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Abstract

The EnterTrain project aims to develop an exergaming platform for older adults that motivates them to exercise in a playful and rewarding way, and in consequence enables them to enhance their independency and their quality of life. This report consolidates the main findings from a two-month field pilot in Austria and the Netherlands. Two participants aged between 77 and 88 years in each country, in Austria and in the Netherlands took part and had the exergames installed in their homes. Over the course of the two months (between June and August 2017) test users gave valuable feedback and insights among others into their gaming experience, the usability of the platform, (subjective and objective) impact on their health and wellbeing.

Generally, the analysis showed that the exergaming platform was well received by participants. For the 1st field pilot phase the platform consisted of five games, including a Bingo and an arithmetic game which challenged the participants both physically and cognitively.

Keyword List EnterTrain; Exergames; End-User Involvement; Field Trial;

DOCUMENT CHANGE LOG

Document Issue	Date	Reasons for change
Version 1.0	2017-10-11	Initial version
Version 2.0	2017-10-14	Final Version after feedback from partners was integrated

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1. Introduction

The objective of EnterTrain is to enhance the health and quality of life of independently living older adults by motivating to follow physical training by digital exergames. The development of the EnterTrain system follows several steps, always focused on assessing and including the needs and preferences of primary (older adults living at home) and secondary end-users (care-takers, relatives). Before a field trial phase, consisting of two test phases (duration of 1st test phase of 2 months and 2nd test phase of 12 months) a large scale user needs analysis was conducted in Austria and the Netherlands. Findings from the survey and focus group discussions were reported in D1.1" Catalogue *of requirements*". This report consolidates the main findings from a two-month pilot test phase in Austria and the Netherlands. Two participants in each country, Austria and the Netherlands took part in an 8-week field trial phase where the games were installed in their homes. Over the course of the two months (between June and August 2017) test users gave valuable feedback and insights among others into their gaming experience, the usability of the platform, (subjective and objective) impact on their health and wellbeing.

The field trial phase aimed to gather technical and users' feedback in regards to the EnterTrain system, the games and the digital mobility model with the system. Findings from the 1st pilot phase impact upon technical features and evaluation design for the second field trial phase. Technical findings and implications for Field Trial phase 2 are reported in D3.1 "*System revision*" report.

Report structure

The report is structured in four main chapters, including methodology, results, indications for field trial phase 2 and conclusions.

Chapter 2 describes the applied evaluation methods which included both qualitative and quantitative measures. The methods were applied at different points within the 8-week test phase and comprised a quantitative pre-and-post questionnaire filled out before and after the test phase, regular mobility assessments by physiotherapists, qualitative problem-centered interviews with test users as well as participants' observations during the initial installation of the system and when playing the games. **Chapter 3** discusses the main findings in regards to the game design in general, including single features and needs for additional functions. Also the systems usability, as well as feedback about the research participation by test users are presented. **Chapter 4** summarizes the main results from the mobility assessment tests by physiotherapists in Austria and the Netherlands. **Chapter 5** summarizes the results in regards to the games tested during the trial phase. Altogether five games were evaluated by participants. **Chapter 6** discusses the main indications in regards to technical specifications and evaluation design for the 2nd field trial phase. **Chapter 7** concludes with the main findings gathered over the field trial phase as well as indications for adaptations for the 2nd field trial phase starting in November 2017.

2. Methodology

In this first pilot test phase, four users tested the EnterTrain system over a period of two months. Over the course of these two months (between June and August 2017) two participants in Austria and two participants in the Netherlands gave crucial feedback and input in regards to technical requirements. The evaluation methodology consisted of quantitative and qualitative measures which are described in greater detail in the following chapters (see 2.2).

The evaluation focused on four main topics:

1. *game use*
2. *impact on subjective and objective health and wellbeing*
3. *system usability*
4. *feedback regarding the research participation.*

The applied methods included 1) a baseline study (short quantitative survey about personal background of test users), 2) quantitative pre- and post-survey, 3) mobility assessment tests, 4) qualitative problem-centered interviews, and 5) participant observations (during the installation and playing of the games).

Over the course of the 8-week test phase test users were invited to give feedback about the game use, the system usability, impact of playing exergames on their health and mobility and generally their participation in the research. As applicable in table 1 below test users were visited quite frequently by staff from SOC and CogVis in Austria and NFE and SIL in the Netherlands.

All results and implications from test phase 1 will impact the changes in regards to the technical design of the EnterTrain system as well as the applied evaluation methodology for test phase 2 (starting in November 2017 in Austria, resp. December 2017 in the Netherlands).

Week	***Methods***
Week 0	Installation of the System, Mobility Assessment, 1st game settings installed, Baseline Study, Pre-survey
Week 1	
Week 2	Change Game setting
Week 3	1st Interview
Week 4	Mobility Assessment, 2nd change game settings
Week 5	
Week 6	Change game settings, user experience interview;
Week 7	2nd Interview
Week 8	De-installation of the System, Mobility Assessment
Week 9	3rd Interview, Post-survey

Table 1: Timetable for Field Trial Phase 1

2.1 Sample and Recruitment

The sample comprised two female and two male users in Austria and the Netherlands. In addition to gender as one selection criteria, the test users varied in their age and had to live alone. Thus one participant in the third age, and one participant in the fourth age tested the EnterTrain system. Further exclusion criteria included that potential test users are not diagnosed with dementia, or with depression

within the last 12 months; participants had to be able to move around their apartment without additional walking aids, for instance wheelchairs or walkers. Test users were contacted and recruited by project partners from NFE in the Netherlands and from SAM in Vienna, Austria. Potential users were contacted via telephone or face-to-face meetings and oftentimes visited at home by NFE or SAM staff members. Personal contacts, established prior to the research project proved helpful in recruiting test users.

The age range of all four male and female test users was 77 to 88 years. In table 2 below all four test users in Austria and the Netherlands are briefly described with regards to their age, health status and living situation.

- **Participant A in Vienna is a divorced 75-year old male**, who is leading a very active life despite occasionally suffering from back and elbow pain. He was diagnosed with low blood pressure last year; since then he regularly measures it but has stopped taking any medication. Some of the activities include hiking, swimming and spending a lot of time at the Danube river, either on a paddleboat or meeting with friends at the sailing association where he is also a member. He doesn't get any formal or informal care support. Participant A uses a computer daily, mostly to write and edit articles for two magazines from associations that he is part in. The magazines are published quarterly.

- **Participant B in Vienna is an 89-year old female widower,** who had a hip fracture some years ago, and has been seeing a physiotherapist since. A (formal) caretaker visits her three times a week to do grocery shopping together (she uses a walking frame when walking outdoors) or support her with cleaning and other household chores. She spends most of her time at home, as she cannot walk long distances and feels unstable and oftentimes unsafe when using public transportation. Participant A uses a tablet to almost daily read E-mails (a way she keeps in touch with family members) and to play games online, preferably the quiz game "*Who wants to be a Millionaire*?". Sometimes she searches for specific terms in Google. She already took part in testing a fall-detection system in her apartment, as part of the AAL project "Fearless" some years ago.

- **Participant C in the Netherlands is an 82-year old female widower,** who has to take daily medication due to some heart-, lung-, and kidney issues. She describes herself as a positive person, who does a physical work-out with some neighbors once a week. In addition, she has a stationary bike in her apartment that she sometimes uses. Participant C is in close contact with some neighbors, and has formal care support with household chores once a week for about 3 hours. The lady is not very technical, however, she does have any experience with using a computer. She has a tablet which she used to use, but not uses so much anymore. She also has an e-mail-address but she prefers to use the phone (landline). However, she is very curious and likes to learn new things.

- **Participant D in the Netherlands is a 78-year old male widower,** who has to take medication and be monitored regularly due to a previous heart infraction. He does Tai Chi every week and has a member card for the local gym that he currently does not do as much anymore. Twice a week he has informal support to clean the house. The participant does have some technical devices in his house which he taught himself to use. However, when sometimes something goes wrong, he needs help to fix it – (using the cd/video/dvd, mobile phone) but he doesn't dare to always ask for this help. The technical device he uses the most is the television: every morning he turns on the television (mainly to watch sports) and only turns it off when he goes outside.

Table 2: Short Description of Test Users

2.2 Evaluation methodology

The following chapters describe the applied evaluation methods, ranging from qualitative problem-centered interviews to quantitative mobility assessment tests. Please note that all interview questions, along with a copy of the survey are attached in the appendix.

