

Healthy Weight Game!: Lose weight together

The design and evaluation of a serious game for Overweight and Obesity

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Abstract—Overweight and obesity pose a serious and increasing problem worldwide. Current treatment methods can result in weight loss in the short term but often fail in the longer term. Increasing motivation and thereby improving adherence can be a key factor in achieving the needed behavioral change. One approach is to address affective state (i.e. to promote positive emotions) by making people aware of their condition in a playful manner, possibly with peer interaction. Serious gaming is envisioned as one way to achieve this. Based on a study of the scientific evidence, the serious game ‘Healthy Weight Game!’ was designed. The design incorporates most of the features shown to be beneficial in the scientific literature. An evaluation of the design involving a survey of 53 subjects produced positive results. The game was well understood and seen as a good method to help people lose weight and induce positive behavioral change. It was seen as a good addition to own initiatives for being physically active and as a useful addition to dieting and physical therapy. The design of the game (appearance and content) was positively received. Some gender differences were found in reactions to features such as visualization of goal achievements (e.g. avatar getting thinner as exercise goals are reached) and the kind of informative feedback which was appreciated. Overall the game design was rated 7.57/10 over all respondents. We conclude that this design demonstrates potential for improving physical and, indirectly, mental health of people facing overweight and obesity by increasing adherence and promoting sustainable behavioral change. Next steps are to implement the game and conduct a larger scale evaluation.

Keywords—*Serious gaming; lifestyle change; obesity; E-health.*

I. INTRODUCTION

According to the World Health Organization more than 1.4 billion adults were overweight worldwide in 2008. Of these adults over 200 million men and nearly 300 million women were obese [1]. In 2012 Lee et al [2] published results in The Lancet showing that physical inactivity caused 9% of premature mortality worldwide in 2008. The authors estimate that if inactivity were decreased by only 10%, more than half a million deaths could be averted every year worldwide. Furthermore if physical inactivity were eliminated completely this would increase the life expectancy of the world’s population by 0-68 years [2]. The fundamental cause of overweight and obesity is, when not considering people with metabolic diseases, an energy imbalance between the consumed and expended energy. A ‘bad’ lifestyle (i.e., limited physical activity and/or a high energy diet) makes weight increase almost inevitable and is associated with serious health problems [1]. It is widely accepted that the answer lies in a combination of improved lifestyle habits in terms of healthy diet and increased physical activity. However, bringing about sustainable behavioral change in terms of healthy lifestyle has proved difficult. Serious gaming, which is ‘[any] computerized game whose chief mission is not entertainment [including] entertainment games which can be reapplied to a different mission other than entertainment’ (Sawyer 2004) [3], is envisioned as one way to achieve this. In the research reported here the possibility of motivating (lasting) adherence to physical exercise programmes by means of serious gaming is investigated. The remainder of this paper is structured as follows: (II) Research Design, (III) Serious Gaming for Obesity, (IV) Game Design, (V) Evaluation and (VI) Conclusions.

II. RESEARCH DESIGN

The goal was to investigate the potential of a serious games approach for the prevention and treatment of overweight and obesity by increasing adherence to physical exercise programmes in order to achieve lasting behavioural change.

The objectives of the game were to:

- Make people with overweight or obesity aware of their condition in a playful manner;
- Stimulate physical health in a playful way;
- Encourage people to adhere to a health enhancing programme in a playful way.

Based on a literature study on the topics of 'overweight, obesity and weight management', 'behavioural change' and 'serious gaming' the game was designed and evaluated. To investigate how the game would be received by potential users, an online survey was conducted. The survey included a tutorial video¹ of the 'Healthy Weight Game!' followed by open and closed questions. The intention was to validate and improve the design with a view to future implementation as in this short project the intention was to design the game only and not implement it.

III. SERIOUS GAMING FOR OBESITY

A. Overweight, Obesity and Weight Management

Body Mass Index (BMI) is an accepted standard for measuring overweight and obesity in adults. BMI is determined by dividing the weight of the person by the square of their height. A BMI of 18.5 - 25 is considered normal, 25 - 30 is classified as overweight and 30 or higher is classified as obese. For children, especially in puberty, overweight and obesity is difficult to determine precisely using BMI since it is not sufficiently accurate [4]. Therefore the use of BMI as in serious games gives more accurate measurements for adults. This however should not exclude adolescents and children from participating in and benefitting from the game. In the Netherlands over 50% of the adult population were overweight and 14% were obese in 2008, and 70% of obese children and 80% of obese adolescents go on to be obese in adulthood [4]. This underlines the potential impact of involving adolescents and children in serious games aiming to encourage healthier lifestyle.

