The Use of Exer-learning Games for Rehabilitation in Spa Clinics and at Home

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Abstract. This paper examines benefits of the exer-learning concept HOPSCOTCH for rehabilitation in spa clinics and at home. It describes a specific application to motivate obese patients in spa clinics for exercise. Furthermore results of an empirical study are reported where HOPSCOTCH was implemented in two spa clinics for a period of four weeks. The results of the study have shown that the concept is very convincing, but mainly depends on the content of the application; however the idea of HOPSCOTCH appeared to have a high potential to be used as a therapeutic agent in terms of motivation for exercise.

Keywords. Exercise, exer-learning games, motivation, rehabilitation, spa, obesity

Introduction

The process of rehabilitation after a serious disease or an accident demands long-term psychological and physical therapy offered to patients by rehabilitation centers, hospitals, in ambulatory centers, and even at home. Often mental and motor functions have to be re-trained or re-learned. Therefore various therapeutic approaches, tools, and agents can be used for rehabilitating these patients. In this paper we focus on the rehabilitation of motor functions and supporting of exercise, especially for obese patients.

According to medical aspects, scientific training and physiological factors, Hollmann defined fundamental forms of motor functions which could be used and even enhanced as part of therapy – coordination, power, speed, endurance and flexibility [1][2]. As part of preparing the rehabilitative training and sports therapy, any performance-limiting diseases need to be detected. Simultaneously, a corresponding individual concept should be developed for enabling and promoting the healing process as well as being a motivation concept for further prevention (e.g. nutrition, physical activation). A long-term effect should thus be stimulated in a way that the patients continue their therapy when being back home [2][3].

In this paper we introduce exer-learning games as possible instrument to motivate patients for physical – and thus mental – exercise. HOPSCOTCH as the first concept for exer-learning shall act as an example with its general design concept requiring the user to enter answers to simple questions or perform simple tasks, such as memory and

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mind training, by tapping on a sensor pad. After the introduction of the exer-learning games principle we present a study where a HOPSCOTCH-health-application was designed and integrated into everyday life of a spa clinic for rehabilitation of obese patients to verify the hypothesis if gaining knowledge could foster exercise.

1. Motivation of Obese Children and Adolescence Based on Digital Games

Obesity is a disease that demands a large amount of patience and endurance from patients. It can be seen in a way that “the success of the rehabilitation is influenced by sex, height [sic.], sports and motility and certain eating habits” [4]. For the most obese children and adolescents a behavioral rehabilitation program is advisable [4]. To reach sustainable impact, the obese should be motivated to change their habits in terms of eating and exercising. Tiedjen et al. [4] showed that long-term rehabilitation could lead to long lasting success for obese patients; however, the relevant physical and psychological therapies are very consuming in terms of personnel and time. This is why instruments are to be developed that support therapy (1) to relieve the therapists, and (2) to widen the length of therapy measures beyond the clinic stay. To reach this goal, two major factors should be fulfilled by the instrument: (1) it is motivating, and (2) it supports at least two aspects of the therapy - in terms of obesity these aspects are “exercise” and “nutrition”.

1.1. Motivation

In order to achieve long-term success of exercising, the motivation of rehabilitants has to be significantly increased. In motivational research area, a difference between the extrinsic and intrinsic motivation is usually carried out. The former activity is based on results or consequences; while the intrinsic motivated activity is performed due to the action itself [5][6]. Especially in terms of movement, an increase in intrinsic motivation seems useful to achieve long-term endurance and fun. Actions that are intrinsically motivated have an experience way - the “flow”. It describes the feeling of the complete fulfillment of an activity. The action itself is perceived as a “[…] unified flowing” [7].

Many successful computer games give players this flow experience by offering various tasks of a moderate degree of difficulty (1) that challenge the user, and (2) that can be successfully solved with high probability.

The area of game-based learning aims at creating such intrinsically motivating flow experience for learning [8][9]. The intrinsic motivation arises from activity-specific incentives that are inherent in games, so they can be used to engage and encourage children and adults alike in learning and training activities[10][11][12]. This leads to the assumption that games which need body movement as input have an even higher potential to motivate people to exercise. The so-called exer-games will therefore be introduced and explained in the following.