2.2.1 Problem-centered Interview

> *"The principles guiding a problem-centered interview (PCI) aim to gather objective evidence on human behaviour as well as on subjective perceptions and ways of processing social reality" (Witzel 2000, 1)*

Three basic principles of a problem-centered interview

The problem centered interview is distinguished by a (1) problem-centered orientation towards socially relevant problems which also characterizes the organization of processes of cognition and learning. Furthermore, the (2) object-orientation emphasizes methodical flexibility in face of the different necessities of the objects. The (3) process orientation focus on the communication process. If the communication is focused reasonably and acceptably on the reconstruction of orientations and actions, the interviewees feel that they are being taken seriously. This faith motivates participants to remember and to be self-reflective (vgl. Witzel 2000).

Interview-Instruments

The interview guideline is one part of the problem-centered interview. The guideline is a supportive device to remember main interview topics - not a standardized questionnaire. (vgl. Witzel 2000).

2.2.2 Participant observation

Participation observation is one way in the qualitative research to collect data. Marshall and Rossman define observation as "the systematic description of events, behaviors, and artifacts in the social setting chosen for study" (Marshall und Rossman 1989, 79). DeMunck and Sobo describe participant observation as the primary method used by anthropologists doing fieldwork. Fieldwork includes active looking, improving memory, informal interviewing, **writing detailed field notes**, and patience. (vgl. DeMunk und Sobo 1998)

DeWalt and DeWalt suggest that the observer should study what is happening and why, sort out the necessary from the unnecessary activities, look for the negative cases or exceptions and plan systematic observations. (vgl. DeWalt und DeWalt 1998)

Field notes are the primary way of capturing the data that is collected from participant observations. Notes taken to capture this data include records of what is observed, informal conversations with participants and records of activities. Detailed observation notes are very important for that way of data collection. (vgl. Kawulich 2005)

2.2.3 Pre-Post Questionnaire

A Pre-Post Questionnaire is used to compare selected phenomena before and after an intervention or treatment. Ary et al. (2014, 326) describe that "*the one-group pretest-posttest design usually involves three steps: (1) administering a pretest measuring the dependent variable; (2) applying experimental treatment to the subjects; and (3) administering a posttest*."

The directly administered questionnaire is used to gather quantitative data about information given at chosen moments. In this case, the Pre-Post questionnaire serves as opportunity to gather personal information before and after the intervention period to see what has changed in the subjects' point of

view. Therefore, Likert-Scales have been used to assess basic health related information and information about the use of and attitudes towards ICT.

2.2.4 Baseline Study

The Baseline Study assesses topics related to the study at the beginning of an intervention period to examine the current status of the subjects participating in the treatment and aims at gathering background information of the participants as well as quantifies certain health factors such as physical and cognitive fitness.

3 Results

3.1 System Usability

This chapter summarizes our main findings from evaluating the 2-month test phase with various instruments. Throughout the test phase usability feedback was gathered regularly through qualitative problem-centered interviews with the test users. By interviewing participants in a two-week interval, changes in attitude towards the platform, information about when and how the platform was used and usability experience in general have been recorded.

In general, participants had no problems with turning the platform on and off and got used to exergaming every day for about 30 minutes rather fast. Participants described the platform as a "*great invention*", "*something creative*" and a motivation to move and being cognitively challenged. Also, test users stressed that the EnterTrain system was user friendly and had a good distribution of games which train mental as well as physical skills.

3.2 Support by Physiotherapists

Although during the first test phase, the platform couldn't adjust to the users' capabilities (yet), the right level of difficulty for each test user could be adjusted due to regular visits and tests by a physiotherapist. A physiotherapist came to see the users regularly not only to adjust the game difficulty according to the participants' needs, but also to assess changes in mobility by using the Timed Up and Go test. Visits by the physiotherapists were very much appreciated by participants who reported, that they felt cared for:

> *„So, she* [physiotherapist] *is really and she said that she will call me again, I, If it* [shoulder pain] *got better, and if not, so I feel very much cared for." (Participant B)*

Users explained that it was easy to turn the platform on and start the games. The platform guided participants through the whole exergaming session, asking them if they wanted to start playing after turning it on and telling them how to get into the proper position, so that the platform could adjust its sensor to the users. In between games, the platform asked users about the difficulty of the game on a 10 point Likert scale from 1 (very easy) to 10 (very difficult) and after a short break told them to sit quietly to start the next game.

3.3 Level of Game Difficulty

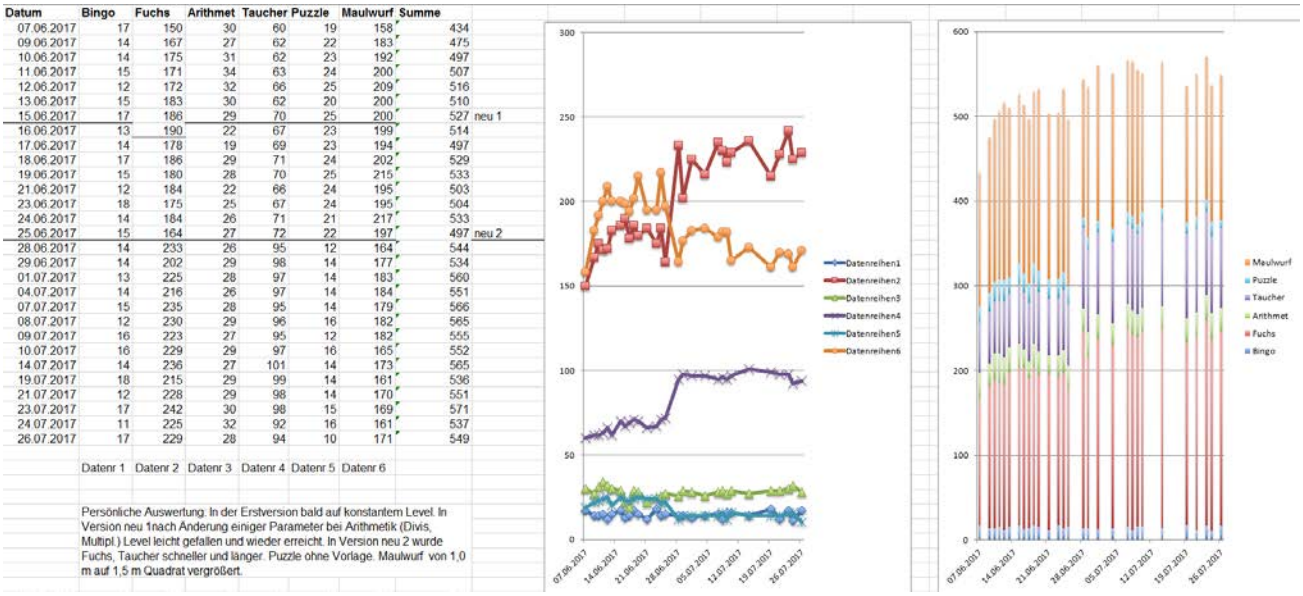
The option to evaluate the level of difficulty of each game proved to be a rather difficult task for the test users. They generally thought that the games were not too exhausting, saying that they would have preferred the game duration to be longer sometimes. In Austria, one of the users often chose the middle of the 10-point Likert-Scale, rating it as neither too difficult nor too easy. In this sense, he suggested the option of setting the duration of a game according to ones' needs and likes to maximize the enjoyment aspect and health impact. Also, giving examples of how someone was supposed to feel after an exhausting or not exhausting game would make the evaluation of the game difficulty easier. Still, the other user didn't have any problems with evaluating the level of difficulty and added that she almost always set the cursor at "not difficult" at the beginning of the test phase. In the Netherlands, no problems occurred with evaluating the level of difficulty.

3.4 Self-motivation and Ambition

At the end of each session, users were surprised about how easy the platform turned itself off without them having to put much effort into it.