The most important determinants of overweight and obesity are environmental and individual factors. Sedentary lifestyle and a diet poor in micronutrients promotes weight increase. As for environmental factors, it is known that members of the same family are often all overweight or obese as they share habits and live in the same environment [4]. For the design of a serious game it can therefore be an advantage to include multiplayer options so that people who

influence each other can stimulate one another in becoming healthy. The 'Healthy Weight Game!' also attempts to influence individual factors; for example a sedentary job can be mitigated by incorporating physical activity into working breaks. A weight loss of 10-15% is seen as successful treatment for people with obesity and the UK's NICE-guideline states that even a 5% weight loss is clinically relevant [4].

Dietary interventions are of course part of the solution; in this study however we focus on physical activity. Physical activity norms for weight loss as defined by the Dutch government are supported by the game. They are: the 'Nederlandse Norm Gezond Bewegen' (NNGB) [5] which specifies at least 30 minutes moderately strenuous physical activity for five days per week. The second norm supported by the game is the Fitnorm [5] which specifies strenuous activity for at least 20 minutes a day, three days per week. And finally the game supports the Combinorm [5] standard which relates to the distribution of the percentage of Dutch adults who meet the NNGB and/or the Fitnorm standards. Kemper et al (2004) [6] recommend that physical exercise should be moderately intensive rather than very highly intensive [6]. Research also shows that moderately intensive activity has preventive effects on chronic diseases such as cardiovascular disease, COPD and diabetes mellitus type 2 with moderately active people having three to five times less chance of contracting those conditions than inactive people. It also aids weight loss and lowers blood pressure [4], [6], [7]. Kemper et al (2004) [6] also recommend that overweight and obese people should be physically active with moderate exertion for 60 minutes per day for at least five days a week, although for obese people 90 minutes would be more suitable. This level of physical activity would also possibly be sufficient to keep people that are moderately overweight from becoming obese [6], [8]. The advice 'Overweight and obesity' [9] also recommends that the minimum physical activity should be 60 minutes a day of moderately strenuous activity to prevent weight gain, and physical activity should be built in into daily life activities including taking opportunistic exercise or physical exercise after work. Participation in sporting activities can be helpful in increasing activity levels in order to prevent a positive energy balance [9].

The literature shows that many Dutch people fail to meet the (NNGB) [5], Fitnorm [5] and Combinorm [5] targets and this failure correlates with overweight and obesity. The research showed that three-quarters of (slightly) active people who did not meet the Combinorm standard were nevertheless positive about physical activity; and two-thirds found being physically active enjoyable. In contrast, the inactive group was less positive about physical activity and the majority of these did not enjoy it. In both groups it was noted that the environment of these people is also not physically active or stimulating to be physically active.

¹ <http://www.youtube.com/watch?v=kY4StufTgks>

Almost half of the (slightly) active people that did not meet the Combinorm expressed interest in becoming more physically active. In the inactive group this intention was lower (one-fifth to a quarter). The literature also shows that it is beneficial to pay attention to everyday activities at work or school and the home environment. The work environment, especially characterized by increasing automation, computerization and attention to comfort, needs attention to offset the associated decrease in physical activity, in particular relating to work tasks with low demand for movement such as policy- and administrative functions. Furthermore, leisure activities have become increasingly sedentary as more time is spent watching TV and using PCs and mobile devices for leisure. Changing patterns of transport also contribute to a more sedentary lifestyle. Especially for the young, the amount of time children play outside has decreased over the years and watching television and playing computer games accounts for more leisure time [5].

To summarise, the current consensus is that people of normal weight should perform 30 minutes of moderately strenuous physical activity for five days a week in order to avoid becoming overweight. For overweight people the daily minimum is 60 minutes and for obese people 60 or if possible 90 minutes. [4], [5], [6]. It has also been shown that daily exercise of moderate intensity is more effective than very high intensity exercise which leads to over exertion [6]. It is important to build regular physical activity into daily life, for instance by walking for an hour after work, together with being more physically active during the day through opportunistic exercise. These targets are supported by the 'Healthy Weight Game!'. Our hypothesis is that with use of serious games such as this, physical activity can become less of a burden and more enjoyable, especially if shared with others. The physical activities of the 'Healthy Weight Game!' were also designed to align with work/school schedules by for example enabling play during breaks, but also by utilizing the free-time of the player after work or school.