1.2. Exer-games

Exercise Games (exer-games) are games with the input being done with body movements rather than with the finger. The body movement is detected by sensors that are placed in dance pads, handles or special (balance) boards [13][14]. Since 2006
players can “run”, “bowl”, “box” or “hit” by using the input devices of the Wii. Lately the Microsoft Kinect invites players to a camera-based exer-gaming.

Most of the exer-games, however, are only based on a simple stimulus-response scheme. Motivation is mainly based on quick reaction, if one is not quick (anymore) due to disease or an accident, it is hard to get a high score. The motivation concept of exer-learning games is based on knowledge and on quick input [15]. They not only seek to combine playing and moving but introduce learning as a principal component.

1.3. Exer-learning Games

Exer-learning games connect playing, moving, and learning to improve intrinsic motivation for learning and exercising in parallel [15][16]. HOPSCOTCH is the first concept for the design of exer-learning games. The players solve various tasks by tapping on a pad with nine sensor fields, the HOPSCOTCH input device. Technically, the sensor pad resembles the keyboard of a mobile phone with numbers and letters for writing short messages (SMS). To win the game, the player must tap on the correct fields in the correct order as quickly as possible [15][16][17]. The fields and the rows result from the correct answers of given questions.

Based on this concept, a health application was developed and implemented that teaches the origin of fruit and vegetables in the form of a picture guessing game. On the basis of photographs of naturally grown plants, the players recognize which fruit grows on it (see Figure 1: What grows on this plant?).

![Figure 1. HOPSCOTCH: Question about the origin of a fruit.](image1)

In a second step (further levels), the acceptance of the displayed element of healthy food is improved by the introduction of their Latin terms. Thus, for example the “normal banana” is translated as the “cool” “musa paradisiaca” (see Figure 2. What is this fruit called in Latin?).

![Figure 2. HOPSCOTCH: Question about the Latin vocabulary.](image2)
2. Empirical Examination

After the prototype development was completed, studies were carried out in spa clinics. The focus of the observations was on the thesis: “Knowledge motivates for exercise”. Therefore, HOPSCOTCH was integrated in the everyday life of two spa clinics for one month. In both clinics, HOPSCOTCH was installed in a particular room, which was available at certain times (game time). So the patients could decide on their own when and how long they would like to play (exercise).

The data of the game history was recorded in log-files, which were assigned to particular login names (pseudonyms). In addition to individual players, group logins were also offered. A feedback questionnaire could be filled out voluntarily by the players to provide their first impressions about the HOPSCOTCH application. At the end of the testing phase, in one spa clinic the clinic director as well as the responsible supervisor was interviewed with the help of a semi-structured questionnaire about the overall context of the tests. Furthermore the advantages and disadvantages of HOPSCOTCH were discussed and a first assessment about the integration of the exer-learning game in therapeutic processes was determined. However, in the other spa clinic just a short final report was prepared by the responsible supervisor. In order to reconstruct the circumstances of the situation in general, protocols about the accessibility and the premises were made available to the developers by responsible caretakers.

3. Results

Overall, 40 patients have used HOPSCOTCH at the period of testing it in the spa clinics (N=40). So every participant was able to use HOPSCOTCH for one month. Most of the patients were children and adolescents with obesity. HOPSCOTCH was well accepted by the participants. Nevertheless there is a difference about the first impression of HOPSCOTCH between both clinics. On a scale from 1 (‘very good’) to 5 (‘very bad’), the majority of spa clinic #1 rated the gameplay quite negatively (M = 3.77; SD = 1.343), because of the initial technical problems of the hardware. In contrast, the participants of the other spa clinic #2 evaluated HOPSCOTCH as good to very good (M = 1.89; SD = 1.23).

It is of course possible to adapt the gaming principle to virtually any field of task-based therapy-supporting exer-gaming.
Figure 3. First impression of HOPSCOTCH (Average value)

In the first week of the examination, curiosity and interest in HOPSCOTCH was particularly large. Especially the gameplay could motivate the participants. In the feedback questionnaire the game idea, the HOPSCOTCH mascot animal “kangaroo” and the component of exercise were positively mentioned mostly. In the second week the patients had more and more turned away from HOPSCOTCH, because they didn’t have any choice except the health application. From their perspective the healthy nutrition theme was ‘boring’: “Why are there just these vegetables and nothing cool, nothing trendy?”, reported the responsible supervisor. The responsible supervisor of the other spa clinic reported that “the sensor pad as well as the game concept could motivate children for playful learning immediately”. But also in this spa clinic the patients assessed the application as one-sided after three times of playing. Because of that, the participants just played in Level 1, so they didn’t discover the new Latin terms of fruits and vegetables. Therefore, the improvement of the image of healthy foods has to be verified in further research.