In addition, participants also interacted with the platform by for instance talking to it, speaking aloud in general and laughing at simple mistakes they made while playing games:

> *„It's also good entertainment and I (laughs) and I also talk to the game, the Bingo game." (Participant A)*



Datum	Bingo	Fuchs	Arithmet	Taucher	Puzzle	Maulwurf	Summe	
07.06.2017	17	150	30	60	19	158	434	
09.06.2017	14	167	27	62	22	183	475	
10.06.2017	14	175	31	62	23	192	497	
11.06.2017	15	171	34	63	24	200	507	
12.06.2017	12	172	32	66	25	209	516	
13.06.2017	15	183	30	62	20	200	510	
15.06.2017	17	186	29	70	25	200	527	neu 1
16.06.2017	13	190	22	67	23	199	514	
17.06.2017	14	178	19	69	23	194	497	
18.06.2017	17	186	29	71	24	202	529	
19.06.2017	15	180	28	70	25	215	533	
21.06.2017	12	184	22	66	24	195	503	
23.06.2017	18	175	25	67	24	195	504	
24.06.2017	14	184	26	71	21	217	533	
25.06.2017	15	164	27	72	22	197	497	neu 2
28.06.2017	14	233	26	95	12	164	544	
29.06.2017	14	202	29	98	14	177	534	
01.07.2017	13	225	28	97	14	183	560	
04.07.2017	14	216	26	97	14	184	551	
07.07.2017	15	235	28	95	14	179	566	
08.07.2017	12	230	29	96	16	182	565	
09.07.2017	16	223	27	95	12	182	555	
10.07.2017	16	229	29	97	16	165	552	
14.07.2017	14	236	27	101	14	173	565	
19.07.2017	18	215	29	99	14	161	536	
21.07.2017	12	228	29	98	14	170	551	
23.07.2017	17	242	30	98	15	169	571	
24.07.2017	11	225	32	92	16	161	537	
26.07.2017	17	229	28	94	10	171	549	

Datenr 1 Datenr 2 Datenr 3 Datenr 4 Datenr 5 Datenr 6

Persönliche Auswertung. In der Erstversion bald auf konstantem Level. In Version neu 1nach Änderung einiger Parameter bei Arithmetik (Divis, Multipl.) Level leicht gefallen und wieder erreicht. In Version neu 2 wurde Fuchs, Taucher schneller und länger. Puzzle ohne Vorlage. Maulwurf von 1,0 m auf 1,5 m Quadrat vergrößert.

Figure 1: Personal Gaming Statistics by participant A

Communication with users or rather feedback by the platform was very much appreciated. Users received not only information about their score at the end of a game as well as guidance on how to properly position themselves, but even feedback in terms of praise, especially when a new high score was achieved. Feedback like "well done" or "you are getting better" was an additional motivation to play and get better. And the analysis even showed that one of the users reflected about which time of the day would be the best to play to achieve a higher score. Surprisingly, users were able to remember previous scores and two of them even kept notice by developing personal and detailed statistics and diagrams of his scores on paper and using Microsoft Excel (see Figure 1). One of the statistics contained notes about visits from the physiotherapists, who set the games to a more difficult setting each time and showed how the users' scores dropped after an intervention by the physiotherapist and again inclined after a week or two. The document also includes a short memo of why changes in performance occurred and shows how the participants scores improved gradually by playing almost every day.

However, some users stressed that the variety of games was getting boring after a few weeks of playing the same games. One problem was that the games are being playing in the same order every day and need to at least be changed in order to diversify the gaming experience a bit. It was suggested to change the games after a few months and let users play new games that would challenge them differently:

> *"Yes, in a certain way I have.. I am a type, I am quite ambitious. So then I would get those points and I know what's coming. I throw high and low, so to say, but if you did that for two months now, you're a bit done with it." (Participant C)*

3.5 Feedback provided by Gaming Platform

Nevertheless, feedback provided by the system often confused users, when they received rather neutral feedback, even though they scored higher than the previous time:

> *„And today I have 192 and i have really stumbled .. and then and I thought oh that's a lot, that's when he* [the system] *usually … no gratulating word (laughs) but I knew, 192 points is a lit (laughs) for my standards." (Participant B)*

Furthermore, one user was annoyed when receiving positive feedback even though he scored low, saying that getting positive feedback every time he played, even though he had a low score, would fail to be a motivation.

Regarding the score achievements for each game, especially in Austria, test users were confused by how the points could be achieved. Both users insisted on a few scores calculated wrong by the platform, wherefore they didn't get as many points as they thought they would, even though they felt good about their performance in the sessions. After a few incidents, one of the participants had the idea of looking up further information about the calculation criteria in the information booklet, but was disappointed when he couldn't find an explanation.

3.6 Information booklet

Furthermore, details about how to play games (e.g. positioning, execution of specific movements) have not been explained sufficiently by the platform and/or the physiotherapists. Uncertainty couldn't get cleared by watching the tutorial for each game, as participants still didn't know, what they did wrong to achieve as few points as they did:

> *„I don't have it worked out, with the Bingo Game, I think one has to get up" (Participant A)*

This indicates that the information booklet is incomplete and should provide more information about general topics like how the scoring system works or how exactly to perform tasks demanded from the platform.

3.7 Game Settings and Tutorial Videos

After having used the platform every day for a few weeks, especially the test user who was physically mobile, fit and younger mentioned that he felt impatient with the platform due to long pauses in between games. He explained, that an experienced user already knows which game comes next and therefore the pause in between two games is felt as unnecessarily long:

> *„if you are used to the program than it takes a little too long. Then the next one is Bingo, then there is nothing, you have to wait, and you know, you know anyway what you are supposed to do, instead you can also just start." (Participant A)*

However, the other user enjoyed the length of the pauses by stating that:

> *„There is a break every now and then, but not too long, otherwise I get inpatient, but it is well timed, for me it is well timed." (Participant B)*

Furthermore, one user explained that the tutorial to each game was unnecessary and got annoyed with it after having seen it a few times. To skip the video, he had to get out of the proper exercising position, walk to the platform console and manually press the skip button. He suggested that the use of a remote control may solve this problem. In comparison, other users enjoyed seeing the tutorial again every time when using the platform, as they were having problems remembering how the games are played the right way.

During the first test phase the platform had no pause setting. A pause setting is necessary to stop the game immediately, when for instance users need a break from playing or have to pause the game when the phone rings. A pause setting (e.g. pressing a pause button or having an implemented voice control and saying "stop") prevents the game from continuing while the user is unable to play due to unforeseen events to not lose any points:

> *„And the telephone rings, and the doorbell rings (laughs), oh how does that work, ah there is a cross that one can press on the corner, maybe one could also say "stop" or something, I don't know." (Participant A)*

3.8 Gaming Routine and Skill Improvement

Users soon developed a habit of playing their games at certain times and got used to playing the games every day rather fast, having developed a routine they followed regularly. Using the platform was likely to be linked to other daily routines which users had already developed in their everyday lives:

> *„After playing the games I make the exercises from my physiotherapist, then I sit down and read." (Participant B)*

Using the platform was perceived as entertainment, either after breakfast in order to properly wake up and have a good start into the day, or after dinner before going to sleep. One of the users explained that he was happy to come home in the evening and let the day die out by playing the games, a quite relaxing activity and a diversion in the day-to-day-life before going to sleep, replacing other activities like watching TV or lying on the couch. One user mentioned that he always played the exergames at the end of a day rather late at night right before he went to sleep.

Another user also mentioned that she had a lot of time to spare anyway and thus using the platform was another task that saved her from boredom and gave her something to do. Apart from that, the platform motivated to think and move, which was very important for both users and improved their day.

These statements by test users indicate that users are able to develop a routine using the platform at different - individually chosen - times of day. This stresses the importance and benefit of the EnterTrain system which allows users to play at a time which is convenient for them.

Another aspect of using the platform was that in the beginning of the test phase participants underestimated the challenges provided by the game. Later, they learned that the tasks (especially the cognitive tasks) were not as easy as expected and criticized themselves for overestimating their capabilities.

Additionally, it was interesting that not only higher scores throughout the test phase indicate improvements in mobility and flexibility, but that one user herself perceived massive improvements in flexibility, which she traced back to using the platform on a daily basis:

> *"Yes, I notice that, it makes me more flexible. I do sports one afternoon in the week, but that's closed now for six weeks in the summer. And now they are doing it here at the Monday mornings, so I can join. Yes, you're right, it makes you fitter, this, it helps. That's the most important thing." (Participant C)*

3.9 Multiplayer Mode

Lastly, participants have been asked about a multiplayer mode for two people and what they would think about playing the games they've been playing on their own with another person, e.g. an external care-taker or a relative. Although one of the participants was excited about the idea, saying that it would be a great addition to the game, the other person shortly mentioned that there was no one she could think of, who would like to play with her. Also, if acquaintances were interested in using the platform with the test users, one user explained, they would always have to come and visit him to try it out which would be rather impractical.

Still, some arguments have displayed the idea in a positive light:

> *„Yes that would be great. Because it also triggers the competitive situation and everyone of course wants to win. And it also that one could show the other one* [player] *something." (Participant A)*

4 Mobility Assessments

During the 8-week test period physiotherapists visited the test users three times including regular follow-up phone calls. The regular visits and assessments were very well received by the participants. After each assessment the levels of game difficulty were adapted according to the results and current health status. Verbal feedback and comments by participants were written down by the physiotherapists and are summarized for each specific game in a separate table (see 3.4.1 - 3.4.5).