B. Behavioral Change

Various behavioural and cognitive theories were considered in the research, specifically the Transtheoretical Model [10], Social Cognitive Theory [11], the Theory of Planned Behavior [12], the Theory of Meaning Behavior [13] and the Health Belief Model [14]. Of these theories the Transtheoretical Model and the Social Cognitive Model were considered most appropriate and were applied in the design of the 'Healthy Weight Game!'.

Of the different stages of change of the Transtheoretical Model (TTM), it was concluded that for the people in the 'precontemplation' or 'contemplation' phase a serious game regarding physical activity probably will not be suitable. The people in these two stages are not ready to change and

either do not want to be helped or do not know if they want to be helped yet. Helping and convincing those people falls out scope of this short research project. Those in the 'Preparation' phase are the most suitable target for a serious game. These are the people who want to take action quite soon and will seek methods to achieve their goal. They are in the stage that they might buy a self-help book for example, or join health education classes, or may download a serious game to help them to become more physically active. The intention is that use of a serious game will support people in entering the 'action' stage where they make changes in their life-style thanks to the motivation provided by the game. If this is successful they arrive in the final stage, 'maintenance', where they will work to prevent relapse and become more confident. Literature shows that most people relapse during the action stage with around 85% downgrading by one or two stages. Suitable methods used to prevent relapse are: changing the behaviour by small increments; and use of social networking and a multiplayer environment to reinforce support for the players' efforts [10].

The TTM can be found applicable in terms of the concept of 'Processes of Change', which have been shown to be relevant for various kinds of intervention. These processes include 'Consciousness Raising', 'Dramatic Relief', 'Environmental Re-evaluation', 'Social Liberation', 'Self Re-evaluation', 'Stimulus Control', 'Helping Relationship', 'Counter Conditioning', 'Reinforcement Management' and 'Self Liberation' [10].

In the design of the 'Healthy Weight Game!' only the last five processes are of importance because as stated above the target users of this game are those in a state of change where they are ready to change. We found that often it is not immediately clear how to use these processes in a serious game, but the concepts did influence the design. The processes that were applied or influenced the design were 'Stimulus Control' where certain environmental factors are removed to discourage bad behaviour. An example of 'Stimulus Control' is parking further away than normal to increase physical activity. The concept of 'Helping Relationships', which relate to social support by therapists, buddies and so on, was also applied by creating multiplayer options. 'Counter Conditioning' refers to learning other behaviours to replace the problem behaviour, such as taking the stairs instead of the lift and thus incorporating opportunistic exercise. 'Reinforcement Management' means rewarding good behaviour. In the 'Healthy Weight Game!' users are rewarded by earning credits which they can use to buy goodies (like a music player) and by receiving group recognition. Finally, the concept of 'Self-Liberation', which combines the belief of change and the commitment to act on that belief, was applied. Making choices and making commitments to those choices, for example, improves chances of adherence [10].

The Social Cognitive Model includes various concepts, some of which we believe are applicable for serious games. These concepts are 'Environment', 'Situation', 'Behavioral capability', 'Expectations', 'Expectancies', 'Self-control', 'Observational learning', 'Reinforcements', 'Self-efficacy', 'Emotional coping responses' and 'Reciprocal determinism' [11].

In the design of the 'Healthy Weight Game!' these concepts are applied as follows; the 'Environment' for social supports is achieved by means of providing a multiplayer option. The 'Situation' concept is to correct misperceptions and promote healthful forms which are achieved in the game by giving information and feedback to users. The 'Behavioral capability' concept means promoting mastery and learning through skills training. In the 'Healthy Weight Game!' this is done for example by repeating physical exercises. For the 'Expectations' concept, the serious game models positive outcomes of healthful behaviour, but only outcomes that have a functional meaning according to the 'Expectancies' concept. The 'Self-control' concept shows that opportunities for self-monitoring have to be given and also for goal-setting, problem solving and self-rewarding. The 'Observational learning' concept means acquisition of behaviour by watching actions and outcomes of the behaviour of others. The 'Reinforcements' concept promotes self-initiated rewards and incentives. Examples are reaching a better personal high-score or winning over opponents. It is important to change behaviour in small steps in order to ensure success ('Self-efficacy' concept) and individuals need to be trained in problem solving and how to cope with stress ('Emotional coping responses' concept). And finally, the 'Reciprocal determinism' concept which is considering multiple avenues to behavioral change, including environmental, skill, and personal change [11].

