin Board (100%); and receive messages on the InBox (73%, some participants never received a message, so they were not able to express their option about it). Although, the writing activities showed the same high usage, not all were able to write private messages on the Bulletin Board (64%) and public messages on the InBox (46%). Both messages are written following the same approach and appearance, the only difference is that the public messages can be read by all the elderly participants, as opposed to the private messages that are only available for selected persons.

Few participants felt anxious to use the app (19%). With further questions we discovered the reasons: One woman had problems to use the app alone the first day; after the extra meeting she, however, learned the use and was comfortable with it. Another woman performed the exercises very early in the morning when she usually has very cold fingers. Due to that, the tablet was not very effective to react to her touches.

4. Discussion

The aim of the current study was to investigate i) the feasibility of the ActiveLifestyle system ii) the adherence of the participants to the pre-defined training plans, and iii) the effectiveness of the motivation instruments built into the system.

We demonstrated the feasibility of acquiring acceptable attrition and adherence rates for independent living elderly to the experimental training. Our target of about 70% recruitment rate for the total sample frame was by far not met. Those individuals that responded and visited an information session, however, showed a large inclusion and adherence rate. These findings indicate the importance of recruitment strategies and information sessions for elderly individuals. The differing adherence for the strength and balance training components should be addressed in a revised version of our app. It might be that the balance part required less effort and was easier to perform in contrast to the strength exercises. Many participants made remarks about the load and the side effect of the strength exercises, e.g. some participants
had difficulties to walk or had had surgery on the knee or hip and, therefore, could not perform the recommended number of sets.

The ankle weights were a stronger barrier to the adherence to the strength exercises. Apart from the effort required to lift the weights, most participants reported difficulties to wear and close them around their ankles. One man bought a new pair of weights that were easier to wear and close. Another woman mentioned “tie the weights is almost the hardest!”

Compliance with the intervention was excellent. Eleven of initially thirteen included elderly individuals completed the training. This is far more than the rate that could have been expected. It should be noted, however, that the mean compliance rate for interventions in independent living elderly that was determined for several studies summarized in a systematic review [26] mainly focused on studies with far longer time periods. Our data should, therefore, be replicated in another study where the intervention is applied during several training sessions over several weeks. It can be expected that because of such a longitudinal design less favorable compliance and retention rates are to be expected. Our findings warrant, however, such follow-up studies based on these first results.

Regarding motivation, we noticed that all participants felt motivated by making something grow with their effort and by receiving a simple reward (e.g., a new picture of the flower metaphor). We infer that positive reinforcement using the growing flower metaphor worked successfully, even if approximately half of the participants (55%) would prefer another metaphors. The selection of a metaphor is indeed very subjective and depends on the individual preferences of each participant.

About the low rate of writing activities we hypothesize two possible reasons. Firstly, participants did not know each other, so they did not feel very comfortable to write. Secondly, a minor part of them did not have good typing skills. For instance, one woman wrote once on the board but the message was impossible to understand, since it was not correctly written. When she was asked about the sending messages option, she said “I would write more, but
for that I need to learn how to do it better”, which is understandable, she is 81 years old and never used the Internet or a computer before.

4.1 Lessons learned

We conclude that the participants enjoyed and felt motivated to follow the training plans using the ActiveLifestyle app and an iPad. At the final meeting we received encouraging and motivating comments from the participants, e.g. their desire to continue using the app, their disappointment for not being able to perform the exercises in the last days (the training plan finished on Friday, and they tried to perform after that). One woman, used to perform exercises with a book ("Fit after 40"), commented, “the app is much better”. For her the study was a motivating way to exercise. She and her husband took notes to continue the exercises even after the study. Another woman said that her doctor was impressed with the result of her cholesterol exam. The oldest man sustained a heart attack two years ago and stopped doing sports. According to him, “this was a great opportunity to reactivate” “… it was perfect. I noticed progress, especially on my balance”. One person bought a tablet after the third meeting, and two expressed their intention to buy one soon and to install the app.

We learned that the motivations instruments worked. However, the social motivation instruments were not as effective as we expected. Most of our participants were not familiar with social networks and virtual friends. Due to that, they were initially not willing to share their thoughts and life with strangers. However, we assume that if they learn how to use the app to make friends, receive feedback from people experiencing the same aging effects, and find a way to keep close and share their thoughts and life with old friends and family members, they might change their attitude. For that we need to build additional motivation and encouragement (i.e., dedicated mechanisms or features, in which the elderly users have to reply questions, participate in a collaborative activity or comment on a specific topic). Another important aspect is to enable communication and sharing of information between the elderly and their younger family members. During the intervention, we had only six comments on the Bulletin Board, of which three were addressed to our IT expert. We received sixteen private messages with suggestions and general comments about the exercises/app (e.g., “I’m glad, my legs
are not always so hard!” “The right leg is much stronger than the left leg! I feel that the training is necessary.”).

We also noticed that some of the participants felt very proud about using the tablet and shared this experience with their families. One woman showed the tablet and the app to her grandchildren, who were impressed: “our grandma has an iPad, wow!!!” The oldest woman received hints from her daughter about how to perform the heel-to-walk exercise; she had difficulties to walk along a straight line. Finally, another participant invited her sister to perform the exercises together. These results reinforce our intention to allow family members to interact with the elderly and to monitor their performance. We strongly believe that social and emotional support is a strong motivation instrument. This is a point of attention for the revised version of our app.

4.2 Limitations
This study had several limitations that should be mentioned. This work is a pilot study to assess the feasibility of our approach in a rather small sample, due to that we did not focus on recruitment strategies. For our experience we can conclude that sending letters to potentially qualifying elderly was apparently not a good strategy.

We also decided to start with a short training period to avoid risks (e.g., late detection of bugs that can cause a higher participants withdrawal, high investment to provide the tablets and 3G SIM-card Internet connections) and to collect novel requirements. In the next study we will also perform medical assessments of the physical conditions of participants before and after the study.

5. Conclusion
We conclude that pilot studies with explicit feasibility objectives are important foundation steps in preparing for large trials. On-going formal review of the multifaceted issues inherent in the design and conduct of pilot studies can provide invaluable feasibility and scientific data for IT developers and rehabilitation specialists alike, and may be highly relevant for furthering
the development of theory driven mobile-based rehabilitation. This study shows that Active-Lifestyle has valuable potential to support physical exercise at home and it is worthwhile to further develop it into a more mature system. Furthermore, the results add to the knowledge-base into mobile-based applications for elderly, in that it shows that elderly users can learn to work with mobile-based systems. The ActiveLifestyle app proves feasible to support and motivate independently living elderly adults to autonomously perform balance and strength exercises at home. The app in a main study is deemed feasible with some need for protocol modifications regarding recruitment strategies, motivational instruments and information on strength exercises. In our further work we should more specifically examine the effectiveness of ActiveLifestyle on measures of physical functioning, with a longer training period, and a larger set of participants.

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