The data represent the results of 5 assessments in a period of 2 months. The assessments took place on the first day of the study (week 0), four weeks later (week 4) and on the last day of the study (week 8). 4 users were included in the study (2 in Austria and 2 in Holland). 2 physiotherapists conducted the assessments (users 1 and 2 were evaluated by the physiotherapist in Austria and users 3 and 4 by the physiotherapist in Holland). All the tests were conducted one after another. All users were evaluated according to following standardized mobility assessments: "*Timed up and go*" (TUG) and "*Short physical performance battery*" (SPPB). Additionally, habitual gait time of 3-meter distance (HGT) and habitual stand-up time from a standard chair (HST) were registered. The TUG and SPPB were conducted once and the HGT and HST 3 times at each assessment day. Also, the users were asked to evaluate their pain (if existing) in a 10-point "Visual analogue scale" (VAS). A higher score indicates a higher pain intensity. The SPPB is a 12-point score, which evaluates 3 different physical performances (Guralnik., et al. 2000). Higher score represents a better physical condition. The TUG measures the time to stand up from a chair, walk 3 meters, turn around, walk back and take a seat again (Podsiadlo et al., 1991). The less time the user needs, the better is the performance. HGT and HST estimate the user´s performance time (gait and sit-to-stand respectively) at a regular self-paced motion speed. To conduct the assessments, some additional materials, like a standard chair without armrest, tape line and a stopwatch, were used.

Results

- User 1

Considering each single assessment, similar results can be observed over the time. The registered values were rather constant, showing only little fluctuation comparing all 3 assessment times. The user showed high scores in SPPB, average was 11.67 points (11-12 points). An average TUG time was 8.85 sec (8.57-9.28 sec). An average HST was 1.78 (1.62-1.89 sec) and an average HGT was 3.60 sec (3.52-3.69 sec). An average pain was 2.5 points (2-3 points) in VAS.

- User 2

When the TUG time, HST and HGT showed constancy in registered values, then SPPB showed the highest variation between measurement days. The SPPB score changed from 4 points (week 0) to 8 points (week 4) to 6 points (week 8). Thereby, an average score was 6 points. The TUG time was nearly identical (17.00 sec and 16.68 sec respectively) at first 2 evaluations, it was 15.82 sec at the last test day. An average TUG time was 16.50 sec. An average HGT was 6.75 sec (6.08-7.64) and an average HST was 2.41 sec (1.96-2.72 sec). The TUG time correlates with HST, showing a slight trend of a constant improvement. In contrary, the SPPB score suddenly increases at week 4 and decreases again at week 8, meanwhile as the TUG score remains to stay on week 4 as it was on week 0. An average pain was 4.5 points (4-5 points).

- User 3

Considering each test, slight fluctuations can be observed during the assessment period. The highest variation can be observed in SPPB score. An average was 10.67 points (9-12 points). The SPPB score changed from 9 points (week 0) to maximum 12 points (week 4) to 11 points

(week 8). An average TUG time was 9.03 sec (7.79-10.40 sec). An average HGT was 3.16 sec (2.80-3.42 sec). An average HST was 1.45 sec (0.87-2.37 sec). Both HGT and HST show a slight trend of

constant improvement. However, the physiotherapist reported, that the user kept conducting the activity very quickly, although the instructions were given to raise as she/he normally does. An average VAS was 1.33 points (0-4). The pain disappeared by the end of the study.

- User 4

The measurement results of each test showed only slight fluctuation during the measurement period. The SPPB showed a slight increasing trend. The result was 8 points (week 0), 9 points (week 4) and 10 points (week 8). An average TUG time was 10.37 sec (9.81- 10.80). An average HGT was 3.78 sec (3.36-4.69). An average HST was 1.27 sec (0.63-2.11 sec). Both SPPB and HST show a slight trend of a constant improvement. Again, although the instruction from a physiotherapist was to stand up as the user is used to (at a normal regular speed), it was still done rather quickly. The average pain was 1.33 sec (0-4 points). The pain was gone by the end of the study.

Discussion

Regarding average performances of all 4 users, it can be observed, that the results remained similar during the whole assessment period. Only a slight fluctuation (rather a slight improvement) could be noticed by most of the assessments. However, the data differs only a little and should be tested in a bigger set of users to make statements about the change of physical condition of users over the time.

Moreover, the fluctuations of data can be influenced by various factors. Firstly, by measurement error, since the data is registered using only a stopwatch. Secondly, each test was not conducted more than one time in a row, while the users were older adults and fatigue had to be taken into account. More repetitions of each test would have given more accuracy. Thirdly, the users were verbally instructed before the assessment took place. However, the comprehension and an actual performance could not be influenced by the health professional. For example, the physiotherapist instructed the user to raise from a chair at his/her normal regular speed. Still, the user kept standing up in a very high speed (noticed by user 3 and 4).

To sum up, it can be observed, that the users 1 and 3, who scored in average >10 points in SPPB, needed less than 10.00 sec for TUG. These findings support the standardized interpretations of SPPB and TUG, in which a performance less than 10.00 sec in TUG is considered to be a good performance as well the performance 10-12 points in SPPB. In contrast, the user 1 scored in average 6 points at SPPB and needed in average significantly more time (16.50 sec) for TUG. These findings correlate to the interpretations of TUG and SPPB, since the performance >14 sec in TUG indicates a higher risk of fall and a score 0-6 points in SPPB is considered to be insufficient and therefore elevates the risk of falls (Shumway-Cook et al., 2000; Guralnik et al., 2000). 2 users reported a similar VAS score, and 2 users claimed a major change in VAS score during the study. The interpretation of HST remain unclear, since no regularity can be seen jet comparing different users with different physical status. Another reason for such a data can be the problematic of interpreting the task in overall from the side of users. It means, that is difficult for the users to differentiate between a slow and a fast sit-to-stand activity.

5 Technical Requirements

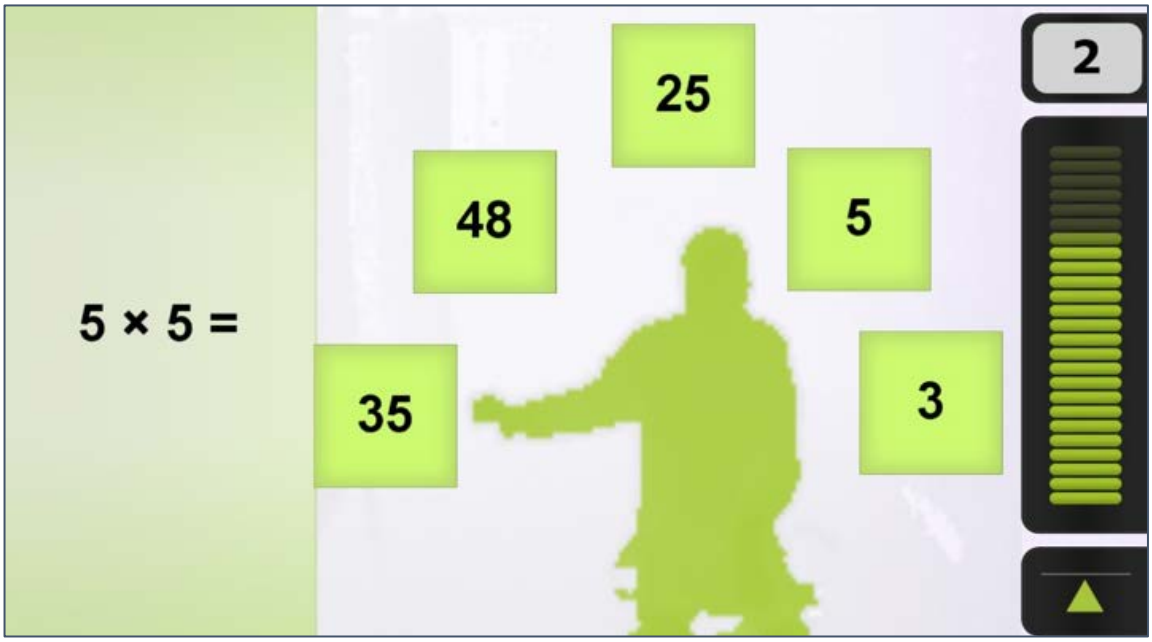
The platform consisted of six different games, whereas one of the participants only got five games due to the difficulty of the sixth game (the game asked players to get up from the chair and take a few steps forward and backward). Physiotherapists decided which of the games were suitable for each person and manually configured the platform settings. Playing the games was enjoyed in general and successfully completely almost every day as asked for.

The duration of each session was approximately 30 minutes. Participants explained that it was easy to get into the correct position in order to start playing the games (a certain distance had to be kept between the player and the system) and the platform gave feedback on which steps followed next. Before every game a short tutorial video was shown to the users describing how to play each game, which was perceived differently between users. One of the users was annoyed after having seen the tutorial every day for a few weeks, stating that after a certain time it is no longer needed to watch the tutorial, whereas the other user liked seeing the tutorial each time to freshen up her memory. Additionally, the tutorials allowed for short breaks in-between the games.