The Theory of Planned Behavior [12], Theory of Meaning Behavior [13] and the Health Belief Model [14] were not found to be directly usable for the 'Healthy Weight Game!', but nevertheless provided good information for better understanding of the behaviour of individuals.

C. Serious Gaming

A serious game consists of four basic elements, namely: the storyline, the game play, the interface and the visualization. These elements must be in balance for a good design. In addition there has to be an educational element, but the four elements mentioned above are of real importance to keep the game interesting. The educational part has to be integrated in such a way that the player can enjoy the game and learn without really noticing [15].

In the Netherlands 43% of the population from 12 to 75 years of age used a Smartphone with internet in the last three months of 2011, and mobile phone internet usage doubled from 21% in 2010 to 43% in 2011[16]. Therefore

using a Smartphone as the platform for the serious game seems to be a logical choice. With the growth of mobile internet, mobile gaming with (multi-player) connectivity gives opportunity for shared gaming experiences and the extra motivation this brings. Another advantage of using a mobile phone is the fact that most people carry their phones with them all the time. This means that the game can be played anywhere and anytime. Some design considerations for mobile-phone-games, according to Trifonova's (2003) [17] overview, are:

- Applications meant for learning should support a playful interaction and be self-explanatory.
- The learning content has to be divided into small parts so that playing the game and learning can take place in short periods, e.g. in a coffee break.
- Using the application whenever the user wants to is important, so it should be integrated into the situational and local context of the user.

Surveys from the mobile Game Based Learning project (mGBL) [17] resulted in some basic rules concurring with Trifonova's work when developing mobile games, namely:

- The learning content should not be the focus point, but instead problem-solving activities that result in arriving better skills and self-knowledge. In mobile Game Based Learning (mGBL) games these activities are based on Anderson and Kratwohl's learning goals in the year 2000; "remembering, understanding, applying, judgment and analysing".
- Mobile games should be challenging, exciting and should give feedback. They also should have short tasks for earning rewards. The games must not be all about learning with a gaming aspect but they must be real games. Prensky (2001) emphasizes that fun should be priority in a learning game and that the learning content should be second.
- The learning game should keep the user central. The learning needs of the user, capabilities, level and information needs to stay relevant. The game must remain simple and lets the user be in control. Because of the possibility to play the game also in short amounts of time, like a break, results should also be given after these short sessions. And users should be given the space to make their own preferences.
- Keep in mind that a mobile phone has a small display and uses a battery. Do not replicate PC-style games.

In the mGBL project [17] some of the above points are noted as success factors. Findings included that learning games have to be challenging, cause excitement, respect, have social experience, give feedback and enhance knowledge. The word ‘learning’ has to be mainly avoided with the youth, being incompatible with the concept of fun games. In order to quickly see the game skill values, feedback should be easily accessed and available. Rewards such as getting approval from peers or gaining new information are of great importance. Experts mentioned the importance of multiplayer gaming with collaborative and competitive options. Crucial here is the simulation of real-life communication with for example a convergence platform. For multiplayer games playful competitions were preferred above competitions with fast knock-outs. The mobile game should also be built out of small parts which the user can complete during game play in order to play during breaks for example [17].

When designing everyday fitness games, according to Campbell et al [18], the following design principles are important:

- Core mechanic; this is the set of interactions that is the most repeated during play and which should be used by the developer to influence physical habits. The interactions are hard to master but easy to learn which makes it interesting and fun to improve and learn these interactions.
- Representation; this is how the game presents itself in the aesthetics and narrative form. Making a good representation means the game should not be too complex or too shallow. It should drive player’s interaction, provide context and it should immerse players in the game world.
- Micro goals; in games players have to achieve certain goals, which mostly are in the form of solving conflicts. By ensuring these goals can be achieved with little work a path of goals is set in order to complete the bigger goal. In this way players will not be overwhelmed and completing more goals provides more frequent gratification which in turn entices the user into sustained play.
- Marginal challenge; the challenges provided in the game should meet the margin of a player’s ability. This is important to keep the game experience fun, meaningful and stimulating to proceed to the next level. Free play; some game designs can benefit from not setting too many rules. Thus in a way that players can play at their own pace where and when

they like and if possible also how they explore the narrative of the game.