The analysis of the recorded data and the questionnaire-based information showed that the patients generally liked the HOPSCOTCH concept, but refused the theme of fruits and vegetables almost categorically. In the opinion of the spa clinic management, this is typical for people of this age and problems. Therefore the spa clinic manager Dr. Baudach recommended that rather the “unhealthy” theme of “Fast Food” at the beginning could be better, because the children know a lot about it. After that introduction into HOPSCOTCH, the food pyramid could be implemented into the game: “In a first step, food is offered from all three areas and after that the children should be influenced to prefer food in the green area or other areas”, said Dr. Baudach, the manager.

Generally, the participants had mainly played in groups of three or four. Thereby they experienced a lot of fun with the game itself, but could not exchange views about nutrition, because of their lack of interest and knowledge in this subject. They instead talked about other stuff and “lost their interest in the game”, as reported. Nonetheless, the obese adolescents achieved a movement level that was higher than usual. Thereby, they were very fast, which had surprised the spa clinics supervisors. However, the patients missed a change in topics, so a long-term motivation was not reached.

Regarding the operation of the prototype there were no problems in the spa clinics observed. Even the supervisors used the input device after overcoming their initial ‘fear’. The patients had understood the gameplay very quickly and got on well with the
system. “They did not look at their feet. They knew the location of the fields. So I think the system is very, very useful. The adolescents are absolutely fit in it.”, reports the clinics supervisor.

4. Conclusion

In summary, the tests with patients in spa clinics have clearly shown that exer-learning games could become part of the strategies to influence patients toward exercising self-motivated. However, the thematic content of healthy nutrition, which was selected by the developers to support the therapy aspect of influencing the eating habits, was extremely disliked and rejected. In the future, topics should therefore be chosen that are of more interest to the target group.

Overall, the concept HOPSCOTCH appeared to be a promising approach toward the active combination of learning, reminding, exercising, and playing. It could thus be used as supporting instrument within spa clinics and as a bridging component to overcome the “hard break” after spa. HOPSCOTCH could support patients to keep going on at home. Therefore, the content must be designed in closer relationship to the clinical practice, “so the patients could synchronize the content in exer-learning games with the structured training they get in the spa clinic”, agreed the management and the supervisors of the two involved spa clinics.

5. Future work

As already mentioned in the introductory part of this paper, the problems of patients in the rehabilitation area are multilayered. Different patients suffering from different diseases or limitations have different treatment needs and must therefore be treated by applying different rehabilitation methods to them. HOPSCOTCH as such cannot support all the various rehabilitation measures. For the motivation for exercise of obese children HOPSCOTCH seems – with appropriate tasks – to be suitable in addition to traditional therapy aids. The principle of combining body movement with learning aspects and finally with knowledge acquisition might also be suitable for adults suffering from similar health problems. However, it is certainly not suitable for other rehabilitation areas, e.g. fine motor skills training or rehabilitation of cognitive skills, as particularly required after a stroke or for Alzheimer's or generally for Dementia patients. The authors are well aware of this fact; therefore technologies and concepts are to be designed and developed for covering larger areas of rehabilitation needs of convalescent patients.

For these new concepts, a direct haptic manipulation of objects becomes the crucial element. Exploratory movements of the hand are expected to help to support, maintain, or recover physical mobility and cognitive abilities as a first step. The combination of physical actions and digital enhancement, common in augmented reality [18], is realized by the use of advanced camera technology and software. Thus the authors consider other target groups in the rehabilitation area and realize other supportive treatment concepts. Both the HOPSCOTCH concept and the briefly described extension aimed in terms of "Ambient Assisted Living" [19] at providing not only the ambulatory rehabilitation procedures, but particularly its application in private
homes of the patients guaranteeing a chain of rehabilitation activities starting at hospitals, and being pursued in ambulatory rehabilitation and at home.

References