5.1 Game: Calculation

The calculation game proved to be a very cognitively and physically challenging exercise. The game required the users to reach out with their arms towards the right answer to a previously posed task as fast as possible to achieve a high score while the platform is counting down the time (see Figure 2).

The game aims at strengthening both arm and shoulder muscles as well as improving mobility in general. The calculations can vary in difficulty level and in time limit to answer, also by implementing advanced calculation types (multiplication and division).



Picture 1 Calculation game by SilverFit

The calculation game was the game which was most enjoyed by test users and challenged them to logical thinking.

One of the users mentioned, that it was her favorite game of all:

> *"That was what fascinated me the most, if I, how far I can come, not, yeah. That I especially liked." (Participant B)*

In the beginning, users underestimated this game's difficulty in particular and said that they have been calculating their whole lives, wherefore they would be sub challenged and probably bored with that game. However, it occurred that users have criticized themselves for thinking about it being too easy for them at first and said that they had problems solving the tasks in time.

The interviews showed that participants set a focus on how much fun playing this game was and that they have already found ways to cheat on the system by guessing and trying to find out the last figure of the solution at first to be quicker and guess more easily. Users felt that their cognitive skills have improved rather fast. Also the game didn't ever get boring for users and kept users busy with an activity they wouldn't do otherwise:

> *"Calculating can be the same, because all of these are different. Because when I started, calculating was minus and plus and now it's already multiplying. And you see, that's something you lost […] And keeping busy with calculating, which I wouldn't do otherwise"*

In addition, one of the users had a problem understanding the division sign. She referred to having learned the division sign in school as follows ":", which is still used in Austrian schools, but the game showed an internationally used variation: "÷".

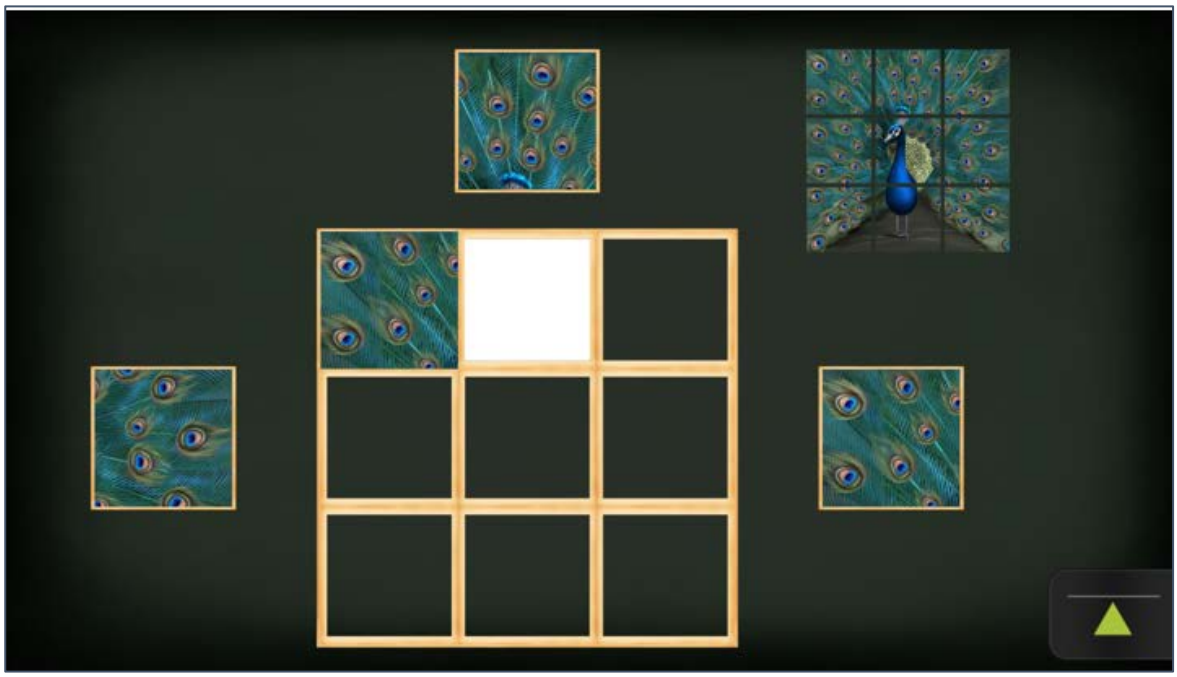
Arithmetic
o She subconsciously changes division and multiplication. She also believes, that the left side/left hand is integrated less in the game. By bigger calculations she is rather estimating than really calculating.
o The user claims this game to be the most emotional of all for him. He remembers very strongly his school time and math lessons. The settings are ok like that.
o He couldn't stretch his right arm far enough, because the closet was too close. Maximum distance to stretch is distance 3 for his right arm. He likes games with numbers. He had to calculate a lot during his working period.
o Because of the space in her room, the left movement distance couldn't be increased. She likes this exercise, because of the brain exercises.

Table 3: Observations made by the physiotherapists regarding the arithmetic game

5.2 Game: Puzzle

The puzzle game focusses on improving stability and mobility by training the back, abdominal, upper leg, gluteal and side muscles. Users have to lean to the left or the right while sitting or standing up to choose the right puzzle pieces situated on the sides and above the illustration in order to put it in the spot highlighted in white color by the platform. Therefore, different motives have been chosen to make the game optically appealing. In regards to the differing motives and challenging single puzzle pieces, no time limit is set to solve the puzzle.

The puzzle game was perceived as rather difficult for one user. Images like the one in picture 3 have challenged her because of the similarities of single puzzle pieces. The puzzle not only focused on



Picture 2: Puzzle game by SilverFit

challenging the physical fitness of the player, but also engaged in cognitive arousal. One of the users mentioned in every interview that she underestimated the game and couldn't solve every puzzle:

> *"but right at the beginning i was boastful, I already told you that, i think the puzzle, that i have never actually liked and well good, but that's just part of the game, do it anyway (laughs) and then I noticed, I don't even get along and I thought I'd be sub challenged" (Participant B)*

One participant criticized the size of the puzzle. He explained, that he had problems seeing the display properly because the distance between his seat and the monitor was too big:

> *„the puzzle is relatively small, with one i've had to look five times, is that the piece that fits or not." (Participant A)*

He continued by saying, the complete puzzle showed in the upper right corner as assistance resulted in a rather small illustration, in which single pieces are to be put in. This problem however was solved by introducing a more difficult level later. To make the puzzle game more difficult, the platform hid the original and users had to solve the puzzle without knowing what it looked like in whole. Therefore, the illustration was enlarged and the participant could see it more easily.

> *„I now play the puzzle without the whole thing shown. It's easier in that the illustration is expanded. You don't have the whole and the puzzle shown, but now it's relatively big, I have, I think only four boxes, four times four is sixteen boxes, now it's enjoyable." (Participant A)*

Another issue, that hasn't been considered is that one test user has a moderate color-blindness. This often made it difficult differentiating between two similar puzzle pieces. Also, after having put a piece in the wrong spot, it was difficult for him to move it to another spot:

> *"With the flowers, perhaps this time it went fast, but need this tale here or need it to be there, and then I think ow well he need to be there but then I have some troubles to get it there. Not really the good movement. […] where I had trouble, but that is because of me, that were my eyes, I am modestly colour blind." (Participant D)*

Puzzle
o The user reported, that yesterday the system shut down on itself during performing the „Puzzle“. This was the second time as something like this happened. She still has coordination problems considering moving to left or right side. She has to think a lot before deciding a right movement direction.
o Since the game settings cause the disappearance of the example, a memory-type puzzle (in which each piece contains an individual image) may not be appropriate, since the example appears/ disappears very quickly.
o He couldn't see the pieces of the puzzle well enough if the setting was more than 9 pieces, That's why 9 pieces were selected the whole time. Physically he could do more repetitions, but he couldn't see it properly.
o Some pictures are very hard to do, especially the ones with the flowers she mentioned. Sometimes she wants to move too fast, and therefore selects the wrong answer. However, she thought if it as extra movement.

Table 4: Observations made by physiotherapists regarding the puzzle game

5.3 Game: Fox

The fox game aims at strengthening the upper body, specifically the core/abdominal and lower back area. Slightly different to the puzzle game, the fox game is designed to stabilize the upper body muscularity and the vertebral column by leaning to the left and right. In this game, the user represents the fox and has to either catch berries or avoid branches falling from the sky.

The game can be set in different levels of difficulty, in which the speed of the items falling from the sky and the range of motion having to be used by the player to catch or avoid falling items can vary.

Picture 3: Fox game by SilverFit

Also arms and shoulders can be trained in a more difficult setting, in which a chicken has to be caught by the fox aka the user. In this case, the chicken can be caught by reaching out above towards the chicken with their arms. One point can be scored by catching chicken and berries, whereas if the user gets hit by a branch they lose two points.