- Social play; social relations in gameplay come in both internal and external forms. Internal refers to the roles emerging from the formal structure of the game. External roles come from outside the game, such as rivalries and friendships. For strong social play aspects it is wise to utilize internal roles to assist in establishing new external relationships. Communication tools can then help build and maintain those relationships.
- Fair play; in social play the players should have equal chance of keeping the gameplay fair. This should be embedded in the rules and core mechanic by for example giving a player that is lagging behind a temporary game-advantage in order to restore competitiveness. Another way is to match players of approximate skill levels.

Most of these principles were relevant and were taken into account in the design of the ‘Healthy Weight Game!’

Receiving information about the performance of other players, e.g. friends or colleagues, is an important motivational factor; and becoming the best is the driving force of its success. Another important factor is that human opponents always ensure a different game play which supports sustainability in terms of motivation [19]. Peng (2003) [20] showed that 43.35% of internet users find multiplayer gaming more fun than single player gaming.

Use of avatars in health games can enhance game play according to Yee (2009) [21] and Lim and Reeves (2006) [22] found that letting players select their own avatar improves their engagement in the gaming experience.

IV. GAME DESIGN

For the design of the ‘Serious Weight Game!’ certain system requirements were determined. Firstly, the software should perform well on the target platform. Secondly, the system should be capable of giving direct and indirect visual feedback to the user. Thirdly, the system should be able to exchange data between users. And fourthly, the system incorporates an objective measure of physical activity of the user. To meet these requirements we selected a Smartphone with built-in accelerometer running Android 4.0’ as the target platform.

The serious game design assumes use of a Smartphone and its onboard accelerometer with a step-counter algorithm to measure physical activity of the player. Depending on the player’s BMI score, age and base-line (the average number of steps the player takes in a day) a step-goal is set. There

are five goals per week, spread over the weekdays, following recommendation from the literature of activity five days per week. To stimulate players to stay active they receive rewards in the form of credits for completing a daily goal. No credits are given when the goal is not reached, but extra credits can be earned if the targets are exceeded. Earning extra credits is limited, however, to avoid the risk of over-exercising. The five daily goals summed together form the weekly goal which, if achieved, is rewarded with extra credits and a higher level and which may also result in the character losing weight (the avatar gets slimmer). When a daily goal is not reached, the player can still achieve the weekly goal by making up the shortfall in number of steps taken. This can be done by doing (limited) extra steps on weekdays or by catching up during the weekend. On every weekday the current step-count and related calorie count are reset and a new daily goal is given. The weekly goal however remains unchanged during that week and the remaining steps of previous daily goals are stored. The reason for resetting is to prevent players who fell behind becoming discouraged and dropping out. At the end of the week the remaining stored steps will be deleted and the game will start again with new daily and weekly goals. Each player is assigned their own character (avatar) with a choice between a male and female version. The characters start in their underwear and players can use their earned credits in the ‘Shop’ to upgrade their character or buy “cool gear” items such as the music player so they can receive songs. In the ‘Shop’ only some basic items are displayed and players have to level up (i.e. complete weekly goals) to unlock new items. The character represents the player’s weight (e.g. chubby) and activity level (showing mood changes between happy, neutral and sad). The game is playable in single mode but strongly supports multiplayer gaming. Players are able to invite others to a game in which they race against each other. This is done on the ‘Race’ screen where the racetrack corresponds to the weekly goal of the player and the five divided stages with the daily goals (named stage-races). The player’s position is shown by a pawn which is driven by the number of steps he has taken with a correction factor based on the baseline and level of the player to keep the game fair and challenging. All players start from the flag in each stage-race (regardless of their previous performance) which corresponds with the daily goals being set to zero each day. The race-track also contains a ghost pawn to show the player’s schedule. During the race players can also earn extra credits e.g. by completing a stage the fastest, being the fastest over all stages in that week or by taking most extra steps during that week. On a daily basis players can earn a (limited) head start in the next stage-race by doing more steps than required (i.e. passing the daily goal). At the end of the week the summed up credits, including spent credits, will reveal the winner of that week’s race. The first three places will then be rewarded for their victory.