Users liked playing the fox game, even though they mentioned that it was difficult for them to react at more advanced levels on time because the items fell down at higher speed:

> *„only if you don't watch out, or, this is relatively, only short, the duration, in which you can see it" (Participant A)*

Another user pointed out that the fox looked cute and that the game had great entertainment value.

Still, after a game setting has been set to an easier level for one user, he was unhappy about it and mentioned, that it was now too easy for him and boring. He continued by saying that the previous level of difficulty included falling branches, which was too difficult for him from time to time, but by only focusing on the fox catching the grapes, the game wouldn't be interesting any more:

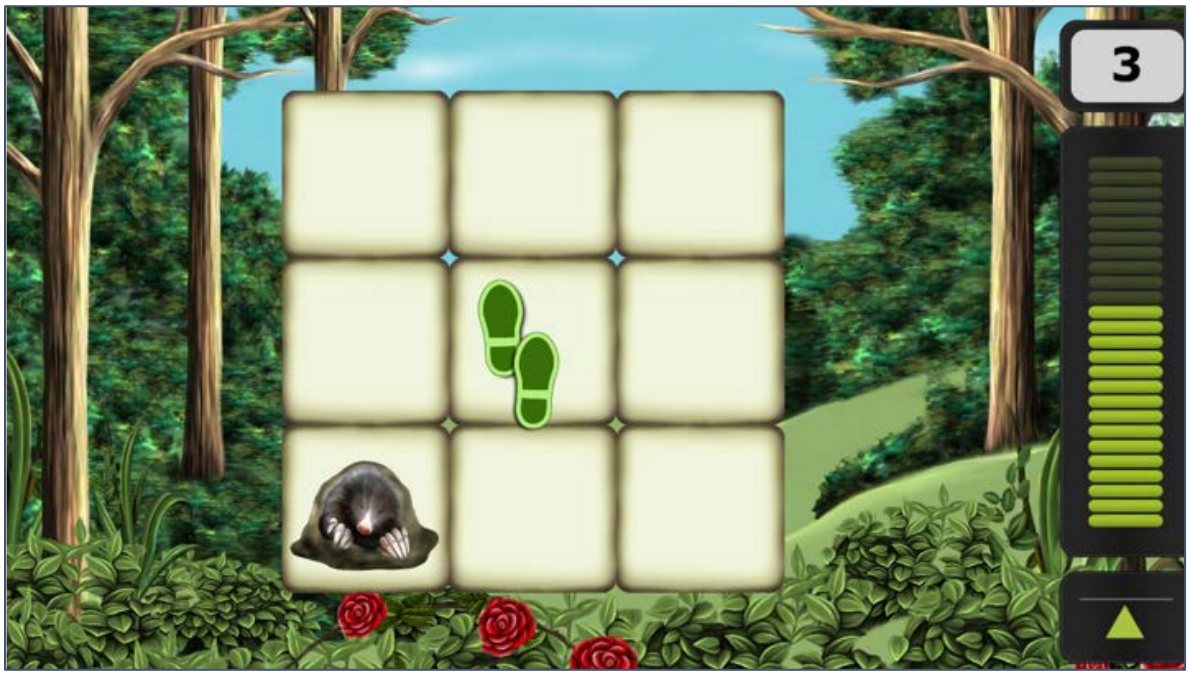
> *"Well.. I would change the game with the fox, to bring in the branches again. Now I see only the fox, that's boring. On a certain moment you've seen everything. With the branch, I needed to split my attention and that was not easy. That was the reason she took it away, to make it more simple. Yes.. With the branch I tried to do it better and to catch things.. but that's not possible anymore." (Participant D)*

Fox
o The game makes her really enthusiastic. She said, that it is not possible to pick all the grapes, since they are divided all over the screen on the same time. She would like to be able to catch all of them.
o The game setting is completely ok for him. The game is very amusing. The user enjoys the high speed as a challenge.
o The fox with the branch and the chicken were sometimes confusing for him. The last two weeks of this test phase, he exercised more and could remember and redo the exercise properly.
o This game is her favorite, especially the setting with the branch and the chicken. It is extra challenging, and she writes down her score. She can then easily show and see her scores. She knows that the scores are also visualized in the system, but then she would have to turn on the system when she had a visitor.

Table 5: Observations made by physiotherapists regarding the fox game

5.4 Game: Mole

The mole game aims at improving balance and coordination while walking and is one of the more difficult games provided by the platform. The user stands on a 1m²-field divided in nine spots. Each time a mole appears in one of the nine spots, the participant has to step on it so it disappears again. Each mole that is being stepped on counts as one point.



Picture 4: Mole game by SilverFit

Additionally, the level of difficulty can be modified by implementing mice running over the field, which are also meant to be stepped on by the player. Furthermore, ladybugs, who appear from time to time, should be avoided. Each time a ladybug touches the player, they lose two points. If these tasks are still too easy, the field in which the user moves can be expanded to 2,25m².

Only one user in Austria was allowed to play this game due to the physical fitness. It was reported that the sensor didn't function properly in this game. Playing the game was made difficult because the sensor didn't capture the users position and thus reacted with a time lag:

> *„I experienced that it often doesn't react immediately. The mole is still quacking even though you're in the right field." (Participant A)*

The user reported that this was one of the more challenging games. It was quite hard to only step on moles, as there also appeared many ladybugs as the game was set to a more difficult level and one had to be very precise in where to stand so the sensor would fully recognize the players' movement. Stepping into a specified field to step on the mole became even more difficult when the field grew to 2,25m² as an even more difficult variation of the game throughout the last weeks of the test phase:

> *„This mole game has been expanded to 1,5 metres, sometimes you can step into the right field only narrowly" (Participant A)*

Mole
o The user is not supposed to play the mole-game.
o He enjoys the game with increased movement distance. He recommended to add on the same time more ladybirds (since they are very sensitive) to make the game more difficult in the future. He said that 5 minutes makes him sweating –> means that the game settings are a good challenge for him.
o There was enough space in the room for this game. He played this correctly.
o The mole couldn't be selected, because of the lack of space in her room. Her living room was very full with furniture. Physically, she could have done the mole easily.

Table 6: Observations made by physiotherapists regarding the mole game

5.5 Game: Deep Sea Diver

To execute the deep sea diver game, a stretchable resistance or gymnastics band is used, depending on the users' strength. The aim of this game is to strengthen arms and shoulders as well as the upper back muscles and helps to develop an upright posture.

The intention of the game is to collect as many shells as possible, each collected shell being the equivalent of one point for the overall score at the end of the session. By stretching the band, the deep sea diver swims higher on the display to collect shells higher in the sea, whereas when the gymnastics band is let loose, the deep sea diver lets itself sink to collect shells nearer to the ground. Therefore, what's of importance is that the band is stretched in the proper way to make sure no injuries occur.

Regarding this, the band is supposed to be stretched in front and a little above the head to shoulder width, so that not only the sensor can recognize the band respectively the movement, but also to stimulate the designated muscles for the exercise and prevent injury.

Picture 5: Deep sea diver game by SilverFit

The deep sea diver game was approved to be a rather difficult game to master. To position the arms and the band properly, as well as the stretching of the band itself was a complex exercise and getting into the right position was a difficult goal for older adults. Thus the game was problematic for all four users and had to be supervised regularly and explained a few times by the physiotherapists. One test user wasn't able to fully figure out how to stretch the band in order to achieve a higher score throughout the whole test phase:

> *"I still don't get it. At least, I have the impression that I still don't have the right movements." (Participant D)*

Even though participants were amused by the game, a few problems occurred. One user, who has had shoulder issues prior to the test phase, had her shoulder pain worsen throughout the first week, due to a dubiety of how to use the resistance band properly. Hence she had to stop playing the game for a short period of time to recover:

> *„Later I thought that can only be because of that, it's the game, hands up and I've confused this and have held my hands up while stretching and that was especially bad. And by this I probably have, probably nothing too bad happened, because, I mean, if I can live with it for two days, I will overcome it." (Participant B)*

This indicates that the speed of the game was too fast for the participant. She also mentioned, that the game had a time lag, which worsened her shoulder pain. She explained, that she mistook one movement for another because the time lag confused her, which let her move too fast and resulted in her shoulder pain getting worse. The last time she was interviewed, she complained about still having problems with the time lag, that couldn't be fixed in the two-month test phase, and thus lost points in the overall score.

Another user repeatedly stated that the game was too exhausting for his arms and that doing the exercises would hurt his arms:

"Pulling that thing is a bit complicated. That hurts my arms." (Participant D)

This problem couldn't be solved throughout the two-month test phase, which indicates that this game isn't suitable for everyone.

The time lag in the deep sea diver game was a dominant topic in most interviews. All users had problems with catching all the shells, not because of individual talent but because the time lag didn't allow to.

> *„Yes he doesn't react fast enough, because I can't just stretch earlier, I indeed know, now this appears, but I still have shells that I want to catch at the bottom and I need to stay there until I know the last shell and then stretch, no. And afterwards it shoots to the upwards and the first* [shell] *is golden, this one surely counts more, that one he doesn't catch." (Participant B)*

In addition to the time lag, another problem was that the deep sea diver was controlled by the movement of the player, which was supposed to be captured by the sensor which didn't react at all in various situations. The test users later found out that the problem occurred not only due to the ignorance regarding the width of stretch that is supposed to be put on the resistance band but also, that the sensor couldn't recognize specific widths of the band due to slow capturing of the movements

> *„And the fish.. I don't know, one still has to, I haven't figured it out yet, so, if you stretch [the band], it jolts on the upper side, but when I have already loosened [the band], it sometimes doesn't go downwards and there it's always so.. and it then doesn't catch them [shells]." (Participant A)*

Again, the information booklet for participants wasn't able to answer questions regarding the proper execution of the game. Neither was a detailed explanation of how to place arms or how far to stretch the resistance band to the sides given, nor could the technical deficits be easily explained by technicians. Thus, a more detailed information booklet would be an advantage for future users who have a low capacity for remembering, could help solve problems regarding the execution of tasks without having to call a physiotherapist or technician and thus boost their self-esteem.

Another aspect of the game that was perceived as disruptive, was the incomprehensible scoring system. Both participants mentioned, that they couldn't understand the output of the final score:

> *„Well what what was irritating was the score, the score often is unclear […] But why do I get 12 points one time and 17 points the other time, I haven't noticed any difference." (Participant A)*

Participants felt as if they received a lower score than they deserved, which they said was the platforms fault by giving them fewer points than actually achieved.

Apart from that, the game was perceived as very challenging due to the elasticity of the resistance band, which varied according to the users' physical strength. Stretching the band for a longer period of time stimulated the shoulders and arms noticeable:

> *"it's already after 20 seconds or.. I don't know, no, nonsene, it's after a minute or so that you can feel it […] but it's nicely challenging." (Participant A)*

An interesting detail regarding the stretching of the band was, that one user reflected on how this game could be too difficult for not too fit users. Even though various bands with various grades of elasticity can be used in this game, he mentioned that the game was not easy to execute and users were likely to get injured. A requirement to play the deep sea diver or another difficult game would be being in good physical shape:

> *„Well I'd define it that one, who wants to play this would have to have a certain level of health. That means he has to have good vision, he doesn't need to listen, but he needs to be mobile to some extent, let's say he needs to, he needs to be able to stand up" (Participant A)*

Diver
o She has the feeling that the sensor doesn't follow the arms enough quickly (I believe, that her reaction time is a bit reduced). For that reason, she is still bringing her arms up. To collect the shells on the floor, she is even bending herself forwards and bringing the arms almost on the floor, but still nothing happens, says the user – the diver still swims above the shells.
o The sensor problems as described previously are still there. The user would need even a stronger rubber band, as he is using the green rubber band in double at the moment to increase the resistance. So maybe it would be an option to have also a stronger color in the selection in pilot 2?
o He didn't exercise a lot, so he was a little bit insecure about his performance. This exercise did not change a lot, because the first setting was hard enough for him. The exercise was challenging enough with the green elastic band.
o This exercise is not changed a lot, because the first setting was hard enough for her. The exercise was challenging enough with the green elastic band.

Table 7: Observations made by physiotherapists regarding the deep sea diver game

5.6 Game: Bingo

At last, the bingo game trained the muscles in the pelvic-area as well as the thighs. In this game, the main focus lay on trying to stand up and improving gait and getting up from a sitting position in day-to-day life.

While playing, the display shows a bingo-card with various numbers next to a bingo ball with one number written on it. The intention of the game is for the user to stand up from a sitting position, as soon as the number shown on the ball matches one of the numbers on the bingo-card. By training to stand up, major improvements in gait and standing up can be made and the user can stand up more easily the more it's practiced. The faster and easier the user is able to stand up and react to the number shown on the ball,

the safer walking and standing up will be. For each ticked off number on the bingo-card, the user

Picture 6: Bingo game by SilverFit

receives one point.

Users reported about talking to the platform while playing the game, saying the numbers aloud to remember them more easily:

> *"I also talk to the game, playing bingo. When I play bingo, I read, for example which figures are difficult are always the first figures, because you receive the picture* [bingo board] *and then there's, then you have to scan aha ah two is not on it* [bingo board]*, but then I read it aloud, 17 18 22 is three four five and then there's seven, ah! I've just had seven (laughs) Stand up! (Participant A)*

Even though the game was easily comprehensible, the scoring system was not so easily understood:

> *„But why do I get 12 points one time and 17 points the other time, I haven't noticed any difference, I have solved every task, especially with Bingo I noticed that." (Participant A)*

Users didn't understand why they received a lower score at the end of the game than on other days even though feeling as though the task was solved as easily and successfully as the previous times. Also, there was no information to be found about this in the information booklet. One user even considered failing in order to better understand how the platform decides if he receives a point or not:

> *„I even thought, I will make a mistake on purpose, what happens if I don't see or find one number in Bingo. Do you receive even less or will there be points reduced, but I haven't tried it in the end." (Participant A)*

Developing individual methods in order to achieve a new high score was still a pleasant way to play the game:

> *"But you see on certain point, that I imagine myself then… then sitting in a plan, from 1 till 10, from 11/12 till 20 and so on, and on certain moment you recognize it where to go to, you know which number it is. In which row you need to search. Haha, I find that smart of myself." (Participant D)*

Bingo
o She feels that she is doing the exercise well. The reaction time is ok and she feels, that she is not doing mistakes.
o The game settings are ok. Nevertheless, user recommended to make the game in whole more active/lively, means that there is too much unnecessary waiting in his point of view. For example, the waiting time (when a number doesn´t appear on the screen and he has to wait for the next ball) is too long is too long for him.
o He enjoyed this game because of the brain exercise. He had a job working with numbers and figures.
o She likes this exercise. In the beginning she was a little bit tired after this exercise, but she feels that she is quicker with the sit-to-stand exercise and it's easier to do, despite the increased difficulty.

Table 8: Observations made by physiotherapists regarding the bingo game

6. Indications for Field Trials Phase 2

The objective of the two-month pilot-test-phase was to evaluate how the platform was perceived by test users. The analysis of the problem-centered interviews gave important insights concerning the use of the exergaming platform and what indications can be drawn for the second test phase of the field trials.

Generally, test users experienced the sensor-based platform as entertaining with the games provided not being too difficult but still challenging. The games didn't only focus on physical improvement but also on cognitive strengths. Therefore, the platform provided specific games to strengthen muscles for balance and gait improvement combined with a cognitively challenging note, which was a positive experience for both test users.

Picture 7 Participant in Austria with his certificate received after the test phase

6.1 Game Variety

Findings from analyzing the interviews stressed that the variety of games has been sufficient for a two-month period, but won't be enough for an upcoming 12-month test-phase. Even though the duration of one exergaming session is perceived as good (approx. 30 minutes ± 5 minutes), "not too short and not too long", there needs to be a broader spectrum of games available to be played for users to not get bored after a few weeks or months.

6.2 Difficulty Level

The analysis showed that it is crucial to select the games on the EnterTrain platform according to the physical and cognitive health of each test user. The deep sea diver game for instance was too difficult for the users because of the stretching of the gymnastics band and the execution of the proper movements; the puzzle game however was suitable for all test users. Also levels of difficulty are too far apart, meaning that one level of difficulty was too difficult for users and the less difficult level was too easy and hence boring.

6.3 Personal Score Feedback

Additionally, the feedback provided by the EnterTrain system needs to be more structured to not irritate users. As mentioned before, users couldn't understand why they received less praise than when they scored higher. Consistently neutral or more positive feedback according to one's score and the individual games' level of difficulty is important to keep users motivated throughout a longer period of time.

6.4 Pauses between Games

Another important issue worth considering for the 12-month test-phase is the need for matching the lengths of the pauses individually in between the games. It occurred that the pause lengths in between games were either perceived as too long and unpleasant, or as exactly the time needed to get ready for the next game. A way to solve this problem would be to let users configure this option themselves according to their needs.

6.5 Stop or Pause Button

To give the user more freedom while playing, a “Stop”- or “Pause”-button needs to be installed. Users have complained about not having the possibility to pause the game, if they get interrupted by a telephone call or the user needs to go to the bathroom.