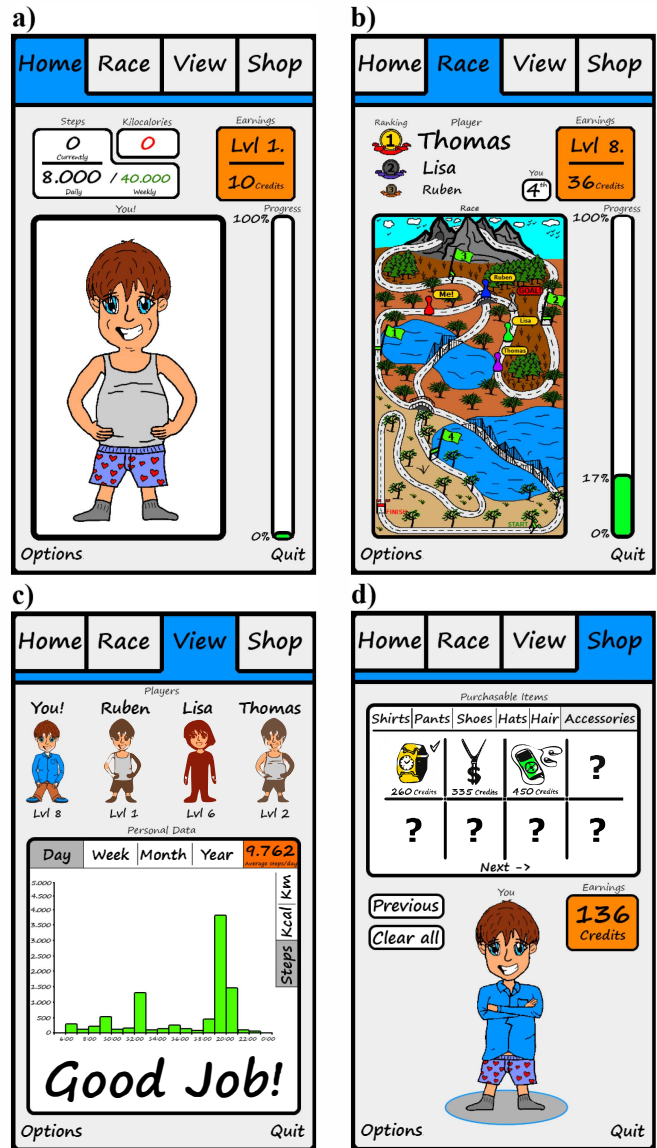


Fig. 1. ‘Healthy Weight Game!’ screens: a) Home; b) Race; c) View; d) Shop

In the ‘View’ screen players are given an overview of their progress and activity history, which can be set for different parameters. Here are also the characters shown of the other players who compete in the race to stimulate physical activity. In ‘Fig. 1.’ the four screens of the ‘Healthy Weight Game!’ are shown and on <http://www.youtube.com/watch?v=kY4StufTgks> the tutorial video of the ‘Healthy Weight Game!’ can be found.

V. EVALUATION

The evaluation was conducted by means of an online survey. The 53 respondents (20M, 33F) were young (18- 25 years) and most were highly-educated. The advantage of such a specific group (of age and education) is that the results give a good representation of the target group.

Another advantage is the acquisition of the insight that younger people have in applications and gaming as this is nowadays already highly integrated into their lives. The biggest advantage however is that with this feedback the 'Healthy Weight Game!' can be improved or even used for this young age category. That would be highly preferred over older people as a chronic disease like obesity needs to be treated as early as possible. The main disadvantage of this sample is that conclusions cannot be extrapolated to other age or educational groups.

A. Game-related questions

Analysis of the survey results showed that the game was well understood after subjects had followed the tutorial, meaning that the game shows no ambiguities. A clear result was that respondents considered serious gaming in general could be a good method to treat or prevent overweight. The majority were also of the opinion that the 'Healthy Weight Game!' specifically has potential to aid weight loss and even to induce positive behavioral change. The 'Healthy Weight Game!' was seen as a good addition to individual's own initiatives to exercise and also could work well as an addition to dieting and physical therapy. According to the participants, physical activity, competition, rewarding, displaying current information (e.g. steps and calories) and the possibility to review results are of importance for a serious game; this is also true for the 'Healthy Weight Game!' A remarkable outcome was that only 17.0% of the participants found characters (e.g. avatars) an added value for serious gaming in general. For female respondents displaying information like steps and calories was quite important. Suggestions for improvement included implementing a message board and having continuous updates on rewards. Adding a calorie intake measurement was another idea for improvement which needs to be researched.

The 'Home' screen was well received and the vast majority of respondents would not change it. Respondents, especially females, wanted to see the daily goals displayed by weekdays. The characters were well accepted overall and did not need to be changed (in apparent contradiction with responses to the earlier question on the use of characters). The character's shape is adjusted to the weight of the user and the character can visibly lose weight by achieving weekly-goals; this was also well received and should remain. The character getting thinner was well received by females especially. The mood changes of the character, indicated by changes in body language and facial expression, were also found useful and liked by the majority (here again female respondents rated this feature more highly).

The 'Race' screen was well received and also here the majority did not want changes. The same applies broadly to the racetrack though some changes could make an improvement according to some respondents. The possibility to race against other players was well received;

females appreciated this feature a little more than males. Suggestions from participants including to implement more levels, showing the current total steps next to the pawn in the race-screen and, especially, the steps between yourself and your predecessor are considered good ideas for improvement of the game.

The 'View' screen was well received and also here the majority would not change it. Slightly more than half of the responses stated that the characters of other players should be shown (males rated this higher than females). The option to hide your own character from other players was mainly desired by females (most males thought it should be an obligation to show the character). An added feature for the game could be to let players decide whether they want to share their avatar with other players or not. The option to see your own results is definitely liked by female respondents. Almost all females voted 'yes' for this option compared to half of the males. The large majority of participants also thought the result-viewing opportunities were fine and not too much or too little.

The 'Shop' screen was well received and also here the vast majority would not change it. The idea of earning credits was exceptionally well received and also changing the character's appearance as a reward was good. Here it should be noted that often it was stated that the shop needs to be kept interesting by having rewards which were more interesting for the player, e.g. earning songs. Other suggestions were to have a mechanism for selling/trading items between players; another was to receive random rewards instead of the option to buy goodies. Another good idea was the option to buy food for your character with the goal of educating users about good food choices. Another idea was to have the option to win points from opponents to make the game more competitive and thus more stimulating.

B. Regarding the expected influence of the 'Healthy Weight Game!' on their own lifestyle,

30.2% of the participants thought that the 'Healthy Weight Game!' could help them become more physically active while 18.8% voted 'maybe'. 17.0% thought it could even help them lose weight while 22.6% voted 'maybe'. 17.0% thought the game was stimulating enough while 22.6% voted 'maybe'. The main reason for not thinking it would be stimulating enough was that it would become boring after a while. This is something to take into consideration when improving the game. As for endurance of playing the game, the results were excellent as the main goal was to let people become more physically active with the idea of inducing behavioral change, even if it is only minimal. From the participants, 5.7% said they would play it for less than a week in total, 7.6% for a week, 9.4% for 2 weeks, 7.6% for 3 weeks, 18.9% for 1 month, 9.4% for 2 months, 1.9% for 3 months, and 5.6% for more than 3 months. 34.0% responded with 'I don't know'. This means that 60.4% would play the game for more than a week of

which 35.9% would play it more than a month. If the game were launched, 79.3% would download it and 13.7% of the participants would even pay for it. The final grading of the ‘Healthy Weight Game!’ was 7.57 out of 10 from both sexes. From the final comments the following ideas need to be noted: linking to social media such as Facebook, giving helpful tips to the users on how to be physically active and keep on schedule, having more personalities for the character and more emotions, and finally the addition of additional exercise assignments such as sit-ups.

VI. CONCLUSIONS

The serious game, ‘Healthy Weight Game!’ was designed and evaluated during an undergraduate research project in the Telemedicine Group at the University of Twente. The short time scale permitted only a literature study, a game design based on the findings of the literature study and an evaluation. The design incorporates most of the beneficial features found from the literature study. The design was “animated” for the purposes of the evaluation. The game design was well evaluated by the potential users surveyed. We believe it can be concluded that the ‘Healthy Weight Game!’ project resulted in a design for a serious game which shows potential for improving physical, and indirectly mental, health of people who deal with overweight and obesity by focusing on increasing adherence to physical exercise programmes and achieving positive behavioral change. The ultimate objective is to contribute to, support or even replace some current methods for treating overweight and obesity by stimulating increased activity in a way that is fun and rewarding. The next steps are to implement the game and conduct a larger scale trial in order to evaluate the real-life characteristics and advantages and disadvantages of the design and conduct a fuller assessment of the potential benefits of the serious game approach in the longer term.

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