6.6 Tutorial Videos

Correspondingly, the tutorial prior to the start of the game was perceived differently by the two test users. As a cognitively fitter and physically healthier person would find the repeatedly shown tutorial videos unnecessary and rather boring, another less fit person needs tutorial videos to remember the proper way to execute certain movements and/or how to score in the game. It is thus necessary to adjust tutorials according to individuals’ needs to keep the game interesting and fun, instead of something that has to be done by all users every single time. A suggestion to guarantee the most pleasurable exergaming experience is, again, to let the users decide themselves how often and if the explanation should be shown. Furthermore, standardized options can be implemented in the platforms software to let users choose if they would like to see the tutorial “every time”, “from time to time” or “never”. If chosen, the setting “from time to time” would show the tutorial in an interval of every third to fifth session.

6.7 Information Booklet

The information booklet needs to be more detailed with a lot more information on e.g. how the scoring system works or how to configure individual options by oneself. Also each game needs to be explained more detailed to guarantee^^1 the best possible execution of each exercise and secure users from injury.

6.8 Sensor detection

At last, the sensor system needs to be capturing users’ movements faster and more easily. Users complained about a time lag, that cost them points throughout the games. Also the sensor didn’t catch the exact spots participants moved in to e.g. avoid a ladybug or step on a mole in the mole game.

7. Conclusions

This report consolidated the main results of a two-month field trial phase with four test users in Austria and the Netherlands. Four test users aged between 77 and 88 years tested the EnterTrain platform for a period of 8 weeks between June and August 2017.

Generally, the analysis showed that the exergaming platform was well received by participants. For the 1st field pilot phase the platform consisted of five games, including the Bingo, Calculation, Puzzle, Mole and Fox game. The games challenged the participants both physically and cognitively. The games were regularly played, almost daily over a period of 8 weeks by all test users.

Most test users were eager to play and continuously mentioned in the interviews that they strived to score more points. Hence, they often remembered single scores for particular games, one user even developed his own gaming statistics in an excel sheet (as shown in Figure 1). Generally, test users described the platform as very user-friendly; most users did not have any issues to turn the system on or off. However, some important feedback regarding single features and functionalities could be gathered, including the availability of a pause-button. A pause-function will enable players to pause the game when e.g. the telephone rings. In regards to the game design the analysis showed that sometimes small issues caused irritations with some test users. An example in the calculation game included a confusion about the division sign used in the game, as it was unknown to one user as she learned another symbol at school. These results can be included in the design of the EnterTrain system as well as the description in the information booklet. Further, results from qualitative interviews showed that feedback about the participation in the research was received positively, especially regular visits by physiotherapists were much appreciated, as test users felt well taken care of.

Concluding, important feedback from end-users was gathered throughout the first field pilot phase which greatly impacts the further development of the EnterTrain system for the 2nd field trial phase. Including the further technical development of the platform, and mobility model (read more about this in D 3.1. "*System revisions*" report) but also specific features of the game design, and game introduction.

8. Literature

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9. Appendix

9.1 Baseline Study/ Interview with participants

The baseline interview aims to gather information about the personal background of the participant before the testing phase starts (it is NOT supposed to be a narrative or biographical interview).

Face-to-face interview: 20-30 minutes

1. **Introduction**

Firstly, please introduce yourself. Then, please continue with the baseline interview.

Thank you very much for your participation. May I please record the interview? You will remain anonymous, and no information will be passed on to third parties.

- **Age:**

I would like to ask you some personal questions. Please tell me how old are you?

- **Work history (if applicable):**

Can you tell me something about the job you did?

- **Current state of health :**

How would you describe your current well-being?

- **Exercise/fitness history**

Can you tell me something about your previous level of exercise?

- **Daily routine:**

Could you describe your usual daily routine?

- **Family background and social contacts:**

How would you describe the contact you have with your friends and family?

- **Current living situation:**

Can you please tell me something about your current living situation?

- **Current care situation:**

Do you at present receive any type of support with your household and/or care?

9.2 Pre-and Post Questionnaire

The survey discusses the topics health and technology. We ensure full confidentiality of all your answers. Only the University of Vienna and NFE have access to this data.

1. How would you generally describe your current health status?

Very good	Good	Fair	Poor
☐	☐	☐	☐

2. Do you feel or are you constrained when performing the following exercises?

		Fully applies	**Partly applies**	**Applies to a lesser extent**	**Does not apply**
a	Walk at a fast pace	☐	☐	☐	☐
b	Vacuum clean	☐	☐	☐	☐
c	Carry a shopping bag	☐	☐	☐	☐
d	Walk stairs	☐	☐	☐	☐
e	Bend over	☐	☐	☐	☐
f	Walk more than 1 kilometre on foot	☐	☐	☐	☐
g	Walk across a big street	☐	☐	☐	☐
h	Take a bath	☐	☐	☐	☐

How does the following statement apply?

3. My current health status limits the contact I have with my family and friends.

Fully applies	**Partly applies**	**Applies to a lesser extent**	**Does not apply**
☐	☐	☐	☐

4. The following set of questions discuss your personal experience of pain. Please indicate, how the following statements apply.

		Fully applies	**Partly applies**	**Applies to a lesser extent**	**Does not apply**
a	I do not feel any pain.	☐	☐	☐	☐
b	Due to my current pain I'm limited in to realize basic activities at home (for example getting dressed, taking a shower, brushing teeth)	☐	☐	☐	☐
c	Due to my current pain I'm limited to realize daily- and householdactivites at home (for example cooking, washing clothes, cleaning up, filling and emptying the dishwasher)	☐	☐	☐	☐

5. The following set of questions discusses your personal attitude towards technology. Please, indicate how the following statements apply.

		Fully applies	**Partly applies**	**Applies to a lesser extent**	**Does not apply**
a	In regard to new technologies I am very curious.	☐	☐	☐	☐
b	Dealing with new technological devises is usually overwhelming for me.	☐	☐	☐	☐
c	I'm interested to use new technical devices.	☐	☐	☐	☐
d	If I ran into problems with technological devises, I usually solve it myself.	☐	☐	☐	☐
e	I am scared to break new technological devises.	☐	☐	☐	☐

f	Whether I am success in dealing with new technologies, mostly depends on myself.	☐	☐	☐	☐

6. How often do you use the following devises?

		Daily	**At least once a week**	**At least once a month**	**Less than once a month**	**Never/ I do not have such a device**
a	Radio	☐	☐	☐	☐	☐
b	Television	☐	☐	☐	☐	☐
c	Mobilphone (Telephone with a keyboard)	☐	☐	☐	☐	☐
d	Smartphone (Telephone with a touchscreen)	☐	☐	☐	☐	☐
e	Computer	☐	☐	☐	☐	☐
f	Tablet (like a computer with a Touchscreen)	☐	☐	☐	☐	☐
g	Internet	☐	☐	☐	☐	☐

If you have answered the question 6e with the category *„Never/ I don't have such a device*" then please skip the last question.

7. How would you rate your computer skills on the scale on the left hand side?

To help you assess how good or bad your computer skills are, we have drawn a scale similar to a thermometer. The best possible skills are marked with a "100", the worst possible computer skills with "0". We would like to ask you to indicate on this scale how good or bad you believe your personal computer skills are. Please put your cross at the place of the scale that best reflects your computer skills.

9.3 Problem-centered interview

1. **Introduction**

Please introduce yourself. After this, start with the opening question (narrative story telling).

Thank you very much for your participation. May I please record the interview? You will remain anonymous, and no information will be passed on to third parties.

I would like to ask you a few questions. Please answer as freely as possible.

Main topics

- Platform use
- Impact on the daily routine
- Usability
- Survey feedback

2. **Questions to main topics**

Platform use

You have tested the platform for one week now. How are you finding it?

- What are your first impressions regarding the game platform?
- Have you shown the games to others such as your family members or care-givers?
- What do you think about the possibility of playing the games with someone else?
- What do you like about the platform?
- What do you dislike about the platform?

Impact on the daily routine

In your opinion, did something change about your daily routine in the last week?

- Do you think using the game platform became part of your daily routine?
- ***Do you play the games at regular times?***
- ***What do you usually do before and after playing the games?***

Usability

Have there been moments where you wanted to quit (or have quit) playing the games? If yes, can you describe the situation when it happened? What have you done afterwards?

- Would you describe the platform as user-friendly?
- How do you feel about the technical aspects (for instance games selection)?

Technology and Images of Ageing

- ***For whom do you think these games are best suited?***
- ***What roles does technology play in your personal ageing process?***

Survey feedback and motivation

How do you feel about participating in this research?

- Are there any aspects of the research you wish to discuss?
- How do you feel about the regular visit of the physiotherapist?
- ***What is your personal interest for taking part in this study?***
- ***Did you set yourself any goals that you would like to achieve by the end of the test phase?***